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FOREWORD

I am pleased to put into the hands of readers Volume-4; Issue-4: Jul-Aug 2019 of **"International Journal of Environment, Agriculture and Biotechnology (IJEAB) (ISSN: 2456-1878)",** an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to **Environment, Agriculture and Biotechnology**. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release issue with DOI (Digital Object Identifier) from CrossRef also, now using DOI paper of the author is available to the many libraries. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Editor-in-Chief
Date: Sept, 2019

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Technical and Economic efficiency of the ruminants feed on Date Seed in Matrouh Governorate

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Abstract*— *Ruminants occupies an advanced rank between farm livestock,, due to its suitability to life under difficult environmental conditions, especially in Egyptian desert governorates.

The high cost of sheep and goat nutrition lead to low the animal meat unit productivity, and low the producer's profit, which facing many investors in the field of sheep and goat breeding in the Egyptian desert governorates.The problem of the study is the high cost of ruminants nutrition (around 60% from the variable total costs), despite there are many high nutrition values of agriculture residues which can enter in the composition of nutrition diet for sheep and goat.

The research aims identify the optimal diet for fatting ruminants in order to maximize the productivity of sheep on one side and on other hand to minimize the cost of sheep nutrition.The research was based on the results of the experiment, that was carried out during the period from April 2017 to March 2018 at Matrouh Resource Development Center, that belongs to the Desert Research Center. The main result is that date seeds as a cheap source of energy, might be used successfully and economically in small ruminant rations during different physiological stages without adverse effects, due to estrogen-like compounds, on their productive and reproductive performance.

***Keywords*— Ruminants feed, date seed, Matrouh, Technical efficiency, Economic efficiency.**

I. INTRODUCTION

Small ruminants (goats and sheep) are a major component of the economic activity and social system of the people of the desert areas of the Arab Republic of Egypt. These animal species are distributed as animals adapted to the natural ecosystem and are the main source of human food (milk and meat). These animals have the appropriate development of their potential as other farm animals, due to their association with dry natural pasture areas in Egypt.

Small ruminants suffer from nutritional, reproductive and health problems in these areas, resulting in low productivity, poor disease resistance and high mortality in their young ones, which hinders the development of their production of milk, meat, leather, wool, wool, hair and other products of great importance to the people of the desert areas.

Owing to the shortage and high costs of animal feeds, especially the grains where a large proportion of it is imported to the country, it becomes necessary to use the industrial or agricultural by-products as a compensatory feeds in animal feeding. The gap between the availability and requirements of feeds is wide and the estimated shortage tended to increase from 3.1 (Abou-Akkada, 1988) to 4.92 million tons TDN by the year 2000 (El-Shazely, 1988). Several efforts were carried out to use local by-products (such as date seeds) in animal feeding as an attempt to solve feed shortage problems.

Dates Phoenix dactylifera L. are very popular in most of the Middle Eastern countries. Over 70% of the total world production is produced in this area. Egypt is the second important country in date world production which produces 1,166,182 tons (FAO, 2004), where the seeds represent about 20.8 % (Kholif, 1997). One hundred and twenty thousand tons of seeds may be used as a feedstuff which is very rich in carbohydrates and amino acids (El-Boushy, 1990). Date seeds had a higher TDN value and contained relatively high percent of fat with a high coefficient of digestibility (Abou El-Naser, 1985). Many workers had reported that date seeds could be used economically and successfully for ruminants' nutrition; they could be used as an energy source to replace a part of concentrates in the ration (Al-Dabeeb, 2005). Date seeds supplemented diets might improve animal performance due to growth stimulating hormones (as estrone, 1.9 mg/kg) that were found in date seeds (Barreveld, 1993).

Research Objectives

- Determine the estrogen-like compounds concentrations in the date seeds and their effects on estrus cyclicity, hormonal profiles and reproductive performance as well as productive efficiency of Barki ewes when fed on date seeds.
- Determine the optimum diet in order to maximize the productivity of small ruminants
- Reduce the cost of nutrition, allowing small-scale farmers to continue to produce optimal production, particularly in desert areas of relative importance in the production of these ruminants.

II. METHODOLOGY

The physiological experiment was conducted to determine estrogen-like compounds concentrations in the date seeds and their relation to estrus cyclicity, hormonal profiles and reproductive performance as well as productive efficiency ofsmall ruminants (Barki ewes) fed the date seeds as a partial or full replacer of yellow corn in the concentrate ration by either 50% or 100% over full reproductive cycle.

The research was based on descriptive analysis; Also use the nutrition problem model (using linear programming method) as one of the methods of process research for the formation of homozygous in the field of small ruminants.

Sampling and Data collection

The research was based on the results of the experiment, that was carried out during the period from April 2017 to March 2018 at Matrouh Resource Development Center, that belongs to the Desert Research Center. Seventy five Barki ewes (2.0-2.5 years old and 37.8 ± 0.63 kg average body weight) were assigned into three groups (25 each). First group (G1) was served as control (0.0% date seeds) and fed a concentrate ration consisted of 43% yellow corn, 22% cotton seed meal, 20% wheat bran, 12% rice bran, 1.5% limestone, 1% sodium chloride and 0.5% minerals mixture. Date seeds were used as a partial or full replacement of the yellow corn in the concentrate ration by either 50% (G2) or 100% (G3). All ewes groups were offered barseem (Trifoliumalexandrnum) hay ad libitum, as a basal roughage diet, and rations were adjusted monthly to cover their requirements during their physiological status according to Kearl (1982). Water was available to all groups twice daily.

Animals were kept in semi-open pens roofed with wood, and were clinically healthy and free from internal and external parasites.Mating season started in June and lasted for 51 days (equal to 3 estrous cycles). Five fertile rams were allowed to rotate among different ewes groups to avoid sire/group confounding effect. Rams were fed the control concentrate ration and removed from the ewes groups at early morning before offering rations.

Once lambing took place, the born lambs were earing tagged and weighed to record their birth weight. Lambs were left with their dams till 3 months (90 days), then weaned and weaning weight was recorded and adjusted for 90 days.

Statistical analysis

First theTechnical Experience: Data of estrus activity was analyzed using “all or non traits” according to **Snedecor and Chocran (1980)**, while continuous data were subjected to an analysis of variance utilizing GLM model of **SAS** for repeated measurements and means were compared using Duncan Multiple Range Test. Model 1 (for birth, weaning and marketing weights)

$$\mathbf{Y_{ij} = \mu + T_i + e_{ij}}$$

Where:

Y_{ij} = Trait

μ = Mean

T_i = Effect of treatment, i, 1-3 (1 = 0% date seeds, 2 = 50% date seeds, 3 = 100% date seeds)

e_{ij} = Experimental error

Model 2 (for blood parameters and milk constitutes)

$$\mathbf{Y_{ijk} = \mu + T_i + S_j + TS_{ij} + e_{ijk}}$$

Where:

Y_{ijk} = Trait

μ = Mean

T_i = Effect of treatment, i, 1-3 (1 = 0% date seeds, 2 = 50% date seeds, 3 = 100% date seeds)

S_j = Effect of stage, j, 1-3 (1 = early, 2 = mid, 3 = late)

TS_{ij} = The interaction between treatment and stage

e_{ijk} = Experimental error

Second the economic evaluation: Alinear programming model to suggest optimum diet for fattening lambs in the study area.

$$\text{Min. } G_1 = \sum_j X_j P_j$$

Subject to

$$\sum_j a_{ij} X_j \geq C_j \quad \text{(m inequalities in n variables)}$$

And $X_j \geq 0$

m: Number of nutrients

n : Number of feed varieties

aij: number of kilograms of nutrient i in one unit of food j.

Cj: The minimum number of kilograms of food element i required in one day.

Pj: The cost of one unit of food j.

Xj: The number of units of feed category j consumed in one day.

III. RESULTS AND DISCUSSION

Body weight changes of ewes and growth performance of lambs

Ewes of the different experimental groups gained weight during the five months of gestation period with mean values being 5.3, 6.7 and 7.6 kg for G1, G2 and G3, respectively, with favor to date seed groups (Table 1), indicating better nutritional management during the different physiological stages and proved that date seeds have potentiality to incorporate into feed mixture for ruminant.

Table.1: Body weight changes (kg) of the different experimental groups during gestation period

Item	G1	G2	G3
Initial body weight	37.90	37.70	37.90
Weight just before lambing	55.50	55.70	56.60
Weight just after lambing	43.20	44.40	45.50
Weight gain during pregnancy period	5.3	6.7	7.6
Conceptus weight	12.30	11.30	11.10

G1; the control concentrate ration (0.0% date seeds), G2; 50% date seeds, G3; 100% date seeds as a partial or full replacer of corn in the concentrate ration.

On the other hand, productive parameters in terms of birth weight, weaning weight and marketing weight did not differ significantly (Table 2) and indicate better performance of the two date seed groups compared to control one. The decrease in post-weaning average daily gain might be attributed to decreased digestibility coefficients as a result of the relative increase in crude fibers as well as low protein content as reported by **Khamis*et al.* (1989)**.

Table.2: Some productive traits (mean ± SE) of the different experimental groups

Item	G1	G2	G3
Average birth weight (kg)	3.89 ± 0.11	3.93 ± 0.09	3.70 ± 0.09
Average weaning weight (kg)	20.9 ± 0.93^{B}	22.4 ± 0.78^{A}	23.7 ± 0.83^{A}
Average daily gain from birth to weaning (g/h/d)	188 ± 10.36^{C}	207 ± 10.26 ^{B}	221 ± 10.36^{A}
Average marketing weight (kg)	45.4 ± 2.62	44.7 ± 2.49	46.6 ± 2.62
Daily gain from weaning to marketing (g/h/d)	136 ± 20.54	124 ± 20.45	127 ± 20.45
Total milk yield (ml/h/d)	441 ± 21.2^{C}	495 ± 21 .2^{B}	585 ± 21.2^{A}

G1; the control concentrate ration (0% date seeds), G2; 50% date seeds, G3; 100% date seeds as a partial or full replacer of corn in the concentrate ration.

Weaning age = 3 months, Marketing age = 9 months

Different superscripts (A, B, C) in a row indicate significance ($P < 0.05$).

Growth rate, particularly in growing animals, is an important measure for the evaluation of new feed resources because it represents the total effect of most feed properties. Date seed groups showed a better maternal and mothering abilities reflected on the pre weaning average daily gain where they scored 207 and 221 g/day for G2 and G3,

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respectively as compared to control one that scored the lowest value (188 g/day). These values were coincided with higher milk yield reported for the same respective groups (495 and 585 ml/head/day) compared with control one (441 ml/head/day). Thus, weaning weight at 90 days old was found to be heavier in both G2 (22.4 kg) and G3 (23.7 kg) as compared to G1 (20.9 kg). However, weaning weights recorded for the three ewe groups were in accordance with that (22.3 kg) recorded by **Abdel-Aziz (2004)** and above that (18.5 kg) reported by **Maharem*et al*. (2003)**.

Table.3: Analysis of variance of litter weight at birth, weaning and marketing of different experimental groups

Source		Mean Squares		
S.O.V	**DF**	**Birth Weight**	**Weaning weight**	**Marketing weight**
TR	2	0.03509174	24.12626774	67.74801421
S	1	0.45958563	26.48193775	192.93750000
TR x S	2	0.12247546	7.67202758	4.01753122
Error	30	0.24963459	20.75400959	29.80148810

TR; treatment, S; sex

Economic evaluation

The simple economic evaluation of the three diets are summarized in Table (4). Date supplementation in diets reduced the feeding costs during the whole fattening period by about 22.7 and 30.6% at level of 50 and 100% date seeds group, respectively. The diet supplemented with 100% was higher in economic efficiency by about 40% relative to control diet.

Table.4: Simple economic evaluation of incorporation of date seeds in the concentrate rations

Item	G1	G2	G3
Weight gain (from weaning to marketing)	24.5	22.3	22.9
DMI (kg/head/180days)			
Roughage	92.0	86.0	83.5
Concentrate mixture	121.5	106.2	114.0
TDMI	213.5	192.2	197.5
Feed conversion efficiency (Kg DM/kg gain)	8.7	8.6	8.6
Roughage cost (LE/ton)	800	800	800
Conc. mixture cost (LE/ton)	1200	950	750
Total Feeding Costs (LE)	219.4	169.7 (22.7%)	152.3 (30.6%)
Fixed costs / head (LE)	55	55	55
Total costs (LE)	274.4	224.7	207.3
Selling income (LE)*	465.5	423.7	435.1
Net income (LE)	191.1	199	227.8
Economic efficiency	69.6	88.6	109.9
Relative economic efficiency	100	127.3	157.9

*; 1kg= 19.0 LE

G1; control concentrate ration (0% date seeds), G2; 50% date seeds, G3; 100% date seeds. TDMI; total dry matter intake.

There was a general trend from the literature cited that inclusion of date seeds in the concentrate with different levels, in sheep, goats and cattle rations, tended to reduce feed costs with values ranged from 67%. The tendency of decreasing feed costs with date seeds in the concentrate mixture proved the success of such by product in ruminant rations without adverse effects on their reproduction and/or fattening performance.

Effect of feeding date seeds on milk production and composition:

Incorporation of date seeds in the concentrate diets of small ruminant tended to increase significantly ($P<0.05$) milk production. Ewes fed on either complete (100%) or partially (50%) date seeds supplementation in the concentrate ration scored higher milk yield (585.2 and 495.1 ml/head/day), over 3 months lactation period, as compared to the control one (441.1 ml/head/day) (Table 5). Milk production increased by 32.7% in G3 (100% date seeds) followed by 12.2% in G2 (50% date seeds). The superiority of both date seed groups might explained the higher pre-weaning growth rate and the better mothering ability of their dams, and confirmed the above mentioned results concerning milk production.

Similar results were reported by **El-Shaer*et al*. (1986) and Khamis*et al*. (1989)**. They demonstrated that lactating ewes fed date seeds as a whole diet (100%) after grazing produced high milk yield than those fed olive pulp, but the percentage of milk fat and protein were higher with ewes fed olive pulp diet. In consistency with **Abo El-Nor and kholif (1999)** on Baladi goats, they found that milk yield was significantly higher in 100% date stone compared to either 50% date stone in the concentrate feed mixture or control group (100% corn) with values being 793, 737 and 713 g/head/day for the three groups, respectively. Likewise, **Khattab*et al*., (2000)** found that milk yield was insignificantly increased with ration contain 13% date stone.

Furthermore, up to 25% date seeds in the ration of lactating cows did not affect the daily milk yield **(Mohamed 1987)**. **Sabbah*et al*. (1997)** observed no marked effect on daily actual or 4% fat corrected milk yield and composition when substituting yellow corn in the concentrate mixture by 50 and 100% date seeds. **Salama*et al*. (1993)** on grazing pregnant and lactating sheep and goats in Sinai, found that milk yield increased insignificantly in both sheep and goats fed rations contained 40% date stone, 40% olive pulp and 20% concentrate mixture as compared with control group (65% berseem hay and 35% concentrate mixture).

On the other hand, milk production tended to increase during early and mid stages of lactation (8 weeks) then declined steadily up to the end of lactation period (12th week) for all ewe groups. Such changes in milk yield within lactation period seemed to be logic since the peak milk yield was recorded during the 6th week (mid lactation stage) then declined **(El-Sherif and Assad 2001)** reflecting the hyper metabolic activity during pregnancy and lactation to save the higher demand of proper nutrition rich in energy , date seeds seemed to be a suitable alternative due to higher carbohydrate content and may play an important role in improving body condition score of the dams and growth performance of their lambs which are in accordance with other reports in the literature.

Concerning plant steroid effects, milk yield of Comisana ewes, fed on subterranean clover (0.2% phytoestrogens on DM basis) compared with control group which fed Italian ryegrass hay, had increased insignificantly **(Orru*et al*., 2005)**. They also added that these results support the hypothesis that the phytoestrogens could play a role on lipid and carbohydrate metabolism and on blood glucose level which might explain the increased milk production in date seed groups.

Milk composition of the different experimental groups as well as the analysis of variance of factors affecting milk production are presented in Tables (6 and 7). Although milk yield was affected significantly by inclusion of date seeds in the concentrate ration, milk composition was not affected among the different experimental groups. This result agreed with the previous results reported by **Khattab (1976) and Allam*et al*. (1997)** that the average of milk fat and protein were slightly increased (P< 0.05) as the levels of date seeds increased in rations. These increases may be due to the high content of crude fiber in the diets containing date seeds as reported by **(Kholif and Abo El-Nor 1998)**.

Table.5: Effect of treatment on milk yield and composition of experimental groups

Variables	G1	G2	G3
Milk yield	$441.14{\pm}21.17^{C}$	$495.07{\pm}21.17^{B}$	$585.16{\pm}21.64^{A}$
Milk composition (%)			
Fat (F)	$2.48{\pm}0.14^{A}$	$2.63{\pm}0.15^{A}$	$2.58{\pm}0.15^{A}$
Protein (P)	$4.11{\pm}0.06^{A}$	$4.19{\pm}0.06^{A}$	$4.27{\pm}0.06^{A}$
Lactose (La)	$4.59{\pm}0.05^{A}$	$4.53{\pm}0.05^{A}$	$4.64{\pm}0.05^{A}$
Total solids (TS)	$13.52{\pm}0.18^{A}$	$13.43{\pm}0.18^{A}$	$13.60{\pm}0.18^{A}$
Solids not fat (SNF)	$11.03{\pm}0.10^{A}$	$10.80{\pm}0.10^{A}$	$11.01{\pm}0.11^{A}$

G1; the control concentrate ration (0% date seeds), G2; 50% date seeds, G3; 100% date seeds as a partial replacer of corn in the concentrate ration.

F; Fat, P; Protein, La; Lactose, TS; Total solids, SNF; Solid not fat

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Table.6: Analysis of variance of factors affecting milk production yield in experimental groups

Source Of Variance	DF	Mean Square
Treatment (T)	2	277409.4**
Lactation stages (LS)	2	751310.6**
LS X T	4	33058.1
Error	114	17292.7

**; P<0.01

Table.7: Analysis of variance of milk composition

S.O.V	DF	Mean squares				
		Fat	Protein	Lactose	Total solids	Solids not fat
Lactation stage	2	5.17**	36.85**	19.29**	3.71	0.66
Treatments	2	0.23	0.25	0.10	0.25	0.62
LS x T	4	2.07	0.17	0.43*	1.82	0.88
Error	112	0.85	0.14	0.10	1.32	0.45

**; P<0.01

The most traditional and non-conventional feedstock's in the study area:

Table 5 shows the most important traditional and non-traditional feedstuffs (peeled husk, non-peeled cotton gain, sesame, nougat-bale, olive oil, soybeans) available in the study area, their food content, the prevailing price at the time of the research, (Weight at the beginning of fattening 30 kg, daily increase 120 g / head).

Variables	Feed type	dry matter * kg DM	protein * digested kg DP	total digested food * kg TDN	Current price of feed ton / pound ***
X_1	Barley straw	1,069845	-	0,6	900
X_2	Wheat straw	1,07088	0,0069	0,5612	900
X_3	DrissBressem	1,04857	0,09315	0,6486	1450
X_4	Yellow corn	1,03914	0,07475	1,0511	2350
X_5	Barley	1,038105	0,07935	0,9683	2400
X_6	non-peeled cotton cake	1,04627	0,2185	0,7682	2350
X_7	Sesame cake	1,04857	0,48645	0,9683	1500
X_8	Peel bean	1,035	0,069	0,644	2500
X_9	Date seeds	1,081	0,08395	0,897	1200
X_{10}	Olive cake	1,012	0,10925	0,391	200
X_{11}	Soybean cake	1,0005	0,506	0,8625	300
Lowest daily needs per kg **		1,15	0,062	0,72	

** Leonard C. Kearl, 1982, "Nutrient Requirements Of Ruminants In Developing Countries", International Feedstuffs Institute, UTAH Agricultural Experiments Station, UTAH Univ., Logan UTAH.

IV. CONCLUSION

Productive parameters in terms of birth weight, weaning weight and marketing weight did not differ significantly and indicated better performance of the two date seed groups compared to the control group.The decrease in average daily gain post-weaning might be attributed to decreased digestibility coefficients as a result of the relative increase in crude fibers as well as low protein content in the date seeds comparing with the control diet. Lambs birth weight of the different ewe groups was found to be 3.89, 3.93 and 3.70 kg for G1, G2 and G3, respectively with differences being insignificant, while weaning weight was significantly (P<0.05) different with favour to date seed groups compared to the control group. Date seed groups showed a better maternal and mothering abilities reflected on the pre-weaning average daily gain, where they scored 207 and 221 g/day for G2 and G3, respectively as compared to the control group that scored the lowest value (188 g/day). Feed intake of concentrated rations relatively decreased in response to increase date seeds in the ration of lambs and this may be attributed to the highest content of crude fiber in G2 and G3 rations. Date seeds supplementation in the diets tended to reduce feeding costs by about 22.7 and 30.6 % at level of 50 and 100% date seed groups, respectively comparing with the control diet. The diet supplemented with 100% date seeds was higher in economic efficiency by about 57.9 % relative to control diet. Over 3 months lactation period, ewes fed on either complete (100%) or partially (50%) date seeds in the concentrate ration scored higher milk yield (585.2 and 495.1 ml/head/day, respectively) as compared to the control group (441.1 ml/head/day). In other words, milk production increased by either 32.7% in 100% date seeds group or 12.2% in 50% date seeds group as compared to the control group.

It could be concluded that date seeds as a cheap source of energy, might be used successfully and economically in small ruminant rations during different physiological stages without adverse effects, due to estrogen-like compounds, on their productive and reproductive performance.

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Effect of microbial fertilizers and dosage of NPK on growth and yield of Upland Rice (*Oryza sativa* L.)

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***Abstract*— *Microbial fertilizers are inoculants made from beneficial microbes to improve soil nutrient availability and increase plant growth.The purpose of this research was to studythe effect of inoculants as microbial fertilizers (phosphate solubilizing microbes and Nitrogen-fixing bacteria) and NPK fertilizers on growth and yield of upland rice on Andisols. This experiment used a Randomized Block Design (RBD) in factorial pattern, consisting of two factors with three replications. The first factor consisted of inoculants, which were; without; inoculants A (Pseudomonas mallei, P. cepaceae, Aspergillusniger and Penicillium sp., Azotobacter sp., Azospirillum sp.); inoculantsB (Azotobacterchoroococum, A. viilandii, Azospirillum, Pseudomonas cepaceae, Penicillium and Acitenobacter) and inoculants A+B. The second factor were NPK fertilizers with four levels (100%, 75%, 50% and 25% dosage of recommendation). The results showed that microbial fertilizers improve growth and yield of upland rice.*

***Keywords*— inoculants, microbial fertilizers, upland rice.**

I. INTRODUCTION

The increased of rice productivity is still constrained, such as the problem of land conversion which is still occur a lot nowadays, climate factors and also a decrease in the quality of land resources (soil sickness) that can affect the decline or slope of productivity (Karmakar, et al. 2016). Farmers usually use inorganic fertilizersto increase land productivity. The tendency of more intensive use of inorganic fertilizers causes a decrease in the content of soil organic matter and the ability of soil to store and release nutrients and water for plants (Issaka, et al. 2019). As a result, the efficiency of the use of fertilizers and irrigation water as well as land productivity have been moredeclined, resulting in negative impacts on environmental and aquatic sustainability.

N, P, K fertilizers are very good fertilizers for growth and production of crop products. The use of appropriate fertilizers is one of the main factors that influence plant growth. The use of different dosageof fertilizers can have different effects. Fertilizers, in addition to increasing production and quality of harvests, can also increase plant resistance to the disturbances of pests, diseases and drought.

Many efforts have been made to increase rice productivity in dry land, one of which is fertilizing the soil in the form of artificial fertilizers or natural fertilizers, but many obstacles are encountered with this artificial fertilization. One of them is the residual effect of fertilizers that can pollute the environment, so that continuous fertilization will causean adverse effect on the physical, chemical and biological properties of the soil. This chemical fertilizer residue also adversely affects the soil.

Efforts to restore and increase land productivity in a sustainable manner can be done by utilizing biological resources, and N, P, K, fertilizers.Microbial fertilizers are inoculants made from active living organisms in liquid or solid forms that have the ability to mobilize, facilitate and increase unavailable soil nutrient availability to become available form through biological processes.

Groups of potential microbial fertilizers to be applied to integrated and sustainable farming systems include: N-fixing, P and K solubizingmicrobial, phytohormone-producing soil microbes (plant growth

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promoting rhizobacteria) (Noumavo, et al., 2013) decomposers and microbes acting as biological agents (Singh and Purohit 2011). Microbial fertilizersthatplay the mostrole in increasing nutrient status of sub-optimal soils include phosphate solibulizingmicroorganisms and Nitrogen-fixing bacteria. Based on the description above, it is necessary to do research on the effect of microbial fertilizers and N.P.K dosage on growth and yield of upland rice (*Oryza sativa* L).

II. METHODS AND MATERIALS

The pot experiment was conductedin the experimental garden of the Faculty of Agriculture, WinayaMuktiSumedang University, with the altitude of 856 m above sea level in May-October 2018, using a 15 kg soil polybag.

The experimental design useda Randomized Block Design (RBD) in factorial pattern, consisting of two factors with three replications. The first factor was the inoculant of microbial fertilizers which consisted of four levels: without the inoculant of microbial fertilizers; inoculant A (*Pseudomonas mallei*, P.*cepaceae*, A.*niger*, *Penicillium*sp, *Azotobacterchroococum*, *Azospirilum*sp.); inoculant B (P. *cepaceae*, *Azotobacerchroococum*, A. *vilandii*, *Azospirilum*, *Penicillium*, *Acitenobacater*); mixture of A + B inoculants. The second factor was the dosage of N, P, K which consisted of four levels, namely: 100%, 75%, 50%, and 25% dosage of recommendations. The dosage of microbial fertilizers is 50 kg ha^{-1} while the recommended dosage of NPK fertilizer was Urea 250 kg ha^{-1}, SP-36 100 kg ha^{-1}, KCl 100 kg ha^{-1}. The soil used as a planting medium wasAndisols from Tanjung Sari which have the characteristics: soil pH 6.1; Organic C (2.90%); N-total (0.23%) C/N (13) P_2O_5 (96.58 mg 100 g^{-1}); available P Bray 1 (15.00 mg 100 g^{-1}); K_2O (15.21 mg 100 g^{-1}), CEC (24.43 cmol g^{-1}). Upland rice seeds using Situ Bagendit varieties. Observations on plant growth consisted of plant height and number of tillers whichwere being observed periodically until the end of vegetative phase.

Propagation of isolatesof phosphate solubilizing microbes and Nitrogen-fixing bacteria using nutrient broth (NB) while phosphate solubilizing fungi using potato dextrose broth (PDB). Each pure culture of each isolate was inserted into the multiplication medium as much as 10% of the volume of the media then shaken with a 112 rpm shaker for 3 days.

The population of phosphate solubilizing bacteria,phosphate solubilizing fungi and Nitrogen-fixing bacteria were calculated using the Total Plate Count method before being added to the carrier material, which were peat mixture and compost in the ratio of 1: 1 as much as 10% byweight of the carrier material.

III. RESULTS AND DISCUSSION

Shootroot ratio

Shoot root ratio (SRR) shows the spread of photosynthate. The ratio of photosinthatebigger than 1 indicates that photosynthate in the sprout or shoot is higher than being stored in the root. This shows good vegetative growth since many photosinthates are contained at the top (shoot).

Table.1: Shoot root ratio at the end of vegetative phase

Treatments	Shoot root ratio (SRR)
Microbial fertilizers	
- control	2,91 a
- Inoculants A	2,04 a
- Inoculants B	2,58 a
- Inoculants A+B	1,44 a
N,P,K fertilizers	
- 100 %	2,12 a
- 75 %	2,91 a
- 50 %	1,61 a
- 25%	2,32 a

Note : The average value followed by the same letter is not significantly different according to Duncan's Multiple Range Test at the level of 5%.

The experimental results showed that the application of microbial fertilizers and NPK did not significantly affect the shoot root ratio. However, the application of microbial fertilizers tends to reduce the value of SRR. It is suspected that the presence of microbial fertilizers stimulates root growth so that root growth becomes more abundant. Rapid root growth can be caused by IAA hormones produced by microbes in microbial fertilizers. Research result of Dhungana and Itoh (2019) showed that Inoculation with *Klebsiella* sp. the highest IAA producer among the test strains, increased fresh root weight of tomato and radish. This is supported by the research results of Fitriatin et al. (2014), that phosphate solubilizing bacteria are able to produce plant growth regulators which is capable of spurring corn growth.

Components of Upland Rice Yield

Observation of yield components was conducted on productive tillers, panicle length, dry grain harvestweight and one hundred grain weight at harvest time (end of generative phase). The results of the experimentshowed that in general the application of microbial fertilizers consortium significantly increased the yield of upland rice.

The result of the experimentshowed that the application of inoculantof microbial fertilizers significantly increases the number of productive tillers. This is in line with the research results ofBiswakarma et al. (2018) who reported that the application of phosphate solubilizing microbes was able to increase the number of rice tillers.

Based on the results of this experiment, it was shown that inoculant A (*Pseudomonas mallei*, P. *cepaceae*, A.*niger*, *Penicillium*sp, *Azotobacerchroococum*, *Azospirilum*sp.) was better in increasing the number of tillers than inoculant B (P. *cepaceae*, *Azotobacerchroococum*, A. *vilandii* , *Azospirilum*, *Penicillium*, *Acitenobacater*) or even a mixture of inoculants A and B.

The effect of reducing the dosage of N,P,K fertilizer from 100% to 25% has a significant effect on the number of tillers. This shows that the application of inoculants of microbial fertilizers is able to increase the efficiency of inorganic fertilizers that is in the absence of an effect of a marked decrease in plant growth (number of tillers) due to a reduction in N,P,K dosage.Naher et al. (2016) reported that application of biofertilizer reduce 50% chemical fertilizer and increase yield of rice.

Inoculant of microbial fertilizers A which complies with the microbes of *Pseudomonas mallei*, P. *cepaceae*, A.*niger*, *Penicillium*sp, *Azotobacerchroococum*, *Azospirilum* sp. give a better influence in increasing crop yields, namely dry grain harvest up to 32.08% and a weight of 1000 grains increased up to 10.58% compared to without microbial fertilizers.Research results of Salamone et al. (2012) indicate that inoculation of paddy rice with *Azospirillumbrasilense*and *Pseudomonas flurescens*increase crop production.

Table 2. Effect of microbial fertilizers and NPK on upland rice yields

Treatment	Productive tillers	Panicle length(cm)	Weight GKP(g/pot)	weight 1000 grains (g)
Microbial fertilizers				
- without inoculant	32,89 a	1,77 a	39,00 a	21,56 a
- Inoculant A	37,45 b	2,09 b	51,51 b	23,84 b
- inoculant B	34,54 ab	2,02 b	40,01 a	22,15 a
- inoculant A+B	36,16 b	2,14 b	38,48 a	21,68 a
N,P,K fertilizers				
- 100 %	37,17 b	2,15 b	45,38 a	21,97 a
- 75 %	36,25 ab	2,00 a	41,01 a	22,50 a
- 50 %	34,70 a	1,92 a	44,40 a	22,33 a
- 25%	32,93 a	1,95 a	38,22 a	22,42 a

Note: The average value followed by the same letter is not significantly different according to Duncan's Multiple Range Test at the level of 5%.

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IV. CONCLUSIONS

The application of microbial fertilizersinoculantsA (*Pseudomonas mallei*, *P.cepaceae*, *Aspergillusniger*, *Penicillium* sp. *Azotobacerchroococum*, *Azospirilum* sp.) and inoculants B (*Pseudomonas cepaceae*, *Azotobacerchroococum*, *Azotobactervilandii*, *Azospirilum*, *Penicillium*, *Acitenobacater*) and the mixture between the two can increase the growth and yield of upland rice plants. Inoculant A was able to provide a better influence on the growth and yield of upland rice.

Reducing the dosage of N, P, K fertilizer to 25% accompanied by the application of microbial fertilizers can provide results that are not significantly different from the provision of 100%.Therefore, giving microbial fertilizers can reduce the need for NPK fertilizer on upland rice plants.

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Poultry Farmers Perceived Constraints and Unwholesome Practices among Feed Mill Industries in Ibadan Metropolis

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Abstract*— *In order to investigate poultry farmers perceived constraints and unwholesome practices among commercial feed mill industries in Ibadan metropolis. Purposive sampling procedure was used for this study and a total of ninety six questionnaires were administered to the farmers out of the one hundred and sixty registered poultry farmers with Oyo State Agricultural Development Project (OSADEP) in Ibadan metropolis.

The socio-economic characteristics of the respondents such as age, marital status, educational level, gender, years of experience, religion were assessed using descriptive statistics, frequency and percentage, while farmer's perceptions on unwholesome practices and types of feed ingredients used and sources were measured using chi-square analytical tool. Other questions like benefits derived and constraints facing self milling in poultry industries were measured using Pearson product method of correlation (PPMC). From the findings it was revealed that majority of the farmers were facing one challenges or the otheras a result of some sharp practices by the so called feed mill industries in Ibadan ranging from poor quality of feeds sold to farmers, short changing the customers in terms of measurement, scarcity of feed ingredients, seasonal instability in agricultural grains among others. Also, (61.5%) of the farmers agreed that already spoilt feed ingredients can easily be detected since they are not usually bought in large quantities which is one the benefits farmers derived from self milling.

Keywords*— *Poultry Farmers, Perceived constraints, feed mill, unwholesome practices.

I. INTRODUCTION

Poultry industries over time have made tremendous adjustments to meet the increasing demand for inexpensive animal protein and safe supply of meat and eggs. Over three decades, the poultry sector has been growing at more than 5 percent per annum (compared to 3 percent for pig meat and 1.5 percent for bovine meat) and its share in world meat production increased from 15 percent three decades ago to 30 percent currently (FAO, 2006).

Livestock production constitutes an important component of the agricultural economy in developing countries and it is an instrument to socio-economic change, improved income and quality of rural life in Nigeria (Okumadewa,1999). It is an important source of protein presently producing about 36.5% of total intake of Nigerians. In livestock production, poultry occupies a prominent position in providing animal protein as it accounts for 25% of local meat production in Nigeria (Okunlola and Olofinsawe, 2007).

In Nigeria, commercial feed milling commenced in 1963 by Pfizer, (Now Livestock feedPlc.). The number of feed mills in the country has been increasing since then. The number of feed millers grew to 303 as at 1983 with a combined installed capacity of 1039 tonnes per hour. Feed production rose from 640,000 tonnes in 1980 to 2.4 million tonnes in 1985, this then declined to about 1.0 million tonnes by 2008 (Eruvbetine, 2009).

An efficient feed mill industry is therefore crucial to the sustainability of viable livestock and poultry production enterprises. The poultry feed industry (broiler and layer industry) according to Fagbenro and Adebayo (2005), dominates the animal feed industry, and accounted for approximately two-thirds (68.2 percent) of the national feed production while the remaining 31.8% is for livestock such as pig, rabbits and fish. The industry comprises two sectors: the small-scale and the commercial sectors. The commercial

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sector manufactured nearly 1.7 million tonnes or 65.4 percent of the country's poultry feed - this included feeds offered to chickens, guinea fowls, ducks, geese and turkeys (Fagbenro and Adebayo, 2005). The Toll millers and farm mixed feed constitute the remaining 35% of the total poultry feed produced in the country. The ingredient composition used in poultry feeds is derived using least cost formulation techniques.

Livestock feed industries or mills are found all over the country, with the largest concentration in the south-west zone of the country. These range from small, medium to large scale operators. Currently there are only six (6) well established reputable feedmilling companies in Nigeria. The major commercial feed millers include, Top feeds, Vital feeds, Livestock feeds, Boar feeds, Animal care, Amobyng, and Feed Masters producing more than 50% of feed requirement of the country while the remaining is balanced by the medium, small scale, toll millers and on farm/ self-mixed feed that can be found all over the country (Bello, 2008). According to Oyediji (2006), increase in demand for feed has led to the emergence of additional feed mills whose size and nature of business differentiate them from one another. According to Munkaila*et al.*, (2012), there exist large scale commercial feed mills whose hourly output ranges from 5tonnes and above, medium scale mills with an output range of 2-4 tonnes and the small scale with an hourly output of 0.5 to 2 tonnes per hour.

II. METHODOLOGY

This study involved all registered poultry farmers under Oyo State Agricultural Development Project (OSADEP) in Ibadan Metropolis and a purposive sampling procedure was used for the study, Out of about one hundred and sixty registered poultry farmers in Ibadan Metropolis, ninety sixof them were randomly selected for questionnaire administration.Data was collected using primary source of data obtained from selected registered poultry farmers in Ibadan Metropolis

A well-structured questionnaire was used to collect primary data in Ibadan metropolis while secondary data was obtained from research report, literature and other publications.

III. RESULTS

Table1.Socio- Economic Characteristics of the Respondents in the Study Area

Variable	Frequency	Percentage(%)
Sex		
Male	62	64.6
Female	34	35.4
Total	96	100
Age		
21-30 years	23	24.0
31-40 years	22	22.9
41-50 years	37	38.5
Above 50 years	14	14.6
Total	96	100
Religion		
Christianity	55	57.3
Islam	36	37.5
Traditional	5	5.2
Total	96	100
Marital status		
Single	9	9.4
Married	74	77.1
Divorced	6	6.3
Widow	7	7.3
Total	96	100
Level of education		
No formal education	13	13.5

http://dx.doi.org/10.22161/ijeab.443 ISSN: 2456-1878

Adult education	32	33.3
Primary education	32	33.3
Secondary education	3	3.1
Tertiary education	16	16.7
Total	96	100

The result shows that 64.6% were male and 35.4% were females and 24% of the respondents were between the age of 21-30 years, 22.9% between the ages of 31-40 years, 38.5% between the age of 41-50 years and 14.6% are above 50 years of age which shows that majority of the respondents were within the productive year. This also means that respondents involved in poultry farming are at their active age when strength as well as energy to work is readily availablethat is the younger the farmers, the more productive they are (Gingras*et al*., 2008). Furthermore, about26.1% of the respondents have within 501-1000 stocks of birds which make it the highest and majority of the respondents realizes between #50,000-100,000 per year 32.3% and majority of the farmer's mills between 201-300 kg of feeds per month 37.5% that is most of the farmers sampled makes use of feed mills on a regular basis.

Table 2: Farmers Perception on unwholesome practices among feed mill industries

PERCEPTION	SA	A	U	D	SD
1. Some feed millers operators have a mindset of Cheating their customers	51(43.1)	36(37.5)	4(4.2)	5(5.2)	7(9.8)
2. Some of feed millerslook for cheap ingredients Not minding their quality	48(50)	35(36.5)	3(3.1)	8(8.3)	2(2.1)
3. Qualities of feed ingredients used in most Feed mill areSubstandard	41(42.7)	31(32.3)	8(8.3)	14(14.6)	2(2.1)
4. Most workers employed in feed mills are Dubious and do steal from ingredients bought	45(46.9)	21(21.9)	24(25)	4(4.2)	2(2.1)
5.Some of the feed millers make use of high moisture Ingredients as to increase the weight of the feeds	40(41.7)	28(29.2)	17(17.7)	7(7.3)	4(4.2)
6. Unwholesome practice can lead to low quality feed at the end	50 (50.2)	32(33.3)	7(7.3)	7(7.3)	6(1.9)
7. Some feed millers adulterates their ingredients by mixing sand and other unhygienic materials.	35(36.5)	22(22.9)	18(18.8)	14(14.6)	7(7.3)
8. Some of the feed millers adjust their scales In other to makemore profit	53(55.2)	32(33.3)	5(5.2)	4(4.2)	2(2.1)
9. Unwholesome practices in the feed mill can Lead to stunted Growth in chickens	53(55.2)	31(32.3)	4(4.2)	5(5.1)	3(3.1)
10. Unwholesome practices can lead to disease outbreak in Poultry		55(57.3)	33(34.4)	6(6.3)	2(2.1)
11. Unwholesome practices can lead to reduction in egg production in case of layers	56(58.3)	33(34.4)	2(2.1)	1(1.0)	4(4.2)

Source: Field survey, 2017

From the above table (53%) of the respondents strongly believed that unwholesome practices can lead to egg reductions, also, 57.3% of the farmers strongly agree that unwholesome practices can lead to disease outbreak in poultry. Furthermore, 55.2% of farmers also believed that some of the feed millers adjust their scale in other to make more profits and that practice alone can lead to lead stunted growths in chickens. 53.1% of the respondents had strong indications that some of the feed miller operators have a mindset of cutting corners and cheating their customers, also, 52.1% of respondents also strongly agreed that unwholesome practices can lead to low quality chickens and 50.0% of the farmers strongly agree that some feed millers look for cheap ingredients not minding their qualities.

http://dx.doi.org/10.22161/ijeab.443 ISSN: 2456-1878

Table 3: Availability of materials for commercial feedmill industry materials

	Not available	Sometimes available	Always available
1. Maize	0(0)	13(13.5)	83(86.5)
2. Fishmeal	0(0)	20(20.8)	76(79.2)
3. Soybeans	0(0)	19(19.8)	77(80.2)
4. Sorghum	6(6.3)	28(29.2)	62(64.6)
5. Millet	8(8.3)	30(31.3)	58(60.4)
6. GNC	1(1.0)	26(27.1)	69(71.9)
7. Rice bran	4(4.2)	36(37.5)	56(58.3)
8. Amino acid	8(8.3)	47(49)	41(42.7)
9. Wheat bran	6(6.3)	32(33.3)	58(60.4)
10. Molasses	24(25)	42(43.8)	30(31.3)
11. Linseed meal	25(26.0)	36(37.5)	35(36.5)
12. Cotton seed meal	14(14.6)	46(47.9)	36(37.5)
13. Salt	1(1)	12(12.5)	83(86.5)
14. Vitamin C	1(1)	12(12.5)	83(86.5)
15. Minerals	1(1)	24(25)	71(74)
16. Copper	10(10.4)	39(40.6)	47(49)

Table 3 continuation: Availability of materials for commercial feedmill industry materials

MATERIAL	Always available	Sometimes available	Not available
23. Methionine	15(15.6)	26(27.1)	55(57.3)
24. Selenium	29(30.2)	22(22.9)	45(46.9)
25. Palm kernel	6(6.3)	30(31.3)	60(62.5)
26. Cotton seed	13(13.5)	26(27.1)	57(59.4)
27. Peanut cake	6(6.3)	25(26)	65(67.7)
28. Pellets	9(9.4)	23(24)	56(58.3)
29. Brewer Dried Grain	9(9.4)	23(24)	64(66.7)
30. Lysine	3(3.1)	30(31.3)	63(65.6)
31. Di calcium phosphate	8(8.3)	40(41.7)	48(50)
32. Premix	3(3.1)	25(26)	68(70.8)
33. Nutritive additives	5(5.2)	35(36.5)	56(58.3)
34. Limestone	5(5.2)	23(24)	68(70.8)
35. Oyster shell	4(4.2)	23(24)	69(71.9)
36. Bone meal	9(9.4)	16(16.7)	71(74)

Source: Field survey, 2017

From the table above, Availability of maize as one of the sources of feed ingredients in feed mill industries had 86.5% which supports Iken and Amusa, 2004, that says 'maize has now risen to a commercial crop on which many Agro-based industries depends on it as raw materials for production. According to IITA 2001, 'maize is highly yielding, easy to process, readily digested and cost less than other cereals. 86.5% of the respondents also said that salt and vitamin C is always available, 80.2% also said that soybeans is always available, 79.2% of respondents supported that fishmeal is always available,77.1% of farmers also said that palm-oil is always available, 74.0% of respondents also agreed that minerals and bone meal materials is always available.

http://dx.doi.org/10.22161/ijeab.443 ISSN: 2456-1878

Table 4: Sources of feed in feed mill industry

Sources	Regularly	Occasionally	Never
1. Open markets	79(82.3)	17(17.7)	0(0)
2. Directly from farmers	44(45.8)	44(45.8)	8(8.3)
3. Friends and family	17(17.7)	46(47.9)	33(34.4)
4. Industrial waste	36(37.5)	45(46.9)	15(15.6)
5. House hold waste	28(29.2)	43(44.8)	24(25.0)
6. Extension agent	20(20.8)	56(58.3)	20(20.8)
7. Feed mill industries	67(69.8)	25(26.0)	4(4.2)
8. Personal farm	50(52.1)	36(37.5)	10(10.4)

Source; Field survey, 2017

Majority (82.3%) of the farmers regularly get their ingredients from open markets. Close to half (45.8%) of the respondents get their own directly from farmers regularly and occasionally.

Also, 47.9% of respondents occasionally get their ingredients from friends and family who own one farm or the other, 46.9% of the respondents occasionally get their ingredients from industrial waste. Furthermore, 44.8% occasionally get their ingredients from household waste, 58.3% occasionally source theirs from extension agents.

Table 5: Benefits derived from self milling

Benefits	NB	LB	MB	HB
1.It is more nutritive than conventional feeds	16(16.7)	7(7.3)	18(18.8)	55(57.3)
2.Self- milled feed saves a lot of money on the Overall cost of production	12(12.5)	6(6.3)	25(26)	53(55.2)
3.The nutrient content of the feed is retained Through self-mill	15(15.6)	9(9.4)	19(19.8)	53(55.2)
4.It is not time consuming	6(6.3)	16(16.7)	27(28.1)	47(49)
5.Feeds are prepared in right proportions needed By the available birds	7(7.3)	12(12.5)	26(27.1)	51(53.1)
6.It is usually milled when needed per time	12(12.5)	13(13.5)	25(26)	46(47.9)
7.Preventive measures are usually taken	7(7.3)	14(14.6)	22(22.9)	53(55.2)
8.There is reduced risk attached to self-milling Compared to commercial feed millers	7(7.3)	18(18.8)	21(21.9)	50(52.1)
9.There is no scarcity of feed for birds	2(2.1)	18(18.1)	27(28.1)	49(51.0)
10.Alreadyspoilt feed ingredients are easily Detected	2(2.1)	13(13.5)	22(22.9)	59(61.5)
11.Farmers can be sure of the nutritive values Quality of the feed at the end	6(6.3)	15(15.6)	21(21.9)	54(56.3)

Source: Field survey, 2017

The table above shows the benefits derived by farmers in self-milling. Majorly, (57.3%) of the respondents agreed to the fact that it is usually more nutritive than that of feed mill industries, also, 55.2% of respondents agree that self-milling saves a lot of money on the overall cost of production and the nutrient content of the feed is retained through self-milling, 61.5% of the respondents supported that already spoilt feed ingredients can't be used when doing self-milling. Furthermore, 56.3% agreed that farmers can be sure of the nutritive values of the ingredients to be used. 54.2% of the respondents agreed that in self-milling, contamination by rodents and other micro-organism is reduced in self-milling.

http://dx.doi.org/10.22161/ijeab.443 ISSN: 2456-1878

Table 5: Contraints FacingFarmers in Commercial Feed Mill Industry.

Constraints	N.C	Min. C.	Maj.C.
1. The feeds are not always in the Right proportion	16(16.7)	37(38.5)	43(44.8)
2. It is time consuming	14(14.6)	42(43.8)	40(41.7)
3. Contaminated feeds can lead to Health hazard	8(8.3)	11(11.5)	77(80.2)
4. Small scale farmers are not usually Attended to on time	9(9.4)	38(39.6)	49(51)
5. Feeds meant for one animal can be Mistaken for another	17(17.7)	39(40.6)	40(41.7)
6. Epileptics supply of light can lead to feed scarcity	13(16.3)	35(41.8)	48 (41.9)
7. Shortage of feed ingredients will lead to unavailability of feeds	6(6.3)	30(31.3)	60(62.5)
8. Increase in prices of feed materials Often leads to increase in feed price	5(5.2)	22(22.9)	69(71.9)
9. Feeds bought from feed millers are Often lesser thanacclaimed quantity	5(5.2)	41(42.7)	50(52.1)
10. Seasonal instability in agricultural Crops do affect ingredients	5(5.2)	26(27.1)	65(67.7)
11. Instability in Government policies do Affect certain crops	12(12.5)	25(26)	59(61.5)

NOTE** **.NC- Not a constraints, Min. C- Minor Constraints, Maj. C- Major Constraints**

Source: Field survey, 2017

The above table shows the constraints facing the farmers in feed mill industries. One of the major constraints facing the farmers is the way animals fed such adulterated ingredients are susceptible to diseases attacks 80.2% of the respondents affirmed this, also feed price increases71.9% indiscriminately. Other challenges' facing the farmers ranges from inadequate power supply to instability in Government policies 65.6% and 67.7% respectively. In addition there are other constraints like unavailability of feed ingredients and shortage in feed supply due to one reason or the other.

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Floristic diversity of a Voluntary Natural Reserve (VNR) of Sucrivoire on the right bank of the Bandama river in Zuenoula, in the West Centre of Côte d'Ivoire.

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***Abstract*— *Several surveys and inventories were conducted with surface survey method using plots, measuring 200 m^2 and supplemented with mobile method in Sucrivoire Voluntary Natural Reserve on the right bank of the Bandama river. The analysis of the data collected focused on diversity and floristic richness and used phytoecological methods such as the ACP. The obtained results concern 200 identified botanical species among which 81 % of dicotyledone and 19 % of monocotyledone belonging to 152 genera and 56 families. The ecological factor most pronouncement being the toposequence, the determination of the diversity indices of various strata showed that for each of it the flora is very diversified and homogeneous in general such as indicated by the coefficient of similarity of Sørensen which remains upper to 50 %. However, this flora is dominated by the families of Euphorbiaceae, Poaceae, Rubiaceae, Mimosaceae, Asteraceae, Caesalpiniaceae and Sterculiaceaes which characterize his phytogeographique position. In this floral diversity, the ACP revealed a single group of floral procession, which mean that the three strata constitute a single forest block dominated by Phanerophytes in 66,33 % and containing 12 species with particular status and 17 species considered as commercial forest essences. All these characteristics confirm the good state of preservation of the flora of the right bank of the Bandama river set up as a Voluntary Natural Reserve by Sucrivoire. This sugar canne structure so makes the flora of this site one of the reservoir of biodiversity of the future green frame of Côte d'Ivoire.*

***Keywords*— floral Diversity, Voluntary Natural Reserve, Bandama river, Sucrivoire, Côte d'Ivoire.**

I. INTRODUCTION

The loss of drilled surfaces in Côte d'Ivoire has been estimated at 12 million hectares since 1960 until the present day (Sodefor, 1994). Currently, the Ivorian forest cover represents less than 20% of its original extent (Koulibaly *et al*, 2010). To safeguard the scarcity of forest that still exists and to counter the environmental threat posed by deforestation, in 2002, the State established a forest policy with new conservation approaches, including incentives for the creation of Voluntary Natural Reserves (VNR). It is into this policy that Sucrivoire sugar canne structure aims to protect the forest relics of its domain. The riparian forest along the right bank of the Bandama river is considered as the most important.

In fact, wherever it is practised elsewhere, there are many benefits in terms of multifunctionality in rural development, such as the creation of income and the provision of services to other agricultural products. Thus, in the regions where sugar industries are established, many populations are flooded, at the same time constituting a significant human pressure on the flora, including that bordering the Bandama river, on which the irrigation of sugar cane plantations is heavily dependent. This forest plays an important role in protecting nests and the cleanup of waterways, and human pressure directly threatens its local biodiversity.

In order to assess the impact of this healthy Sucrivoire decision and then to update the knowledge on the plant biodiversity of these foresters, a floristic inventory was carried out on the right bank of the Bandama river in the Sucrivoire domain in Zuenoula, central-western of Côte d'Ivoire.

This study proposes to characterize this vegetation along the Bandama river.

II. RESEARCH PROCEDURE

The site of study

The sugar canne domain of Sucrivoire at Zuenoula is situated in the west central region of Ivory Coast, in Marahoué, between 7°25 ' 45 " of latitude North

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and 6°02 ' 35 " of longitude West as Fig. 1 shows it. The relief is little accidented and presents an average height of 250 meters. Zuenoula is situated in the sector mesophile of the Guinean domain (N'Da *et al*., 2008) and represent a zone of climatic transition enter half the South more watered (1200 to1800 mm rains/year) and the drier North (1100 to1600 mm rains/year). The annual average temperatures vary between 25 and 28°C. The major part of arable land is established on ferralitical grounds reshaped and weakly desatured with a mosaic of forest and savanna (N'Da *et al*., 2008). The current population of the complex sugar bowl of Zuenoula is 15000 people against 2600 people in 1991 (N'Guessan, 2011) and more than 11000 people live around this complex (Sifca, 2011).

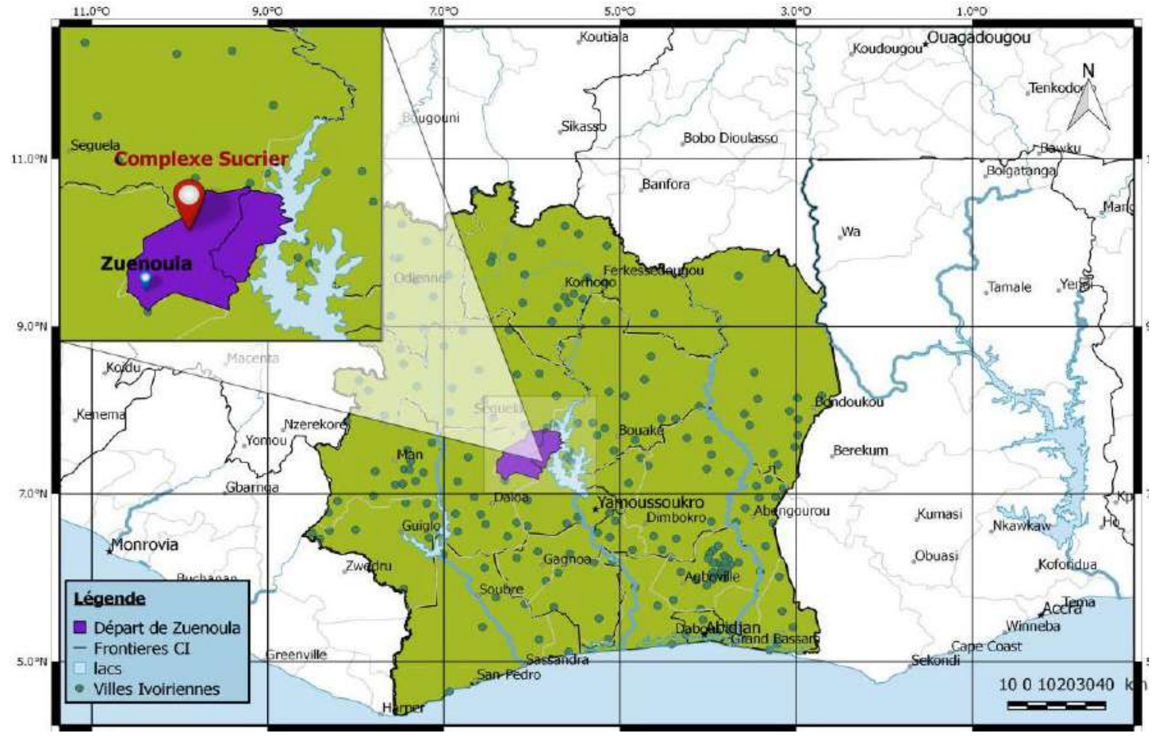

Fig. 1 : geographic localisation of Zuenoula

Material

All the botanical species met in this forest constitutes our biological material. The harvest required a technical material constituted by a machete, a ribbon-meter, some pickets, a camera, a rope and a florae stemming from the National Center of Floral (CNF) as well as a map of land use in 1/25000 edited by the SEMAT in 2013-2014.

Methods

The VNR which lines the right bank of the Bandama river extends over 6825 meters in length for 200 meters in width and presents a toposequence which is the most important ecological factor from north to south. For the floral statements, about three strata two thousand meters in lengths each were distinguished according to the toposequence : the north stratum which is a tray, the central stratum which is a slope and the south stratum which is a low tray. Five small places measuring 20 x 20 m distant some of the others of 30 meters in the width and 100 meters in the length were delimited in every stratum. In each of the small places, the systematic statement of the species was made by mentioning only once the presence of the species. The visit of small places was repeated four times over two consecutive years in dry season and in rainy season.

Outside small places, random itinerant statements were realized with collection of samples of species.

The collected samples were placed in herbarium for the identifications. For every sample, photos were realized to contribute to the determination of the species. The identification of the species was made thanks to the existing florae: Lebrun and Stork (1991; 1997), Kouamé (1998b) and Ake-assi (2001; 2002).

Data analysis

After identification of samples, every species was tidied up in his family and its genrera taxonomique. The absolved frequency (Fa) and the relative frequency (Fr) of every species were considered. The frequency absolved from every species is equal to the total number of its presences in the whole of the statements made in three strata. The relative frequency of a given botanical species defines itself as the centesimal report of its absolute frequency and the total number of statements (Nr) made on a given site (Godron, 1971) as indicates it the following formula :

$$Fr = (Fa \times 100) / Nr$$

The floral diversity and somme diversity indices were considered to characterize the flora :

- the diversity indices of generic and specific (report genrera/families and species/genrera) which give an idea of the degree of floral diversity as well for all the studied zone as for the strata;
- Sørensen (1948) similarity coefficient (Cs) which formula is:

$$Cs = \frac{2c}{(a+b)} * 100$$

In this formula, (a) represent the number of species of the plot of land A, (b) represent the number of species of the plot of land B which we compare with the list A and (c) is the number of species common to the plots of land A and B. Cs varies between 0 and 100 % and if Cs is upper or equal to 50 %, then both compared plots of land are very close and can be considered as floristically homogeneous (Aman *et al*., 2004). The data analysis also concerned the degree of preservation of the zone of study and its face through :

- the biological spectre defined by the percentage of the species belonging to the same biological type according to the classification of Raunkiaer (1905) taken back by Aké Assi (1984) and Kouamé (1998b). For every species, the considered biological type is the one observed at the time of the execution of the statements on the ground;
- the presence of species with particular status and wooden exploitable essences of work;
- the ecological profile through the analysis in main component (ACP) according to Romane (1972) with the software STATISTICA 7.1.

III. RESULTS

Floral diversity

Floral inventories in all three strata allowed us to identify 200 plant species across 152 genera and 56 botanical families. Table 1 shows details of the distribution of species within genera and families at the stratum level. Enrolment at the different taxonomic levels varies across strata but in a non-significant proportion at p = 0.05%. This flora contains 161 species, 81% of which belong to the dicotylédones class and 37 species housed in monocotylédones or 19% as it's showed by Fig. 2.

Table 1: Species, genera and families partitioned by class

	stratum 1			Stratum 2			stratum 3		
	Es	**Ge**	**Fa**	**Es**	**Ge**	**Fa**	**Es**	**Ge**	**Fa**
Mono.	30	11	7	15	7	4	11	5	3
Dico.	148	141	43	128	103	23	154	109	43
Total	178	152	50	143	110	27	165	114	49

Mono. : Monocotyledones; Dico. : Dicotyledones; Es: species; ge: Genera; Fa: families

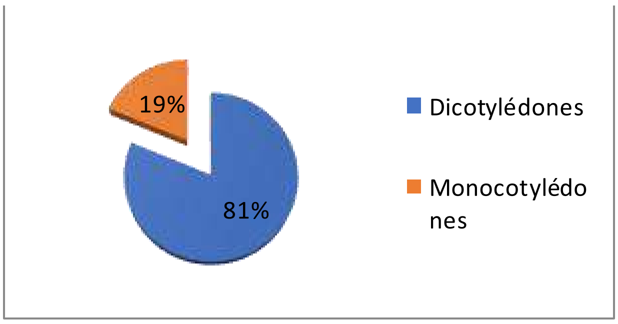

Fig. 2: Percentage of species following broad taxonomic levels of the study area

The data which are listed in the table 1 hase been used to determine the different diversity indices. Thus, for general flora, the values of the generic (2,71) and specific (1,32) diversity indices of the right bank of the Bandama river are low. However, with respect to the diversity indices for each stratum presented in Fig. 3, the south stratum has the smallest generic diversity index with a value of 2,33. This is the most diverse stratum and is followed by stratum 1 with 3,04 as value and finally by the stratum 2 with a value of 4,07. In terms of specific diversity, the tray (stratum 1) has the greatest specific diversity (1,17) followed by the stratum 2 with a value of 1,3 and then the stratum 3 (1,45). Sørensen similarity coefficient calculated for the three strata is presented in Table 2. The values are greater than 50% and reflect a homogeneity of flora from the tray to the bottom of the slope.

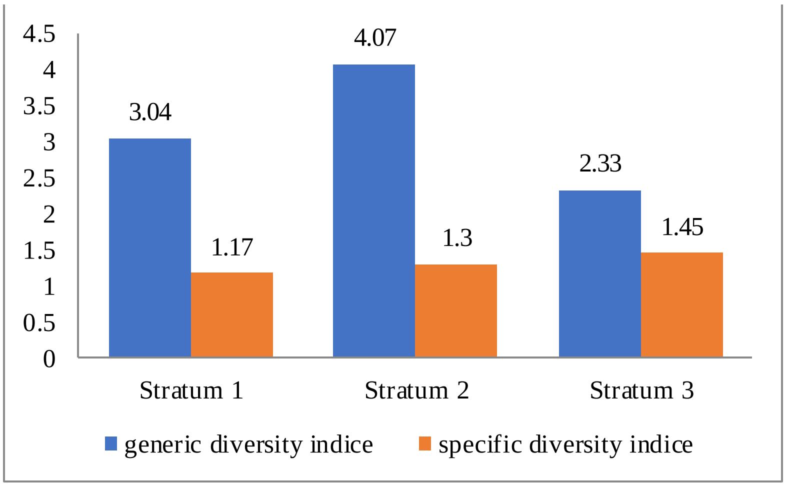

Fig. 3: diversity indices of generic and Specific for all three strata

Table 2: Calculated Sørensen similarity coefficients for strata taken two to two

	Stratum 1	Stratum 2	Stratum 3
Strate 1	-	73,39	83,38
Strate 2	-	-	70,19

However, it appears in this flora, among the 56 botanical families identified, 15 families most represented in number of species. Table 3 lists these, as well as the number of species, genera and specific diversity indice for each family. Considering this indice of diversity, the Fabaceae and Euphorbiaceae, which are the families best represented in number of species, find themselves less diverse than Poaceae, Sapindaceae, Rubiaceae and Annonaceae. Of all species surveyed at the three stratum level, 28 species are also abundant and ubiquitous, as shown in Table 4, which lists these species and their relative frequency.

Table 3: List of families best represented in number of species and their specific diversity indice within the flora of the right bank of the Bandama river at Sucrivoire domain.

N°	Families	Nbre. species	Nbre. genera	Ids
1	Fabaceae	17	13	1,31
2	Euphorbiaceae	12	9	1,33
3	Poaceae	12	12	1
4	Caesalpiniaceae	10	6	1,67
5	Rubiaceae	10	9	1,11
6	Asteraceae	9	7	1,29
7	Combretaceae	8	2	4
8	Mimosaceae	8	5	1,6
9	Moraceae	7	2	3,5
10	Sterculiaceae	7	4	1,75
11	Annonaceae	6	5	1,2
12	Sapindaceae	6	6	1
13	Dioscoreaceae	5	1	5
14	Verbenaceae	5	4	1,25
15	Vitaceae	5	1	5

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Table 4: List of species best represented in number of individuals by their relative frequency in the right bank flora of the Bandama river at Sucrivoire domain.

N°	Noms des espèces	Fa	Fr
1	*Combretum zenkeri* Engl. & Diels	15	100
2	*Paullinia pinnata* L.	10	66,67
3	*Ficus sur* Forsk.	10	66,67
4	*Olax subscorpioidea* Oliv.	8	53,33
5	*Cissus petiolata* Hook.f.	7	46,67
6	*Lecaniodiscus cupanioides* Planch.	7	46,67
7	*Nauclea latifolia* Sm.	7	46,67
8	*Cola caricaefolia* (G. Don) K. Schum.	7	46,67
9	*Lonchocarpus sericeus* (Poir.) Khunt.	7	46,67
10	*Chromolaena odorata* (L.) R. M. King & H. Rob.	7	46,67
11	*Clerodendrum buchholzii* Gürke	7	46,67
12	*Cochlospermum planchonii* Hook.f.	7	46,67
13	*Ceiba pentandra* (Linn.) Gaerth.	6	40
14	*Parkia biglobosa* (Jacq.) Benth.	6	40
15	*Bridelia ferruginea* Benth.	6	40
16	*Diospyros mespiliformis* Hochst. ex A. DC.	6	40
17	*Pouteria alnifolia* (Bak.) Roberty	6	40
18	*Crotalaria retusa* Linn.	6	40
19	*Desmodium salicifolium* (Poir.) DC.	6	40
20	*Alchornea cordifolia* (Schum. & Thonn.) Müll.Arg.	5	33,33
21	*Cryptolepis sanguinolenta* (Lindl.) Schltr.	5	33,33
22	*Antiaris toxicaria var. africana* (Engl.) C.C. Berg	5	33,33
23	*Cola gigantea* A. Chev.	5	33,33
24	*Holarrhena floribunda* (G. Don) Dur. & Schinz	5	33,33
25	*Phoenix reclinata* Jacq.	5	33,33
26	*Cola laurifolia* Mast.	5	33,33
27	*Mallotus oppositifolius* (Geisel.) Müll. Arg.	5	33,33
28	*Desmodium velutinum* (Willd.) DC.	5	33,33

Combretum zenkeri and *Paullinia pinnata* with relative frequencies of 100% and 66.67% respectively are at the head of this floristic procession. Both of these species are invasive and occur in both agricultural, savannah and forest areas. Most of this flora belongs to the taxa of the Guinean-Congolese, Guinean-Congolese and Sudanese-Zambezi regions and finally the Sudanese-Zambian regions.

Statistical Analysis

Key Component (ACP) analysis explains the corelationship between taxonomic levels and ecological descriptors. It focuses on the analysis of the factorial weight matrix and has extracted two components that account for the totality (100%) of the variability between ecological descriptor. The 1-2 design is characterized by 99.82% own values for the F1 axis and 0,18% own values for the F2 axis. The F1 axis represented all variables, forming a single group, while no variables contributed to the definition of the F2 axis. The results of this analysis are shown in Figure 4, which shows a single ecological procession group, indicating that the species in all three strata are virtually the same.

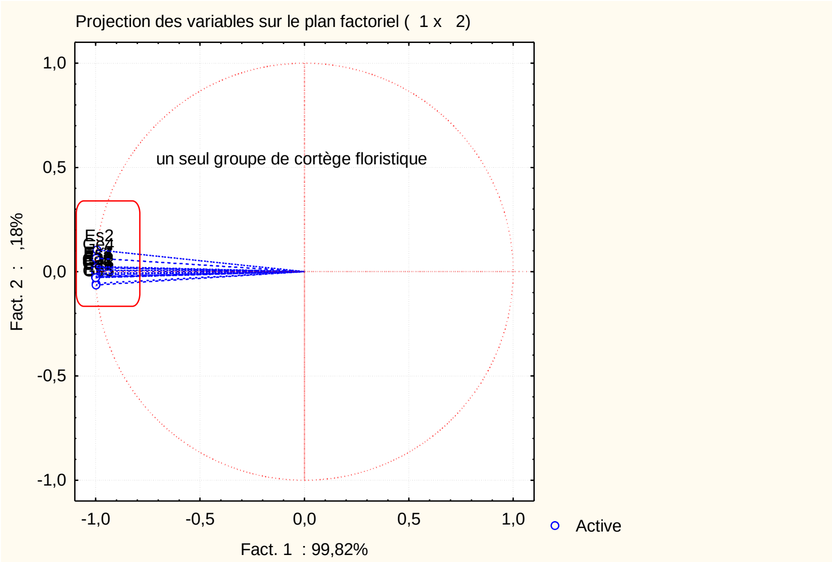

Fig. 3 : representation of the species and the ecological descriptor according to the ACP

Biological types

The identified species belong to diverse biological types and the Fig. 4 presents us the biological spectre of this plant training which gives an idea of its vertical architecture. Phanerophytes (Ph) which Ligneous plants are buds of which are situated higher than 50 cms above ground level, dominate this plant training with a 66,33 % representativeness and are followed by the climbing species or the lianas which represent 19,1 %. Phanerophyte groups here:

- Megaphanerophytes, big trees of more than 25 m of height, which represent 17,8 % of Phanerophytes and 8 % of the total flora, having representatives for *Nauclea latifolia*, *Pouteria alnifolia*, *Ceiba pentandra* and the most frequent *Parkia biglobosa*;
- Mesophanerophytes or small trees measuring between 10 and 25 m of height which represent 40 % of Phanerophytes and 18,1 % of the total flora. The most frequent representatives are *Olax subscorpioidea*, *Lecaniodiscus cupanioides*, *Holarrhena floribunda* and *Phoenix reclinata*;

classified as low risk.

- Microphanerophytes, ligneous plants measuring between 2 and 10 m of height, represent 42,22 % of Phanerophytes and 19,10 % of the total flora and the most frequent are *Ficus sur*, *Cola caricaefolia*, *Lonchocarpus sericeus* and *Bridelia ferruginea*;
- Nanophanerophytes which are small ligneous plants measuring between 0.5 and 2 m of height represents 46,67 % of Phanerophytes and 2,1 % of the total flora.

Species having special Status

There are twelve species showed in the table 5 which have special status representing 4,16% of all species with one species endemic to Côte d'Ivoire (*Baphia bancoensis*), eight species endemic to the West African Forest Block (*Eriosema molle*, *Dalbergia oblongifolia*, *Hymenocardia acida*, *Premna hispida*, *Dialium guineense*, *Aframomum sceptrum*, *Dioscorea sibarensis*) and three listed on IUCN red-listed species (2012) : *Ricinodendron heudelotii*, *Terminalia ivorensis* and *Triplochiton scleroxylon*

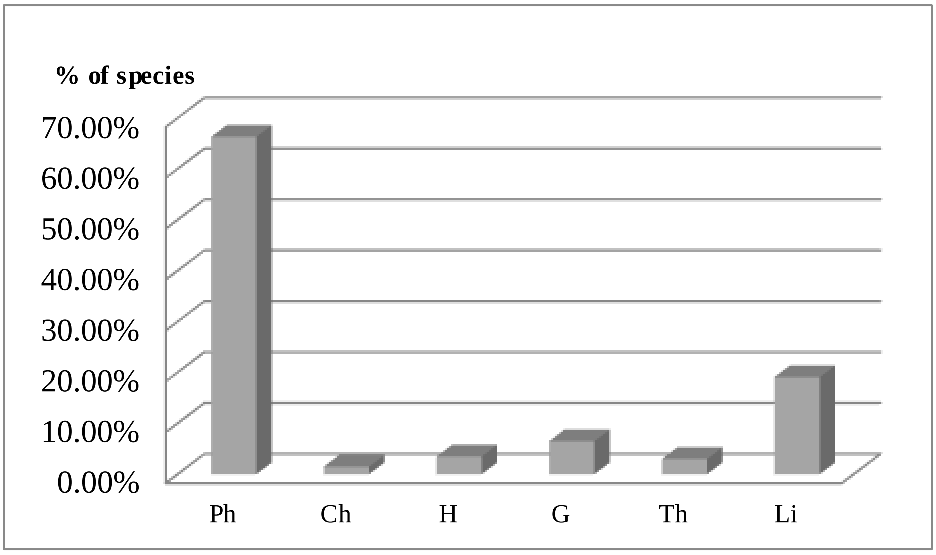

Fig. 4: the biological spectre of the flora of the right bank of the Bandama river at Sucrivoire domain

Ph: Phanerophytes; Ch: Fiepytes (woody or herbaceous perennial plants, rooted, whose regenerating buds are located near the soil, below 50 cm); H: Hemicryptophytes (rooted plants whose bud is on the surface of the soil, and whose aerial portion dies during the adverse season); G: Geophytes (plants whose buds are well buried in the soil. bulb and rhizome geophytes); Th: The Thérophytes (plants that survive with seeds).

In addition, 17 species were identified as commercial forest species in this study. These forest species were subdivided into three categories based on the market criteria used by Kouamé (1998a) in Côte d'Ivoire. Table 6 lists these species and their position on the marketing scale.

Table 5: List of species of special status identified.

N°	Espèces	Familles	Chorologie and Status
1	*Aframomum sceptrum* K Schum.	Zingiberaceae	GCW
2	*Baphia bancoensis* Aubrév.	Fabaceae	GCI
3	*Cola caricaefolia* (G. Don) K. Schum.	Sterculiaceae	GCW
4	*Dalbergia oblongifolia* G. Don	Fabaceae	GCW
5	*Dialium guineense* Willd.	Caesalpiniaceae	GCW
6	*Dioscorea sansibarensis* Pax	Dioscoreaceae	GCW
7	*Eriosema molle* Hutch. ex Mi Ine	Fabaceae	GCW
8	*Hymenocardia acida* Tul.	Euphorbiaceae	GCW
9	*Premna hispida* Benth.	Verbenaceae	GCW
10	*Ricinodendron heudelotii* (Baill.) Pierre ex Pax	Euphorbiaceae	LR
11	*Terminalia ivorensis* A. Chev.	Combretaceae	VU
12	*Triplochiton scleroxylon* K. Schum.	Sterculiaceae	LR

GCI: Species endemic to Ivorian flora; GCW: Species endemic to the West African Forest Bloc; LR: Low risk species; VU = Vulnerable species.

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Table 6: Commercial species found in the flora of the right bank of the Bandama river at the Sucrivoire domain level.

N°	Espèces	Familles	catégorie
1	*Antiaris toxicaria* var. *welwitschii* (Engl.)	Moraceae	1
2	*Ceiba pentandra* (Linn.) Gaerth.	Bombacaceae	1
3	*Erythrophleum suaveolens*	Caesalpiniaceae	1
4	*Mansonia altissima* (A. Chev.) A. Chev var	Sterculiaceae	1
5	*Pouteria alnifolia* (Bak.) Roberty	Sapotaceae	1
6	*Terminalia belerica* Roxb.	Combretaceae	1
7	*Terminalia ivorensis* A. Chev.	Combretaceae	1
8	*Terminalia mentaly* H. Perrier	Combretaceae	1
9	*Terminalia scimperiana* Hochst.	Combretaceae	1
10	*Triplochiton scleroxylon* K. Schum.	Sterculiaceae	1
11	*Sterculia setigera* Del.	Sterculiaceae	2
12	*Sterculia tragacantha* Lindl.	Sterculiaceae	2
13	*Lannea acida* A. Rich.	Anacardiaceae	3
14	*Lannea nigritana* (Sc. Elliot) Keay var.	Anacardiaceae	3
15	*Parkia biglobosa* (Jacq.) Benth.	Mimosaceae	3
16	*Albizia adianthifolia* (Schumach.) W.F.	Mimosaceae	2
17	*Albizia ferruginea* (Guill. &Perr.) Benth.	Mimosaceae	2

IV. DISCUSSION

Floral diversity

Floristic inventories carried out in the Sucrivoire Voluntary Natural Reserve on the right bank of the Bandama River in Zuénoula have identified 200 plants species belonging to 152 genera and 56 families. In 2012, Kouassi *et al* counted 471 species from 96 botanical families identified in Zuenoula area in 2012. This is indicative of the emergence of new frontier species in this area, thanks to the protected domain character of this forest block. This vegetative formation lonely contains 42,46% of the species of the domain and 60% of the families present and are more diversified at the tray and the bottom of the slope. But as a whole it is a well diversified homogeneous block as reflected in the diversity indices, the Sørensen coefficient of similarity and the ACP results.

Also, Kouassi *et al*. (2012) noted on the site as a whole 13 important families in numbers of species headed by Fabaceae, Rubiaceae, Poaceae and Euphorbiaceae that we find among the 15 most represented families, the most diverse of which are the Sapindaceae, Poaceae, Rubiaceae and Annonaceae. The flowering procession of this plant formation dominated by the families of Euphorbiaceaes, Poaceaes, Rubiaceaes, Mimosaceaes, Asteraceaes, Caesalpiniaceaes and Sterculiaceaes is the characteristic of the phytogeographic position of this area, which Guillaumet and Adjanohoun called in 1971 a transition zone between the forest and the savannah belonging to the Guineo-Congolese (GC) and Sudanese-Zambia (SZ) complex.

The natural form of this vegetable formation is dominated by Phanerophytes of which some are ubiquistes: *ficus sur*, *Olax subscorpioidea*, *Lecaniodiscus cupanioides*, *Nauclea latifolia*, *Cola caricaefolia*, *Lonchocarpus sericeus*, *Ceiba pentandra*, *Parkia biglobosa*, *Bridelia ferruginea*, *Diospyros mespiIiformis*, *Pouteria alnifolia*, *Antiaris toxicaria var. africana*, *Holarrhena floribunda*, *Phoenix reclinata*, *Cola laurifolia*, *Cola gigantea* and *Mallotus oppositifolius* and two lianas *Paullinia pinnata* and *Alchornea cordifolia*. Kouassi *et al*., (2012) inventoried in the region 7 Phanerophytes ubiquitous against 16 today in this vegetable formation. This observation testifies of the good state of preservation of this forest because of the privilege it enjoys from Sucrivoire. Indeed, the classsification of this vegetable formation in Voluntary Natural Reserve allows him to benefit from a protection against the human pressure and people activities which remain fatal for the vegetable and animal biodiversity of the site. Also, the important presence of lianas megaphanerophytes and mesophanerophytes testifies of the legitimacy of this protection which favors their stability.

The presence of 12 species with special status and 17 species considered as commercial forest species demonstrates the importance and quality of this flora that deserves preservation. These species have the potential to regenerate frontier biodiversity species (Aubréville, 1936). The flora studied is full of low-risk and vulnerable species (IUCN, 2012), endemic to Ivorian flora and the West African Forest as well as the classified upper

Sassandra Forest where Kouassi *et al*. (2015) counted 37 species with special status and 37 species considered as commercial forest species. The forest species presented here could be used for local reforestation or local forest management replace to exotic species such as *Tectona grandis* L. (Verbenaceae) which sometimes have difficulty adapting to the local environment and climate. This could skew the success rate of a local forest management policy.

Making this forest block and many other sites voluntary natural reserves that are private areas of particular scientific, ecological and tourist interest, Sucrivoire thus contributes to the conservation of biodiversity and shows its regional pattern for biodiversity in consultation with local actors such as SODEFOR and the Ministry of Agriculture. Voluntary natural reserves are now both a vector of regional strategies for biodiversity and a tool for the valorisation of the territories. Thus, the voluntary natural reserve on the right bank of the Bandama river is a key part of the regional schemes for the protection of nature and starts from the "biodiversity reservoirs" of the Ivorian green frame.

V. CONCLUSION

The Floristic Inventory work carried out in the Sucrivoire Voluntary Natural Reserve on the right bank of the Bandama river has identified 200 plants species belonging to 152 Genra that have left between 56 Families. The indices of specific diversity of the three strata, defined according to the toposequence of the study area, have shown that they are very diverse but constitute a single and very homogeneous forest block as shown by the results of the Sørensen coefficient of similarity and those of the statistical analysis which focused on the ACP. However, this flora is dominated by 15 families best represented in numbers of species and 28 most abundant and ubiquitous species.

The vertical structure of this flora is marked by the presence of a large population of species placed among the Phanerophytes (66,33%) at the time of the inventories as well as climbing or liana species that make up 19,1% of the Totole flora. One of the particularity of this flora which justifies its protection the presence of 12 species with special status with an endemic species in Côte d'Ivoire, eight species endemic to the West African forest block and three species listed on the IUCN red list. In this study, 17 species were identified as commercial forest species, thus forming a genetic database for the regeneration of these species.

This work has updated and improved knowledge of ripicole flora and demonstrates that this area is of paramount ecological importance given both the large number of plant species it contains and the presence of species with special status and commercial forest species. It is essential that Sucrivoire accentuate the protection of this ripicole forest as well as other forest relics in its domain with the help of state structures, since it is a crucial area in the conservation of flora in Côte d'Ivoire and in the sub-region West Africa.

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Significance of Zinc Fertilizer on Nutrient Content and Uptake in Rice

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***Abstract*— *A pot experiment was conducted during 2011 in a pot culture yard at Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University to studies on significance of zinc fertilizer on nutrient content and uptake in rice. The nutrient content and uptake of rice significantly improved on addition of graded dose of zinc in both Vertisol and Entisol. The result of experiment revealed that nutrient content and uptake (Zn) increased with zinc levels at all stages of crop growth. Nutrient content decreased while nutrient uptake increased with advancement of rice crop. The zinc content and uptake was highest at 7.5 mg Zn kg^{-1}.However the response of nutrient content and uptake in rice crop was higher in Entisol than Vertisol*

***Keywords*— Content, uptake, zinc, rice.**

I. INTRODUCTION

Stunted growth and small leaves are the most distinct Zn deficiency symptoms which are possibly due to changes in auxin metabolism, particularly of IAA (Alloway, 2003). Auxin synthesis in plants is also controlled by Zn (Skoog, 1940); hence, its deficiency leads to leaf distortion and a shortening of internodes (Irshad *et al*., 2004). Zinc role is as multifaceted, physiologically its role in a plant is either as a metal constituent in an enzymes or as a functional co-factor of number of enzyme reactions. In general, zinc deficient plant show signs of low levels of auxins such as indole acetic acid (IAA). Investigation gives sound footing that zinc is required for synthesis of tryptophan, which in turn is precursor for synthesis of IAA (Ali *et al*., 2012). Level of plant Zn content plays an important role on growth, nutrient composition and antioxidative enzymes activities of plants (Aydin *et al*., 2006).Zn is a structural part of carbonic anhydrase, alcohol dehydrogenase Cu/Zn- superoxide dismutase and RNA polymerase and serves as a cofactor for all 6 classes of enzymes (oxidoreductases, transferases, hydrolases, lyases, isomerase and ligases) (Broadley *et al*., 2007). Application of Zn fertilizer in soil is a general strategy to cope up with Zn deficiency (Rengel *et al*., 1999) and to increase grain Zn concentration (Hussain *et al*., 2012).Realizing the importance of zinc efficient genotypes and biofertication to increase the zinc density in plant grain and at the same time seriousness of its deficiency in soils and plants, the present study was undertaken.

II. MATERIALS AND METHODS

With a view to study the significance of zinc fertilizer on nutrient content and uptake of rice in two soils was carried out during the year 2011 in a pot experiment in a net house of Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University. Bulk surface soil samples (0-15 cm) from two soil series (Kondal and Padugai) were collected air dried, powdered with wooden mallet. The experimental soil was clay loam and sandy clay loam in texture with pH 7.63;7.30, EC 0.70;0.81dS m^{-1}, organic carbon 5.70;8.20 g kg^{-1} (low), medium in $KMnO_4$-N 281;284 kg ha^{-1}, high in Olsen-P 23.2;26.5 kg ha^{-1}, high in NH_4OAc-K 306;318 kg ha^{-1} and low in available DTPA-Zn 0.75;0.70 mg kg^{-1} .The experiment was laid out in FCRD with three replication. The experiment consisted of two factors viz., Factor A – Zinc levels (mg kg^{-1}) Zn_0 - Control (no zinc),Zn_1- 2.5,Zn_2- 5.0 and Zn_3- 7.5 and Factor B – Soil S_1 – Kondal series (Typic Haplusterts) – Vertisol: S_2 – Padugai series (Typic Ustifluvents) – Entisol. Before planting and application of fertilizers, the soil in all the pots were well puddled. All the pots were treated with basal dose of RDF (150:50:50 N, P_2O_5, K_2O kg ha^{-1}) in the form of urea, SSP and MOP and mixed with the soil. Zinc was applied as $ZnSO_4.7H_2O$ in the form of solution which was mixed thoroughly with soil.

Three seedling of rice variety ADT 43 was planted pot^{-1}. The soils in the pots were kept at submergence throughout the crop period. At each stage,plant samples were collected from 24 pots (8x3) and calculate the uptake of nutrient in rice crop.

III. RESULTS

Zinc content

The data in Table 1 showed that various levels of zinc, soil type and their interaction significantly enhanced zinc content at all stages of crop growth over control. The zinc content ranged from 32.76 to 58.78 mg kg^{-1} (tillering stage), 26.93 to 52.53 (panicle initiation), 21.77 to 47.17 mg kg^{-1} (grain) and 19.15 to 44.55 mg kg^{-1} (straw) due to application of various levels of zinc in two soils. The zinc levels increased with zinc doses and the highest zinc content was noticed with 7.5 mg Zn kg^{-1}. The zinc content decreased with stages of crop growth. At all stages of the crop growth, zinc content was higher in Entisol than Vertisol. However, the highest zinc content at all stages of crop growth was noticed when zinc was applied at 7.5 mg kg^{-1} in Entisol.

Zinc uptake

Zinc uptake was significantly enhanced by addition of zinc, soils and their interaction over control (Table 2) at all stages of crop growth. Zinc uptake increased gradually with advancement of crop growth. Zinc uptake ranged from 379.7 to 766.0 µg pot^{-1} (tillering stage), 550.4 to 2373.2 µg pot^{-1} (panicle initiation stage), 297.8 to 1997.2 µg pot^{-1} (grain) and 353.9 to 2647.2 µg pot^{-1} (straw). Zinc uptake increased steadily with zinc levels and the highest zinc uptake was noticed with 7.5 mg Zn kg^{-1} at tillering stage (738 µg pot^{-1}), panicle initiation stage (2065.2 µg pot^{-1}), grain (1719.5 µg pot^{-1}) and straw (2126.4 µg pot^{-1}). The best treatment caused 83.4 per cent to 308.9 per cent increase in zinc uptake over control at different stages of crop growth. Irrespective of the stages of crop growth, zinc uptake was higher in Entisol than Vertisol.

IV. DISCUSSION

Nutrient concentration and uptake (zinc)

Addition of graded dose of zinc improved zinc concentration and uptake in both soils. The zinc content was highest during tillering stage and progressively declined with advancement of crop growth probably due to dilution effect as a result of higher biomass production, while nutrient uptake increased with stages of crop due to increase in DMP. Graded dose of zinc increased zinc concentration and uptake and the highest value was noticed with 7.5 mg Zn kg^{-1} in both soils. Per cent increase in Zn uptake due to 7.5 mg Zn kg^{-1} over control was 83.4 to 68.5 per cent(Fig. 1). Zinc content of plant or uptake is controlled by many factors such as amount of soil DTPA-Zn, transfer of zinc to root surfaces and the interaction between Zn and other nutrients in the soil or within the plant (Robson, 1993). This was confirmed by the significant positive correlation between zinc uptake with available N (r=0.98** (TS), r=0.98** (PI), r=0.99** (grain), r=0.98** (straw), available P (r=0.90**) (TS), r=0.86** (PI), r=0.93** (grain), r=0.90** (straw) and available K (r=0.98** (TS), r=0.99** (PI), r=0.97** (grain), r=0.95** (straw). Shehu and Jamala (2010) reported that application of Zn at 5.0, 7.5 and 10.0 kg ha^{-1} had uptake advantage of 113, 131 and 172 per cent over control.

Increase in zinc content and uptake in different parts of rice plant might be due to the presence of increased amount of DTPA-Zn in soil solution by the application of zinc that facilitated greater absorption (Fageria *et al*., 2011). The zinc content was higher in grain than in straw. Similar result was reported by Naik and Das (2008). Sharp increase in zinc uptake at greater Zn level might be related to greater increase in zinc concentration in soil solution at this zinc level. The above result was confirmed by significant positive correlation between DTPA-Zn with Zn uptake (r=0.95** (TS), r=0.96** (PI), r=0.99** (grain), r=0.96** (straw). Further, water soluble Zn had significant positive correlation in Zn uptake (r=0.96** (grain), r=0.94** (straw). Similarly, exchangeable Zn had significant positive correlation with zinc uptake (r=0.87** (grain), r=0.86**(straw). Wissuwa *et al*. (2008) and Veerendra Dixit *et al*. (2012) reported increase in Zn uptake on addition of 10 kg Zn ha^{-1}.

V. CONCLUSION

The present study find out zinc content and uptake was noticed with 7.5 mg Zn kg^{-1} in Vertisol and Entisol respectively. However the efficiency of rice was higher in Entisol than Vertisol.

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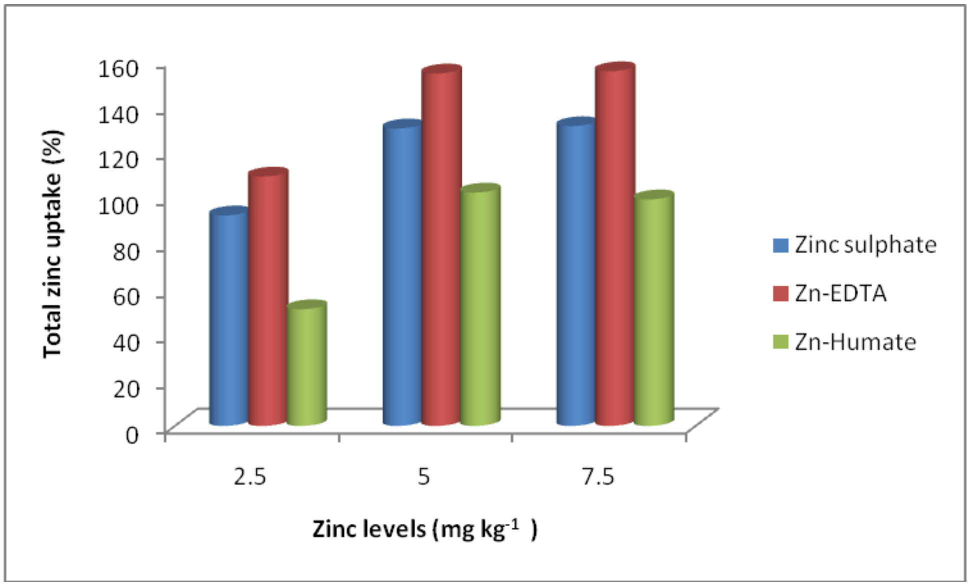

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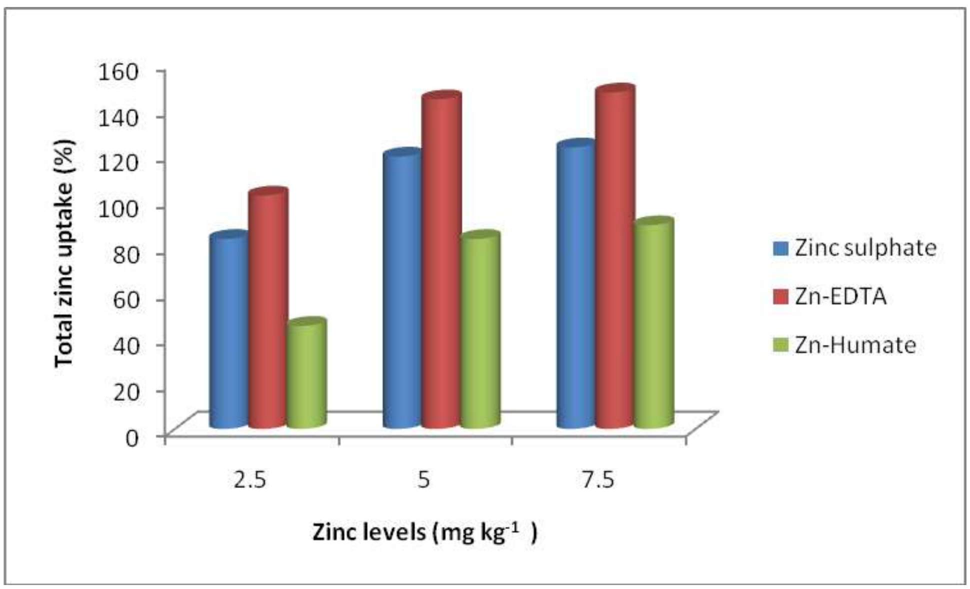

B

Fig. 1. Percentage increase in total Zn uptake
A) Vertisol B) Entisol

Table 1. Effect of zinc application on zinc content (mg kg^{-1}) at different stages of rice crop

Zn levels (mg kg^{-1})	Tillering stage		Mean	Panicle initiation stage		Mean	Grain		Mean	Straw		Mean
	S_1	S_2		S_1	S_2		S_1	S_2		S_1	S_2	
0	32.76	33.92	33.34	26.93	28.12	27.52	21.77	22.96	22.36	19.15	20.34	19.74
2.5	42.65	43.81	43.23	36.82	37.98	37.40	31.66	32.82	32.24	29.04	30.20	29.62
5.0	51.62	52.78	52.20	45.79	46.95	46.37	40.63	41.79	41.21	38.01	39.17	38.59
7.5	57.00	58.16	57.58	51.14	52.33	51.73	45.98	47.17	46.57	43.36	44.55	43.95

Mean	46.00	47.16		40.17	41.34		35.18	36.18		32.39	33.56	
	Zn	S	Zn x S	Zn	S	Zn x S	Zn	S	Zn x S	Zn	S	Zn x S
SEd	0.53	0.37	0.75	0.85	0.60	1.20	0.57	0.40	0.80	0.83	0.58	1.17
CD (p=0.05)	1.10	0.78	1.56	1.76	1.25	2.50	1.18	0.84	1.68	1.72	1.22	2.44

Table 2. Effect of zinc application on zinc uptake (µg pot^{-1}) at different stages of rice crop

Zn levels (mg kg^{-1})	**Tillering stage**		**Mean**	**Flowering stage**		**Mean**	**Grain**		**Mean**	**Straw**		**Mean**
	S_1	**S_2**		**S_1**	**S_2**		**S_1**	**S_2**		**S_1**	**S_2**	
0	379.7	425.4	402.5	550.4	797.8	674.1	297.8	544.8	421.30	353.9	709.7	531.8
2.5	523.7	579.6	551.6	1104.6	1470.6	1287.6	813.0	1203.2	1008.1	890.6	1602.4	1246.5
5.0	645.8	710.4	678.1	1648.4	2153.6	1901.0	1301.8	1797.8	1549.8	1423.5	2344.0	1883.7
7.5	709.6	766.0	738.0	1757.2	2373.2	2065.2	1441.9	1997.2	1719.5	1605.6	2647.2	2126.4
Mean	565.0	620.3		1265.1	1698.8		963.6	1385.7		1068.4	1825.8	
	Zn	S	Zn x S	Zn	S	Zn x S	Zn	S	Zn x S	Zn	S	Zn x S
SEd	8.75	9.75	14.40	36.10	38.61	52.88	32.75	34.60	44.50	33.72	38.25	58.24
CD (p=0.05)	18.20	20.30	30.00	75.10	80.32	110.00	68.13	72.10	92.50	70.14	79.56	121.15

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Morphology and Molecular Characterization of Four Types of Ramies (*Boehmeria nivea* (L.) Gaud) Collection Experimental Farm Faculty of Agriculture Andalas University

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***Abstract*— *The purpose of this study was to collect and determine the morphological and molecular character of the ramies in West Sumatra. This study was conducted in May-October 2018 Experimental Farm, Faculty of Agriculture, University of Andalas Padang. This activity also used the clone Padang 3 and Ramindo 1 as a comparison. The results of this study indicated that the ramie plant could grow to a height of 1058 meters above sea level to the point where the coordinates 0 ° 15'30 "South Latitude and 100 ° 15'45" east longitude. Ramie highest Situjuah accession 150.03 cm and the lowest at 91.7 cm Matur accession. The longest and widest leaf observations contained in the accession Situjuah while the shortest and smallest obtained at Matur accession. On accession Situjuah, Matur, and clones Ramindo 1 had male and female flowers but clone Padang 3 only had female flowers. Harvesting fastest in clones Ramindo 1 was 123 days and the longest in clones Padang 3 was 133 days. The numbers of banding pattern resulting from PCR amplification were 74 tapes (68 a polymorphic bands while the rest was the number of monomorphic bands).*
***Keywords*— Morphology, Molecular, characterization, Boehmeria nivea.**

I. INTRODUCTION

Indonesia is an agricultural country which has a quite extensive forest area with the greatest biodiversity primarily on the varieties of plants, with the number of the existing plant that is equal to 55%, Indonesia occupied the top five in the world (Amin *et al*., 2014). The varieties of plants give several benefits for humansuch as foodstuffs, building materials, traditional ceremonies, industrial materials of drugs and materials of textile.

Along with development of the textile industry in Indonesia, the need for raw materials of cotton fiber also continued to increase. However, to fulfill the needs of these raw materials, Indonesia has to import cotton fiber annually. According to the Directorate General of Estate Crops (2017), in 2013 Indonesia imported cotton fiber amounted to 676.682 ton with a value of US$ 1.3 million, while in 2014 an increase in imports amounted to 711.747 ton of cotton fiber with a value of US$ 1.4 million.

One of the efforts to overcome the dependence on raw materials of the textile industry is by using other natural fibers. Natural fibers that have the potential to be used as raw materials in the Indonesian textile industry is the ramie (*Boehmeria nivea* (L.) Gaud). This is because the ramie's has the characteristics and quality of high fiber (Angelini and Tavarini, 2013).

Ramie's (*Boehmeria nivea* (L.) Gaud.) is a perennial plant that has many benefits. This plant is known for fiber from the bark is used as a raw material in the textile industry, raw material pulp, paper, conservation of land (Mitra *et al*., 2013), compost, animal feed, roots are used as traditional medicine (Huang *et al*., 2015), and various other industrial products.

Productivity of ramie depends on fiber height and diameter, thick-thin bark and fiber yield. Ramie harvested for fiber production every 2 months so the first year can be 5-6 harvests (Liu *et al*., 2009).According to Sarkar *et al*. (2010),fibers of the ramies are two times more powerful than all plant-based fibers.

Ramie fiber also has another advantage such as the resistance to bacteria and a higher tensile strength under conditions of hygroscopic (Satya *et al*., 2013). According to Liu *et al*. (2015) ramie plant height is a major determining factor for the results of the fiber, because fiber ramie is extracted from the bark so that if the ramie is shorterthe fibers produced results also less. Even the results of Liu *et al*. (2014) the results of ramie fibers is largely determined by the number of stems per plant, fiber yield per plant, stem length, stem diameter, and thickness of the skin.

Meanwhile, Indonesia is very good country for the cultivation of ramie because according Suryanah *et al*. (2017) ramies are easy to grow in the tropics and will produce high when planted on the altitude 1310 meters above sea level. In West Sumatra, the variety of vegetation is still very high around the forest so that theunknown typeof ramie is still found. Knowledge of genetic diversity is very important in plant breeding activities to determine the pace of improvement in the quality, quantity and competitiveness of ramie fiber.

Based on the statement above, the conservation work with a ramie crop germplasm morphological observation and molecular characterization is done, which the result of conservation materials is used as comparison of two other clones of the ramies. Information on morphological characters is required to differentiate between plant accessions and probe distance or dissimilarity genetic kinship analysis so that it can be used as a base material improvement of the ramies. The farther the genetic distance elder in one species, the opportunity to produce new varieties are very large (Govindaraj *et al*., 2015). The purpose of this study is to collect and know the morphological and molecular character of the ramie's in West Sumatra.

II. MATERIALS AND METHODS

This research was conducted in May-October 2018 at Experimental Farm Faculty of Agriculture Andalas University. For morphology characterization were observed in the stems, leaves, flowers, and the production of ramie's. This morphological characterization refers to descriptor Mitra *et al*. (2013) and Aiguo (2018). While the molecular conducted DNA isolation, PCR amplification, and DNA electrophoresis. Primers used in the PCR amplification is OPF 04 OPF 05, OPH 07, OPX 02, and OPX 17.

The data collection was based on observation of morphological and molecular. The data were followed by analysis of phenotypic variability and similarity analysis using the Unweighted Pair Group Methods Aritmathic Average (UPGMA) version 2.02 at NTSYS software.

III. RESULT

3.1 Exploration and Collection of Ramie

The determination of two locations was based on the results of a preliminary survey in district. Based ontwo districts which have been designated as areas of research, there were 20 accessions of the ramies got. All ramies that had been explored, and then carried out ex situ conservation in the Experimental Farm Faculty of Agriculture,Andalas University, by means planted and characterized the important characteristics of it. The details of the ramie's accession number per district, sub district, coordinates and elevation can be seen in Table 1.

3.2 Morphology Characterization of Ramie

Based on quantitative terms,the result of morphological observations on two accession and two clones of the ramies showed that there are any differences between population of the plant height, stem diameter, and number of tillers per hill. Qualitative characters showed different results which was found only in the parameters of the surface of the stem, while the stem color parameters for young and old trunks colors do not show different results. The results showed that the height of varieties of plant with the average at 150.03 cm Situjuah accession, acceding Matur is 91.7 cm, Padang 3 as high as 108.03 cm Ramindo 1 is 129.72 cm. Therefore, the highest ramiewasin Situjuah accession and for the lowest plant was contained in the accession Matur.

Based on the results of this research, it can be concluded thatthe largest trunk diameter obtained by accession Situjuah compared to other clones and the smallest trunk diameter obtained byaccession Matur. For Situjuah accession,the average of trunk diameter is 10.37 mm and the diameter of the rod accession to Matur is 6.05 mm then the average diameter of the rod clones Padang is 3 of 8.3 mm and a trunk diameter average at Ramindo 1 is 9, 08 mm. Meanwhile, according to Yang *et al*. (2010) and Bene *et al*. (2011) ramie plant stems cylindrical stem diameter ranging from 11 to 38.5 mm, but does not cover possible if the diameter of ramie only the range of 8 to 16 mm because it will depend on the environmental conditions of the plant growth.

The observations done on the parameters of the number of tillers per hill showed that the average chicks that appear on the accession Situjuah is 14.2 tillers and number of tillers on the accession Matur is 30.4, while the average number of tillers in Padang 3 clones is 9.8 tiller and tiller number in clones Ramindo 1 is 14. From the explanation above, it can be concluded that the highest number of tillers obtained by accession Matur while the lowest number of tillers obtained by Padang 3.

The variety of the height parameters plant, stem diameter, and number of tillers per hill and also the differences of stem surface, it is suspectedthat the plant is affected by inconstant environmental conditions during the research. According to Verdaguer *et al*. (2017), the factors affecting plant height beside the requirements of a place to grow and environmental conditions related to climate and weather in the cultivation area are genetic and nutrient. In accordance with the results of research and Angelini and Tavarini (2013), there was variation among plant height, stem diameter, and number of tillers per hill which is controlled by several or polygenic so strongly influenced by environmental conditions. Genetic factors will not show the character that brought exception with the environmental factors that meets the needs of a plant (Andrew *et al*., 2010). In connection with nutrients, Mitra *et al*. (2013) and Sharma *et al*. (2014) states the ramie is a plant which greedy of nutrients, because these plants have a rapid vegetative growth so that it can be harvested every two months.

Based on the observations of qualitative character on the surface of the rod, there are variations of accession on Matur, but not for Situjuah, Padang 3, and Ramindo 1. In general, the surface of the ramie's stem is hairy, but there are also ramie with thin hairy, rare, and thick. The surface of Matur and Padang 3 population israrely hairy whereas the surface of steminSitujuah and Ramindo 1 is woolly. There is no differences between color parameter of yound and old ramies population The color of Young stem is green and the color of old stem is brown. The color differences between young and old stem can be seen in Figure 1.

In observation of leaf length showed that the average for the accession Situjuah is 18.15 cm and Matur is 12.47 cm meanwhile average lengthof leaves Padang 3 is 14.15 and Ramindo 1 is 12.92 cm. From those data, we knowthat the longest leaf contained is Situjuah and the shortest is Matur. The growth of the ramie's leaf of accession Situjuah has an average 14.94 cm and Matur is 9.69 cm, while Padang 3 is 12.01 cm and Ramindo 1is 11.5 cm. For the average,the widest leaves contained in the accession Situjuah and for narrowestcontained in accession Matur. Based on data from the measurement of leaf length, it is obtained the result of the observations of leaf measure type, in Situjuah and Ramindo 1 is medium type while in Matur and Padang 3 is narrow type.

The average length of leaf petiole in Situjuah accession is 9.55 cm and Matur is 6.67 whereas in Padang 3 is 8.42 cm and the average length of petiole at Ramindo 1 is 7.33 cm. Therefore, it was found the average length of the longest leaf petiole is Situjuah while the shortest petiole length contained is Matur (Figure 2).

This is consistent with Jose *et al*. (2017) that ramie leaves has a characteristic heart-shaped and smooth jagged edges, then the length of 7-20 cm, while width of 6-15 cm. For the length of petiole, ranges from 3-12 cm long and even longer petioles also shorter than the length of the leaf, but everything depends on the clones. According toLiu *et al*. (2014) derived from the ramie plant stem and wide leafy little usually produce puppies are not much different with the parent.

The observation on leaf shape, leaf edge shape, the shape of the tip of the leaf, the leaf base shape, and the shape of the leaf growth showed that there is no difference among the four ramies populations. On leaves hair on Situjuah, Matur, and Ramindo 1. Most ofpopulation is medium type, while in Padang 3, all populationis medium type.

Ramie leaf shaped like a heart wide, with a relatively large size compared to other similar leaves. Ramie leaves had short hair so it seems a bit rough, but it is relatively soft and not woody (Munawar *et al*., 2007; Hwang, 2010).Mitra *et al*.(2013) adds theramie leaf stems in the stem and located alternately, and downy leaf surface. Leaf photosynthetic active only at the top stem, the position of the leaf shoots growing near. The leaves are actively growing at the old plant occupies one-third of the top of the stem to the tip.

There is no different color of the petiole leaf in the population Situjuah, Matur, and Ramindo 1, that is reddish green color, while in Padang 3 clones is green. Furthermore, most of the color of the upper surface of the leaves also did not show any variation in Situjuah, Matur, and Ramindo 1, that is dark green,while for clones Padang 3,the all colors are dark green. There is also no different color betweenunder surface of the leaves and bone leaf, the colors are silvery white and green. Then the leaf color of Situjuah and Ramindo 1is yellowish green but Matur is more dominant yellowish green and Padang 3 is green.

The according to Sharma *et al*. (2014) that the top surface of the leaf color is the dark green ramie and leaf color is silvery white underneath surface. Ramieleaf colored light green to dark green, depending on variety, age, care and cultivation systems.

Ramie flower is compound interest, every stick in one clump. The layout of the male flowers isunder stem segments while the female flowers are on the top of stem segments. Male flowers appear earlier than the female flowers. Observations obtained flowering date of average of Situjuah is 57.6 days,Matur 66 days, Padang 3 is 76.2 days and Ramindo 142.8 days. Therefore, the fastest flowering is Ramindo 1 and the longest is Padang 3. Speed flowering can also be controlled by genetic factors and environmental factors.

Gender flowers on each population Situjuah, Matur, and Ramindo 1 does not show the variety. In that population have sex male and female flowers on one plant, while Padang 3 has only female flowers in one

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plant. This is consistent with Mitra *et al*. (2013) which states that in certain clones and the female flowers are male flowers on one stem.

Male flower color in Situjuah, Matur, and Ramindo 1 did not show any variations, all of them only have green color. There are varieties of Character color of female flowers on the ramie's populations. For Situjuah is yellowish green,Matur is reddish, Padang 3 is green and Ramindo 1 is red.

Type of ramie flowering is different,there are many flowers in clone Situjuah and Ramindo while there is few flower in Matur and Padang 3. According to Mitra *et al*. (2013), a lot or little depending on that clones. It is also suspected nothing to do with the power of adaptation to altitude somewhere. The variety of the interest amount on each accession and clone ramie can be seen in Figure 3.

The fastest of harvesting namely is in clones Ramindo only 123 days than the longest harvesting in Padang 3 is 133 days. The period of harvest time affects the quality of the fibers from the ramies. Old or rapid harvest time can also be caused by altitude, soil fertility and plant growth conditions or factors of the seeds used (Mayerni, 2018).

Plant fresh weight showed that accession Situjuahis the heaviest fresh weight, thatis 632.48 grams then the lightest is in Padang 3, thatis 251.78 grams. Similar to the results of the fresh weight of the heaviest rod is Situjuah, thatis 372.46 grams and the lightest is Matur, with 181.11 grams. As for the weight of crude fiber in clones Ramindo 1 is a coarse fiber heaviest weight (43.83 grams) and for the lightest is Padang 3 (31.51 grams). Value of weights on the parameters of plant fresh weight, stem fresh weight, and the weight of crude ramies fiber is influenced by the number of tillers, plant height, stem diameter.

3.3 Phenotypic Variability Analysis

Based on the value of variability in Table 2, in comparison between the value and the character is seen that the value of the narrow variability does not have much difference between its value. As for the wide variability values show much difference between its value, so the phenotypic variance is less than twice the standard deviation.

Value variability in morphological characters can be influenced by genetic factors and environmental factors. Qualitative character can be controlled by simplegenic with little environmental impact. Environmental factors related to other factors that cause the appearance varies so that a plant has genetic diversity. For the quantitative character is influenced by polygenic and highly influenced by the environment around the plant (Andrew *et al*., 2010). Mulder *et al*. (2016) said that a population has a wide phenotypic variability is not necessarily wide genetic variability, due to genetic via phenotypic appearance is influenced by environmental factors.

3.4 Similarity Analysis

The results of dendogram based on qualitative character or the mixing of quantitative and qualitative character indicate that each variant of ramie found has a different kinship. The Dissimilarity was caused by the different morphological characters between the ramies, both quantitative and qualitative character. All qualitative characters and 2 quantitative characters (trunk diameter and length of the leaf petiole) showed similarities.

Based on dendogram in qualitative characters showed four relationship patterns of ramie's population which had an alliance with the kinship coefficient from 0.29 to 1.00, or 29% -100% (Figure 4). The dendogram had two major groups, namely group 1 contained Situjuah, Ramindo 1, and Matur, whilefor group 2 is only Padang 3. Both of these groups are divided on the point of similarity coefficient of 0.29 or 29%. Then the group 1 is divided at the point coefficient of approximately 42.25%, there is a population group Situjuah 1a and Ramindo 1 and for group 1b is population Matur. Population Situjuah and Ramindo 1 separated at similarity range of values abour 51.5%. Coefficient 100% on the value contained in the fourth of the population with a sense of the value of having close coefficient diversity. For Situjuah population, Ramindo 1, and Padang 3 that the coefficient value of 100% is divided into three groups while the Maturpopulation is divided into 2 groups.

The similarity coefficient value based on the combination of qualitative and quantitative characters shows that the four populations of ramie plants that have been characterized are divided into two major groups, namely group 1 (Situjuah, Ramindo, and Matur) and group 2 (Padang 3). This happens because of the similarity in the character of each population. The relationship pattern of the ramie plant population has a similarity with the similarity coefficient of 17% -75% (Figure 5). In Situjuah and Matur accessions and Ramindo 1 clones are included in group 1 which is divided into groups 1a and 1b, where 1b is only Matur accession whereas 1a consists of Situjuah accession and Ramindo 1 clone. The group is in a coefficient of about 28% or 0.28 . Then in group 1a again split into 2 subgroups, namely groups 1a1 and group 1a2 at a coefficient of around 33.5% or 0.335. Group 1a1 consisted of accession Situjuah 1 to Situjuah 10 while in group 1a2 consisted of Ramindo 1 1 clones to Ramindo 1 10. In Ramindo 1 5 clones with Ramindo 1 8 and Padang

3 1 with Padang 3 5 had close kinship relations with coefficient values around 70%. Ramie plants in one variant have the same morphological character, so the kinship is relatively close. In other words, the diversity of morphological characters in the same variant is quite low. This event occurred only on the access of MTR-3 with MTR-5 which has a 75% similarity relationship.

Relationships between populations classified as close are found in the same location. According to Alemu *et al*. (2018) the similarity coefficient values showed similarities of cultivars in a crop population, where the higher the similarity coefficient values between individuals showed that the genetic kinship of the cultivar was getting closer. The similarity of characters is also thought to be closely related to the location of growth that is relatively the same geographically. While hemp plants in the same similarity coefficient value but come from different regions and have different morphological characters, the two ramie plants have a kinship relationship that is farther than those that grow in the same environment.

From the results of the morphological characters observed and from the dendogram image it is known that the more morphological characters are the same, the closer the kinship relationship or the fewer the morphological characters are the same, the more distant kinship is. In accordance with the statement from Szenejko and Rogalski (2015) that if the higher the coefficient value, the higher the level of similarity, or if the lower the coefficient value, the lower the level of similarity.

3.5 Molecular Characterization of Ramie

Primary primers who were able to show the closeness of the relationship between accession and ramie plant clones were indicated by the presence of different banding patterns at the same distance using five primers in PCR amplification. The results of primary amplification using the RAPD technique for four populations of ramie plants in detail are shown in Table 3.

Based on Table 3, the number of ribbon patterns produced from PCR amplification is 74 bands. From the number of bands it is known that 68 of them are polymorphic bands. While for the number of monomorphic bands as many as 6 bands. Each one of the primers used is able to get 11 to 20 DNA fragments so that using the RAPD technique is able to select the level of polymorphism in a fast period of time. Products from PCR amplification using five primers give a high polymorphism value, indicated by a percentage value of 90%. According to Garg et al. (2015) the tested plants have a fairly high diversity so as to provide a high value of polymorphism.

DNA bands that appear on DNA samples analyzed are closely related to or not the primary primers of RAPD used to amplify DNA accession of ramie plants by comparison. The number of bands produced by each primer depends on the distribution of homologous sites with primary sequences in microsatellite regions.

3.6 Similarity Analysis

The results of the analysis of the similarities of the four ramie plant populations resulting from PCR amplification using the NTSYS version 2.02 software program are presented in the form of a dendogram (Figure 6).

From Figure 6, it is known that there are two large groups between four populations of ramie plants with a coefficient of similarity equal to 25% to 51%. Large groups have kinship relationships between individuals in very remote populations or very small genetic similarities at the coefficient point of 25%. Group 1 is access to Situjuah and Padang 3 clones, where the coefficient points are at 51%. From the coefficient point, it is known that among the population of accession in Situjuah and Padang 3 clones has the closest kinship relationship among all. Then in the second group divided at the coefficient point 42.5% or equal to 0.425. In this second group there are Matur accessions and Ramindo 1 clones. Close kinship relationships show low genetic diversity and vice versa if the long kinship relationship shows high genetic diversity.

IV. FIGURES AND TABLES

Table 1. Details of Plants Accession Number Rami per District, Sub district, Coordinates, and Altitude

Locations		Accession	Coordinate		Altitude
Districts	Sub district	Code	South Latitude	East Longitude	(masl)
Agam	Matur	MTR 1	0 ° 15'28 "	100 ° 15'46 "	1053
Agam	Matur	MTR 2	0 ° 15'28 "	100 ° 15'46 "	1053
Agam	Matur	MTR 3	0 ° 15'28 "	100 ° 15'46 "	1053
Agam	Matur	MTR 4	0 ° 15'28 "	100 ° 15'46 "	1053
Agam	Matur	MTR 5	0 ° 15'28 "	100 ° 15'46 "	1053
Agam	Matur	MTR 6	0 ° 15'30 "	100 ° 15'45 "	1058
Agam	Matur	MTR 7	0 ° 15'30 "	100 ° 15'45 "	1058

http://dx.doi.org/10.22161/ijeab.446 ISSN: 2456-1878

Agam	Matur	MTR 8	0 ° 15'30 "	100 ° 15'45 "	1058
Agam	Matur	MTR 9	0 ° 15'30 "	100 ° 15'45 "	1058
Agam	Matur	MTR 10	0 ° 15'30 "	100 ° 15'45 "	1058
50 Kota	Situjuah Limo Nagari	STJ 1	0 ° 18'19 "	100 ° 35'32 "	588
50 Kota	Situjuah Limo Nagari	STJ 2	0 ° 18'19 "	100 ° 35'32 "	588
50 Kota	Situjuah Limo Nagari	STJ 3	0 ° 18'19 "	100 ° 35'32 "	588
50 Kota	Situjuah Limo Nagari	STJ 4	0 ° 18'19 "	100 ° 35'32 "	588
50 Kota	Situjuah Limo Nagari	STJ 5	0 ° 18'19 "	100 ° 35'32 "	588
50 Kota	Situjuah Limo Nagari	STJ 6	0 ° 18'19 "	100 ° 35'30 "	608
50 Kota	Situjuah Limo Nagari	STJ 7	0 ° 18'19 "	100 ° 35'30 "	608
50 Kota	Situjuah Limo Nagari	STJ 8	0 ° 18'19 "	100 ° 35'30 "	608
50 Kota	Situjuah Limo Nagari	STJ 9	0 ° 18'19 "	100 ° 35'30 "	608
50 Kota	Situjuah Limo Nagari	STJ 10	0 ° 18'19 "	100 ° 35'30 "	608
Total Accession		20			

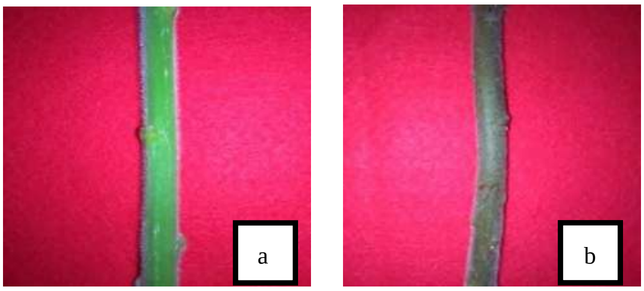

Fig.1. Color Stem Ramie, a) Color Young Stem, b) Color Old Stem

Fig.2: Measurement of Leaf Length and Leaf Petiole Length

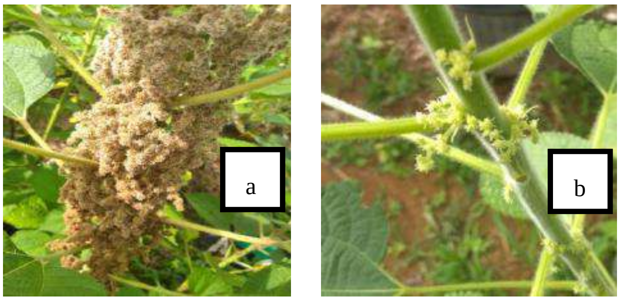

Fig.3. Number of Flowers on Ramie, a) MoreFlower, b) Less Flowering

Table 2. Phenotypic Variability based Quantitative and Qualitative Characters Ramie Plants

No.	Character	S2	St Dev	2 X St Dev	Criteria
1	Leaf outline	0	0	0	Narrow
2	Leaf margins	0	0	0	Narrow
3	Leaf apex	0	0	0	Narrow
4	Leaf Base	0	0	0	Narrow

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5	Color of leaf petiole	1.68	1.29	2,59	Narrow
6	Color of the upper surface of leaf	0.16	0.4	0.8	Narrow
7	Color of the under surface of leaf	0	0	0	Narrow
8	Color of shoot leaf	0.59	0.76	1.53	Narrow
9	Leaf measure type	0.18	0.43	0.86	Narrow
10	Color of midrib	0	0	0	Narrow
11	Shape of midrib	0	0	0	Narrow
12	Leaf hairs	0.21	0.46	0.93	Narrow
13	Type of flowering	0.25	0.5	1	Narrow
14	Color of female flower	1.25	1.11	2.23	Narrow
15	Color of male flower	0.75	0.86	1.73	Narrow
16	Gender of flowers	0.18	0.43	0.86	Narrow
17	Stem surface	0.25	0.5	1	Narrow
18	Color young stem	0	0	0	Narrow
19	Color old stem	0	0	0	Narrow
20	Plant height	647.00	25.43	50.87	Large
21	Stem diameter	3.36	1.83	3.67	Narrow
22	Leaf length	6.39	2.52	5,05	Large
23	Leaf width	4.34	2.08	4.16	Large
24	Leaf petiole length	2.09	1.44	2.89	Narrow
25	Number of tillers per plant	73.74	8.58	17.17	Large
26	Harvest time	14.75	3.84	7.68	Large
27	Plant fresh weight	32751.2	180.97	361.94	Large
28	Stem fresh weight	10127.08	100.63	201.26	Large
29	Crude fiber weight	143.52	11.98	23.96	Large

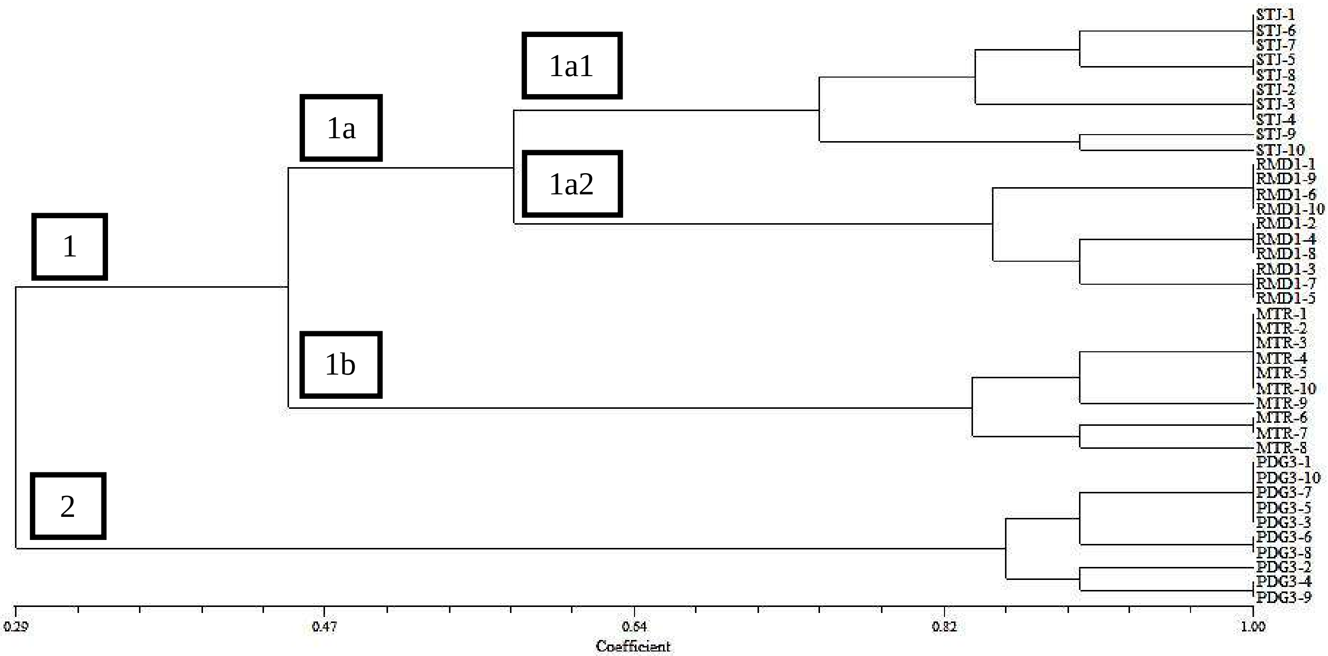

Fig.4: Dendogram with 40 Sample Ramie based on Qualitative Characters

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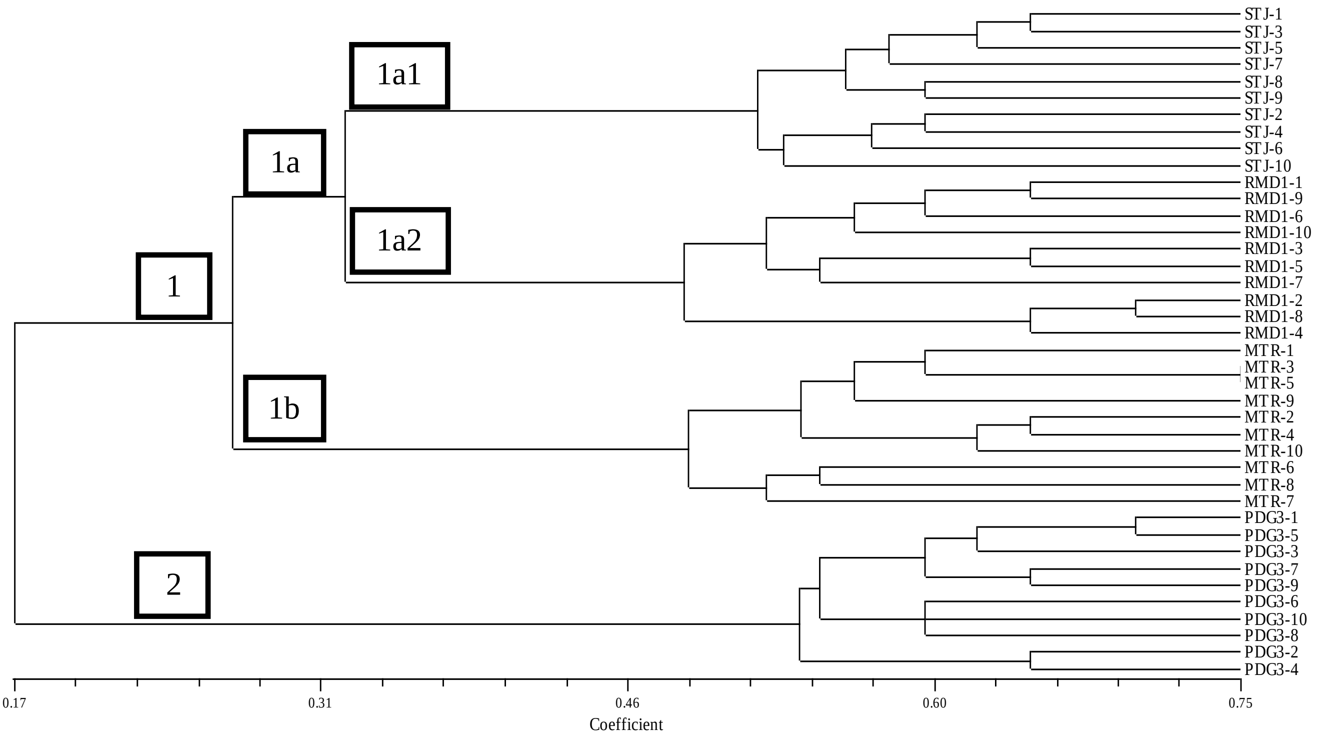

Fig.5: Dendogram with 40 Sample Ramie based on Quantitative and Qualitative Characters

Table 3. The primers used in RAPD and band profiles generated from four populations ramies

No.	Primary	Number of monomorphic band	Number of polymorphic band	Total of band	Polymorphism percentage (%)
1	OPF 04	0	17	17	100
2	OPF 05	1	13	14	93
3	OPH 07	0	20	20	100
4	OPX 02	2	9	11	82
5	OPX 17	3	9	12	75
Total		6	68	74	90

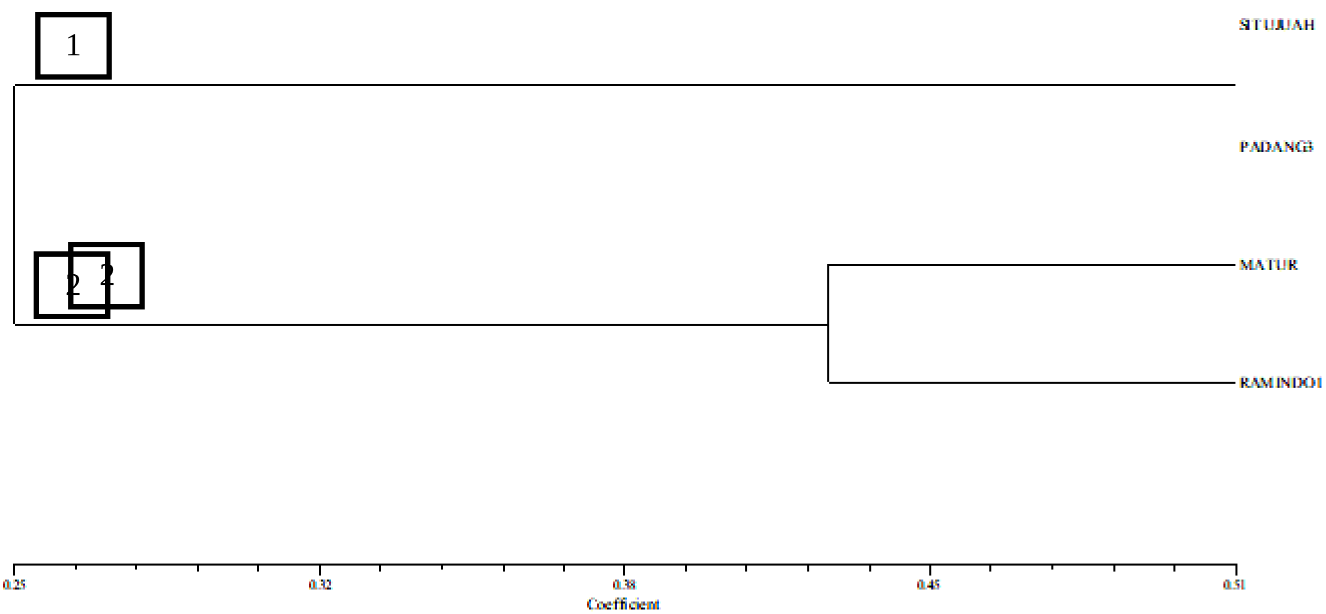

Fig.6: Dendogram with Four Populations Ramie's based on Molecular Characterization

V. CONCLUSION

The spread of the ramies are in two districts of Agam and 50 Kota. All qualitative cahracters and two quantitative characters (stem diameter and leaf petiole length) were observed in the ramies showed no variety. While eight out of ten quantitative characters who observed that there are variations.

Ramie's are divided into two groups based on morphological characters were observed at the level of the lowest coefficient of 17%. Group 1 (Situjuah, Ramindo, and Matur) with the level of similarity 28%, for group 2 (Padang 3) the level of similarity 52.5%. This grouping occurred because of the similarity in the character of each kind.

Number of banding pattern resulting from PCR amplification is as many as 74 bands (68 a polymorphic band while the rest is the number of monomorphic band). Each primer used could get 11 to 20 DNA fragments so that using RAPD technique is able to select the degree of polymorphism within a short time.

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Freeze Drying as a Method to Produce Lyophilized Laban Immo: A Traditional Yogurt base Lebanese Recipe

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***Abstract*— *Laban immo (LI) is a traditional dish which mainly contains onions, meat, starch and yogurt. Based on a registered LI recipe four powdered products with Low Fat (LF) cow- , medium fat (MF) cow-, full fat (FF) cow- and FF goat- yogurt were produced and all were subjected to freeze-drying.*

LI with FF- cow yogurt had the significantly lowest moisture loss (ML) but the significantly highest water activity (aw). LI powder with LF cow yogurt had the significantly lowest water activity, followed by that done with FF goat-, then with MF cow- and ended with FF cow- yogurt being the significantly highest. Concerning the pH, LI with FF goat yogurt had the significantly lowest value and the LI with MF cow yoghurt had the significantly highest value.

As for protein content LI with goat yogurt had the significantly lowest value compared to LI from cow yogurt. Concerning the ash content LI with goat yogurt had the significantly highest value compared to those with cow yogurt.

In this study freeze dried LI with full fat goat yogurt scored significantly the highest in the preference test followed by the LI with FF cow yogurt which was significantly higher than those with MF- and LF- cow yogurt. Triangle tests have shown that LI from natural yogurt and the reconstituted LI are sufficiently similar to be used interchangeably. Therefore, taste wise the production of LI in the powder form is possible and thus rendering it more convenient, easy to prepare and portable.

Keywords*— *Laban Immo, cooked yogurt, Moisture loss, water activity, preference test, triangle test.

I. INTRODUCTION

“Laban Immo” is one of the traditional Lebanese dishes containing many natural and healthy ingredients with yogurt as its base. It literally means “the milk of his mother”. Laban Immo is a yogurt stew with lamb, onions and dried mint. This dish is consumed across the Eastern Mediterranean in Lebanon, Palestine (where it is called Tabeekh), Jordan, and Syria (where it is called Shakrieh). Because of the current fast-paced lives, less time is dedicated to the preparation of meals (Alkerwi, Crichton, & Hebert, 2015). Consequently, the consumption of ready meals (including ready-to-heat prepackaged dishes and fast food restaurant items) has increased. These ready meals present a quick and easy alternative to home prepared meals (Alkerwi et al., 2015).

Concerning yogurt consumption in Lebanon, the Lebanese market continues to have one of the highest per capita consumers of dairy products globally (Elie Haddad & Chamoun, 2014). Supermarket shelves are increasingly stacked with dairy products with a significant increase in demand for goat yogurt; exceeding the available supply (Rahhal, 2018). Thus, presenting a traditional Lebanese yogurt based recipe in an easy-to-prepare format will have a great marketing potential internally and externally. The internal market is showing an increase in the consumption of convenient meals and yogurt based products constitutes a portion of this trend (Sharon Rady Rolfes, Kathryn Pinna, & Ellie Whitney, 2015)

Compared to conventional food preservation technologies, the advantages of freeze drying include: retention of morphological, biochemical, and immunological properties, high viability/activity levels, lower temperature, and shear conditions compared with other drying methods, high recovery of volatiles, retention of structure, surface area, and stoichiometric ratios, high yield, long shelf life and reduced weight for storage, shipping, and handling (Jaya, 2009) (Koc, Yilmazer, Balkır, & Ertekin, 2010). However, freeze

drying is considered the most expensive operation for manufacturing a dehydrated product due to the high energy consumption and high costs of both operation and maintenance (Ciurzyńska & Lenart, 2011).
Therefore, the potential of presenting this basic dish in a dried form that will make it handy, portable, with a long shelf life and a time–efficient-easy-cooking method (Santos, Nogueira, & Rosenthal, 2018). Another aspect is the portion control. This form of food will allow for portion control by customizing packaging.

II. MATERIAL AND METHOD

2.1. Sample Preparation

Four recipes of laban immo (Table 1) were prepared using yogurt with 4 different fat contents: skim fat cow yogurt, medium fat cow yogurt, full fat cow yogurt, and full fat goat yogurt. All other ingredients remained the same in the 4 recipes (Zaarour, 2012).

Table 1 Four Laban Immo Recipes with different yogurts

INGREDIENT	Reciepe 1 SM yogurt (grams)	Reciepe 2 MF Yogurt (grams)	Reciepe 3 FF Yogurt (grams)	Reciepe 4 FF Goat Yogurt (grams)
Oil	6.5	6.5	6.5	6.5
Lean Meat	125	125	125	125
Onions	152.5	152.5	152.5	152.5
Yogurt	500	500	500	500
Corn starch	10	10	10	0
Salt	3	3	3	3
Pepper	0.25	0.25	0.25	0.25
Dried Mint	0.5	0.5	0.5	0.5
Water	126	126	126	0
TOTAL(grams)	923.75	923.75	923.75	787.75

SM is Skim milk; MF is Medium Fat; FF is Full Fat;

Laban immo was cooked to an internal temperature of 72°C for the lamb chops (Sharon Rady Rolfes et al., 2015). Then each recipe was homogenized using a mixer at medium speed for 7 minutes (Anang Catur Sulaksono, Sri Kumalaningsih, Wignyanto, & Santoso, 2013). The paste were placed into 45 ml conical tubes and lyophilized at -40°C and 0.03 m Tor pressure by Boyikang vacuum freeze dryer. For sensory analysis the freeze dried sample were reconstituted to their original moisture content.

2.2. Methods

Moisture content: Drying Oven and Balance method was used for moisture content determination. The oven used was Contherm designer series (Contherm Scientific LTD) following the IS 11623: 1986.
Moisture Loss: Moisture loss was determined by subtracting the weight of the sample after freeze drying, where no loss was detected anymore, from the weight of the sample before freeze drying using the following equation Eq. (1).

%moisture loss= [(initial weight-final weight)/initial weight]*100 Eq. (1)

Weight determination: Weight was measured using Analytical Balance MS304TS/00 with 320 g capacity and 0.1 mg readability.
pH analysis: Microcomputer based pH/conductivity/TDS/salinity and temperature pocket meter Model pH/EC80 was used to measure the pH (Jenco VisionP).
Water activity: It was determined using Pawkit water activity meter. Sample were flattened to cover the bottom of the cup and then water activity was measured at room temperature (Suzann, 2010).
Fat Determination: The fat content was determined using Soxhlet method as described by AOAC 922.06.
Protein Determination: Protein content was determined using the Kjeldahl method according to AOAC 991.20.
Ash Determination: Ash was determined using the AOAC 942.05 method.
Powder Production: The samples were lyophilized by Boyikang vacuum freeze dryer.

2.3. Statistical analysis

All tests and analysis were run in triplicates and averaged. General linear repeated measure model performed via SPSS (statistical Package for the Social Sciences, version 17.0) was used to study the difference in the physicochemical properties of the powder produced from the different yogurt recipes (moisture content, water activity, pH, protein, fat and ash content) (Kwanchai A. Gomez & Gomez, 1984).
Furthermore, chi square was used to compare the preference of the four different recipes (ranking). In addition to that, triangle test was done to evaluate if differences would be detected between the freshly cooked recipe and its reconstituted counterpart.

III. RESULTS

3.1. Moisture Content Moisture loss and water activity of the four laban immo recipes

Starting with the moisture loss the full fat cow yogurt laban immo powder was the significantly lowest, while those of the skim milk cow, medium fat cow and full fat goat yogurt did not differ significantly (Fig.1).

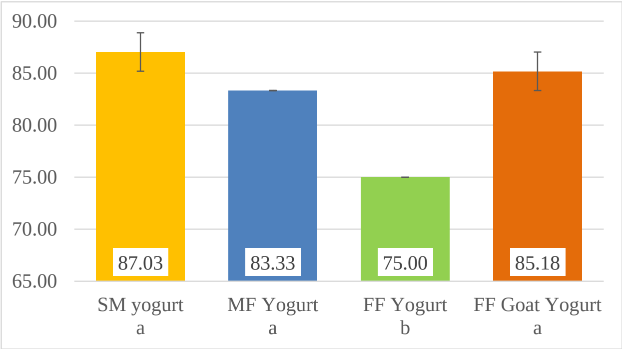

Fig.1: Percent Moisture loss of powder from the four laban immo reciepes

SM is Skim milk; MF is Medium Fat; FF is Full Fat;

The moisture content the laban immo powder done with skim milk cow yogurt was significantly the lowest followed by the moisture content of laban immo powder done with the full fat cow yogurt which did differ significantly from the moisture content of laban immo powder done from those done with full fat goat yogurt and medium fat cow yogurt being significantly the highest (Table 2).
Concerning the water activity, all powders of laban immo done with the different yogurts did differ significantly from each other with that done with the skim milk cow yogurt being the significantly lowest, followed by the water activity of laban immo done with full fat goat yogurt, then by those done with medium fat cow yogurt. Furthermore, the water activity of laban immo powder done by full fat cow yogurt was significantly the highest (Table 2).

Table 2 Moisture content and water activity of the four-laban immo reciepies

Yogurt Used	Moisture		Water Activity	
In Laban Immo Recipe	Mean	Std. Error	Mean	Std. Error
SM yogurt	29.10 a	1.85	0.18 a	0.02
MF Yogurt	55.37 b	0.00	0.46 b	0.01
FF Yogurt	40.73 c	0.00	0.61 c	0.02
FF Goat Yogurt	50.97 b	1.85	0.38 d	0.01
Average	44.04	1.49	0.41	0.02

Numbers with different letter are significantly different
SM is Skim milk; MF is Medium Fat; FF is Full Fat;

3.2. Protein and fat content of the laban immo powder.

There is no significant difference between the protein values of the laban immo powder done from the skim milk, medium fat and full fat cow yogurt, which were significantly higher than the laban immo powder done using full fat goat yogurt (Table 3).

As for the fat content, as expected, all powder did differ significantly from each other with laban immo powder from skim milk cow yogurt being the lowest and the powder done from the full fat goat yogurt being significantly the highest.

Table 3 Protein and fat content of powder from the four-laban immo reciepies

Yogurt Used	Protein		Fat	
In Laban Immo Recipe	Mean	Std. Error	Mean	Std. Error
SM yogurt	44.76 a	0.48	0.95 a	0.19
MF Yogurt	46.83 a	0.26	6.63 b	0.14
FF Yogurt	45.58 a	0.65	7.79 c	0.59
FF Goat Yogurt	39.41 b	1.55	12.48 d	0.18
Average	44.14	0.93	6.96	1.25

Numbers with different letter are significantly different
SM is Skim milk; MF is Medium Fat; FF is Full Fat;

3.3. Ash content and pH of powder from the four-laban immo recipes.

The ash content and the acidity of laban immo powder done with the full fat goat yogurt were significantly the highest with those of the other powders being more comparable (Table 4).

Table 4 Ash content and pH of the four-laban immo recipes

Yogurt Used	Ash		PH	
In Laban Immo Recipe	Mean	Std. Error	Mean	Std. Error
SM yogurt	2.09 a	0.06	5.03 a	0.04
MF Yogurt	3.68 b	0.16	5.15 b	0.03
FF Yogurt	2.14 a	0.03	4.93 a	0.03
FF Goat Yogurt	4.29 c	0.03	4.66 c	0.04
Average	3.05	0.29	4.94	0.06

Numbers with different letter are significantly different
SM is Skim milk; MF is Medium Fat; FF is Full Fat;

3.4. Sensory analysis.

Rank preference test was performed using 30 test subjects in order to rank samples from the 4 recipes according to preference. Furthermore, the preferred recipe was subjected was subjected to delta.

3.4.1. Results of preference ranking test

The laban immo done using full fat goat yogurt different significantly from the laban immo done with full fat cows yogurt, which in turn differ significantly from laban immo done with medium fat- and skim milk- cows yogurt which did not differ significantly (Table 5). Furthermore, the laban immo done with the goat yogurt was chosen as rank one the most (Table 5). Furthermore, the laban immo done with the full fat cows yogurt was chosen as rank 2 the most (Table 5). Last but not least laban immo done with medium fat- and skim milk- cows yogurt were chosen as rank 3 and 4 the most.

Table 5 Preference test results of different laban Immo recipes

	SM yogurt a	MF Yogurt a	FF Yogurt b	FF Goat Yogurt c
rank 1	3	1	4	22
rank 2	4	5	19	2
rank 3	12	14	1	3
rank 4	11	10	6	3

SM is Skim milk; MF is Medium Fat; FF is Full Fat;

3.4.2. Results of Delta test

The number of the correct responses and the number of the total responses were counted then compared to the table determine their statistical significance (Meilgaard, Civille, & Carr, 2016). There was no significant difference between reconstituted the lyophilized freeze dried sample and that of the freshly cooked and served laban immo recipe.

IV. DISCUSSION

Concerning the moisture content, percent moisture loss and water activity, the results show the importance of the water activity measurement as the real indicator of the different chemical reactions that might occur in the product (FU, TAOUKIS, & LABUZA, 1991). While there was no significant difference in the percent moisture loss except for the powdered laban immo done with the full fat cow's milk, the moisture content showed a different story with the powdered laban immo done with the skim milk cows yogurt had the lowest moisture content and the laban immo powder done with the medium fat cows yogurt and full fat goat yogurt had the highest moisture content. This is turn would have been deceiving if the water activity have not been measured, where the labban immo done with the skim milk cows yogurt, as expected, had the lowest water activity but the powdered laban immo done with full fat cows yogurt had the significantly highest water activity. Although the laban immo done with full fat cow's milk had the lowest moisture content the fat also trapped the water and prevented it from evaporation. Concerning the powder laban immo done with full fat goat milk, the fat and the protein components are of different nature than that of cow's milk, where the fat globules are more naturally homogenized and the casein compnents (alfa s1, alfa s2, beta and kappa casein) differ from those of cow's milk (O. Dimassi, Hinrichs, & Zárate, 2006) (Ossama Dimassi et al., 2005) (Clark & W. Sherbon, 2000).

The protein content of all the laban immo powder from yogurt of cow's origin did not differ much from each other but that done from goat yogurt was significantly lower. This might partially explain why the water activity of the laban immo powder from the full fat goat yogurt was lower than that done with the full fat cows' yogurt although it had the significantly highest fat content.

Furthermore, the mineral dissociation and hydration of milk proteins especially the casein the extent of mineral depends on the pH value. At pH 5.2, like that of the laban immo powder done from medium fat cow yogurt, a part of calcium and the totality of the inorganic phosphate are solubilized. The nearer the pH to the 4.6 value, such as the pH of the laban immo powder from full fat goat yogurt, the more the solubilized (Le Graet & Brulé, 1993) (Mekmene, Le Graet, & Gaucheron, 2010). Added to that the casein micelles nearing the iso-electric point 4.6 is less charged thus less water would be bound to them (Graet & le Gaucheron, 1999). This is another factor that would explain the water activity of the full fat goat compared to that of the powder done from the full fat cow's yogurt.

As for the preference ranking test the laban immo done from the full fat goat yogurt scored the highest followed by the laban immo done with the full fat cows yogurt and the goat recipe had the highest fat content. The later scored higher than the laban immo from the medium fat and skim milk yogurt which were significantly lower in fat percent. Although fat in itself is neutral it absorb lots of volatiles and thus the flavors are more conserved.

Furthermore, by comparing the reconstituted laban immo meal and that of fresh one no difference was detected. This gives this method a huge potential for the production of lyophilized laban immo product rendering it easier to store and prepare and most importantly easier to market and thus increasing the yogurt based products diversity, which in turn would help the dairy sector. Care, however, should be taken for the water activity which might be modified by simple additions or changing the drying method which needs further studies.

V. CONCLUSION

The results of this study suggested the yogurt from skim milk is the easiest to dry yielding the lowest water activity. Furthermore, there are differences between the recipe based on yogurt of the bovine and that of the caprine. Thus, more studies should be conducted to capture this difference. Furthermore, this traditional dish is already known in the Middle Eastern area thus it already has a potential market. Furthermore, it would open new possibilities of marketing in new arena.

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Analysis of Tuna Fish Resource Management (Thunnussp) on a Sustainable basis at Fish Landing in Bontotiro District Bulukumba Regency

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***Abstract*— *This study aims to determine the management of the sustainability of tuna resources in Bulukumba Regency using the EAFM approach. This research was conducted in the waters of the Gulf of Bone by taking a fishing base location at the Fish Landing Port (PPI) of BontoTiro, Bulukumba Regency for four months, which began in December 2018 to March 2019. Analysis of data used in this study using 6 EAFM dimensions and assisted with Rapfish software.*

The results of the study show that some dimensions have a fairly good sustainability value (> 50%), namely on the social dimension (57.1%), Habitat and ecosystem (57.25%) and dimensions of fish resources (51.88%). Tuna fishing activities that focus on the management of fisheries resources must be able to cover the regulation of fish resource use environmental management, and human activities in its management. In the smallest dimension in sustainable management, tuna is in the economic dimension with a value of 29.56% or in the bad category. This needs special attention from the local government of Bulukumba Regency, as well as at the provincial and central levels in raising the economic level of fishing communities working on tuna fishing. There needs to be government policy and innovation in providing assistance and providing alternative new livelihoods and tuna processing which can have a significant impact on improving the welfare of fishing.

***Keyword*— Management, Tuna Fish, Sustainable.**

I. INTRODUCTION

Tuna commodity in 2017 based on the Ministry of Maritime Affairs and Fisheries in 2018 was able to produce an export value of 659.99 million US $ with a total production volume of 198.131 tons. The amount is estimated to reach 16% of the total tuna production in the world. South Sulawesi region as one of the centers for producing fisheries in Indonesia. In 2018 the commodity of tuna, skipjack and cobs production amounted to 56,292, tons worth the US $ 342,930 (Department of Marine and Fisheries of South Sulawesi Province, 2018).

South Sulawesi Province is one of the producers of tuna which is spread in Bone Bay and Makassar Strait. Sudirman, et al. (2018) explained the fishing base of tuna fishermen in Bone Bay in Bulukumba Regency, Sinjai Regency, Bone Regency, and Luwu Regency respectively. The increase in tuna activity that also occurs in Bulukumba Regency, from an economic point of view, is a profitable thing to continue but on the other hand, the activity will have an impact on the existence of tuna fish itself. In 2014, Bulukumba District showed an increasing trend in tuna fishing with total production reaching 241 tons, where the catch of tuna in the previous year was 221.3 tons (Department of Marine and Fisheries, Bulukumba Regency, 2014). Zainuddin, et al. (2015) explained that the level of utilization of tuna resource potential based on data from 2008-2013 showed that tuna catches on average were still below the allowed catch. Furthermore, Zainuddin, et al.

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(2015) described the amount of utilization of Total Allowed Catch (TAC) for tuna fish that has reached 55% in the waters of Flores sea

The activities of fisheries resource utilization activities especially on tuna fish by the fishermen who landed their catches at Bontotiro TPI experienced development or change. The fishing port that used to be a community fishing port is now managed by the Ministry of Maritime Affairs and Fisheries. The community that used to only market tuna in the nearest area now has an export scale. Exporters of tuna with an export scale provide distinct advantages for fishermen because of the tantalizing price certainty. But the fishing gear used still uses stretch fishing rods and works individually. So that for the increase in the number of catches, it must use labor/fishermen and fishing fleets whose numbers also increase.

Several studies have been carried out in analyzing the sustainable management of tuna in Indonesia, especially in waters in South Sulawesi (Bone and Sea of Flores), among others, by Sudirman, et al (2018) which have supply chains of tuna in South Sulawesi. Ma'arif (2011), Pranandi (2016) and Wiyono (2017) put more emphasis on capture technology aspects and the economic conditions of tuna fisheries in seeing the ability of sustainable management of tuna fish in Indonesia. Research on the EAFM (Ecosystem Approach for Fisheries Management) approach has been carried out on tuna in Nusa Tenggara, and also on other fish species such as flying fish in the waters of the Makassar Strait and the Flores Sea. This study aims to determine the management of the sustainability of tuna resources in Bulukumba Regency using the EAFM approach.

II. MATERIAL AND METHODS

2.1. Study Area

Location and Time of Research This research was carried out in the waters of the Gulf of Bone by taking a fishing base location at the Fish Landing Port (PPI) of BontoTiro, Bulukumba Regency for four months, which began in December 2018 to March 2019. The number of fleets currently operating is 79, so the used in this study were as many as 22 units of tuna fishing vessels.

2.2. Data Analysis

a. Maximum Sustainable Yield (MSY) Analysis

$$\frac{Ye}{f} = a - bf$$

Where :

a and b = Constants

Ye = Catch (unit)

F = Arrest effort (unit)

$$f_{optimal} = \frac{a}{2b}$$

$$MSY = \frac{a^2}{4b}$$

b. Sustainable Management Analysis

In this analysis using the ecosystem approach fisheries management (EAFM) approach was analyzed using raffish software. The general criteria for determining each dimension's attributes are the ease of being scored objectively, and the extreme point of sustainability can be stated simply as good or bad. The selected attribute must reflect the sustainability of each dimension and can be modified with other attributes if the information is available (Pitcher and Preikshot, 2001). The sustainability attributes of tuna management, both quantitative and qualitative, are grouped into six dimensions (fish resources, ecology, social, economic, technological, and institutional).

attribute

Table 1. Dimension attribute of EAFM

No.	Dimension	Indicator	Methodology / Data collection
1.	Fish Resource Dimension	Raw CPUE	Production of Tuna Fish in Bulukumba Regency 2012-2017
		Fish Size Trend	The size of tuna is landed at Bontotiro TPI in Bulukumba Regency, through length measurements and comparing length averages
		Composition of Catch Species	The proportion of tuna catches in 1 unit of tuna fishing vessels

		Range Collapse	The distance of the fleet in hunting down the catch target
2	Ecology Dimension	Water quality	• Temperature • chlorophyll
3	Dimensions of Fishing Technology	The selectivity of fishing gear	Use of types of environmentally friendly fishing gear
		Fisheries capacities and arrest efforts	The number of fishermen's Effort who landed tuna at TPI Bontotiro
		Certification of fishing vessel crew in accordance with regulations	Personal data of fishermen and ships that land tuna at TPI Bontotiro
		Size of the fishing vessel	The shape and size of the fleet used in tuna fishing activities
4	Social Dimension	Stakeholder participation	Identification of stakeholders and fisheries stakeholders in Bulukumba Regency
		The working relationship of fishermen	The working model of tuna fishing at PPI Bontotiro
		Stakeholder interaction	Stakeholder activity in meeting activities to discuss tuna management in Bulukumba Regency
		Fisheries Conflict	Service activities, fishermen who land tuna at TPI Bontotiro
5	Economic Dimension	Asset ownership	Number of productive assets of fishermen
		Working capital	Use of initial capital in tuna fishing activities
		Profit-sharing system	The procedure for the distribution of income between fishermen, bosses and collecting traders
		Household Income fishermen	Income analysis of tuna production activities that land tuna at TPI Bontotiro
6.	institutional dimension	Compliance with the principles of responsible fisheries	Public perception of the use of environmentally friendly fishing gear and the impact of fisheries policy
		Availability of facilities and human resources in law enforcement	Availability of law enforcement activities in monitoring tuna fishing activities in Bulukumba Regency
		Management Plan	Management plan designed by the Bulukumba Regional Government in the preservation and sustainability of tuna resources
		Level of policy synergy and fisheries management institutions	Analysis of cooperation between fisheries management institutions in Bulukumba Regency

III. RESULTS AND DISCUSSION

3.1. Result

The results In this study is the determination of sustainable management of tuna resources in Bulukumba Regency was based on six (6) dimensions used in the EAFM standard consisting of (i) Fisheries Resources (ii) Ecology (iii) Fishing Technology (iv) Social (v) economy and (institutional). The following are the results of each dimension based on the results of the analysis using Rapfish software.

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a. Fish Resources Dimension

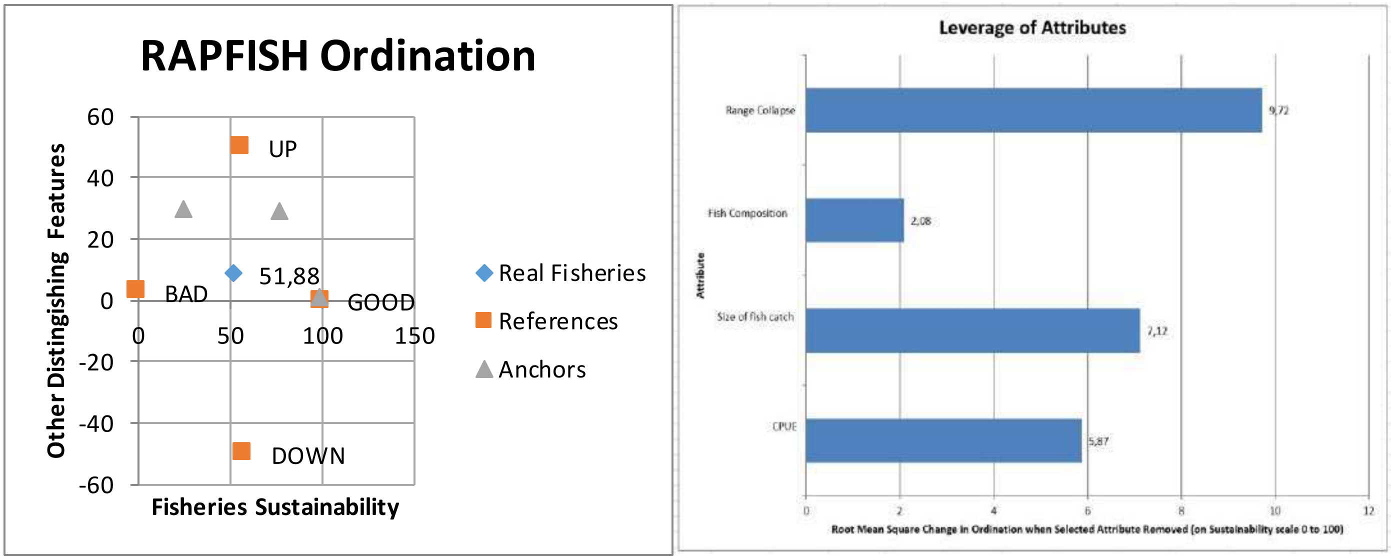

Fig.1: Results of Rapfish Analysis on Fish Resource dimensions

b. Ecology dimension

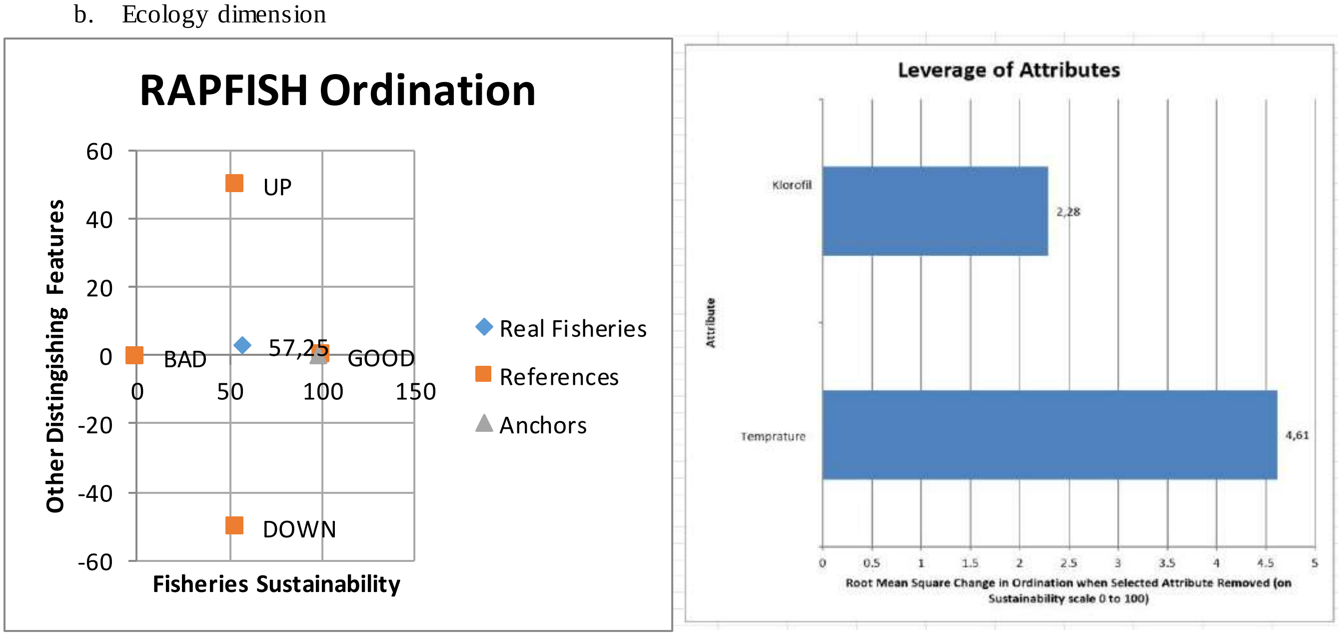

Fig.2: Results of Rapfish Analysis on the Ecosystem dimension

c. Dimensions of Fishing Technology

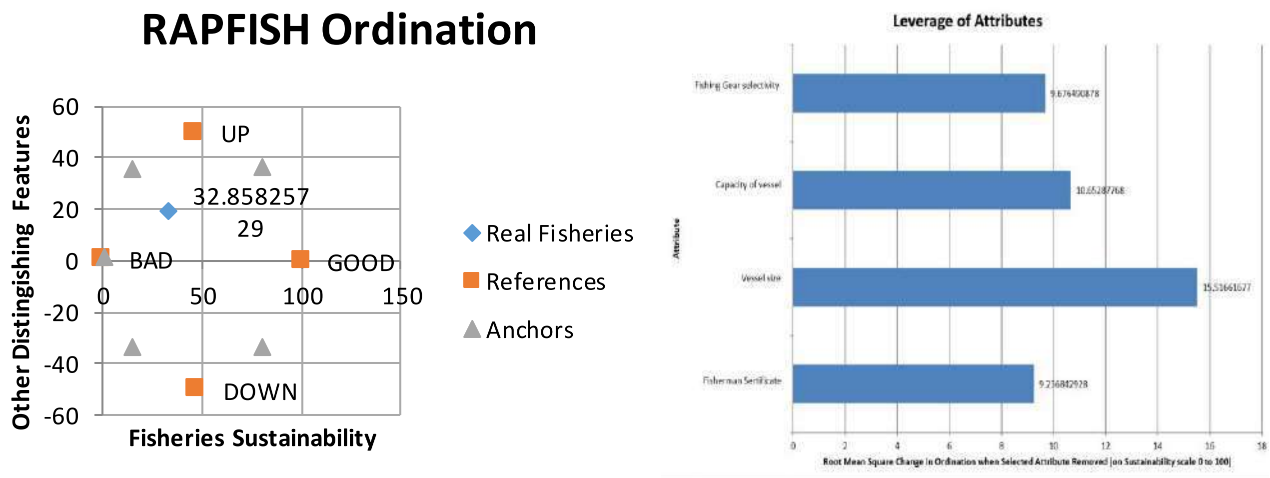

Fig.3: Results of Rapfish Analysis of the Fishing Technology dimension

d. Social dimension

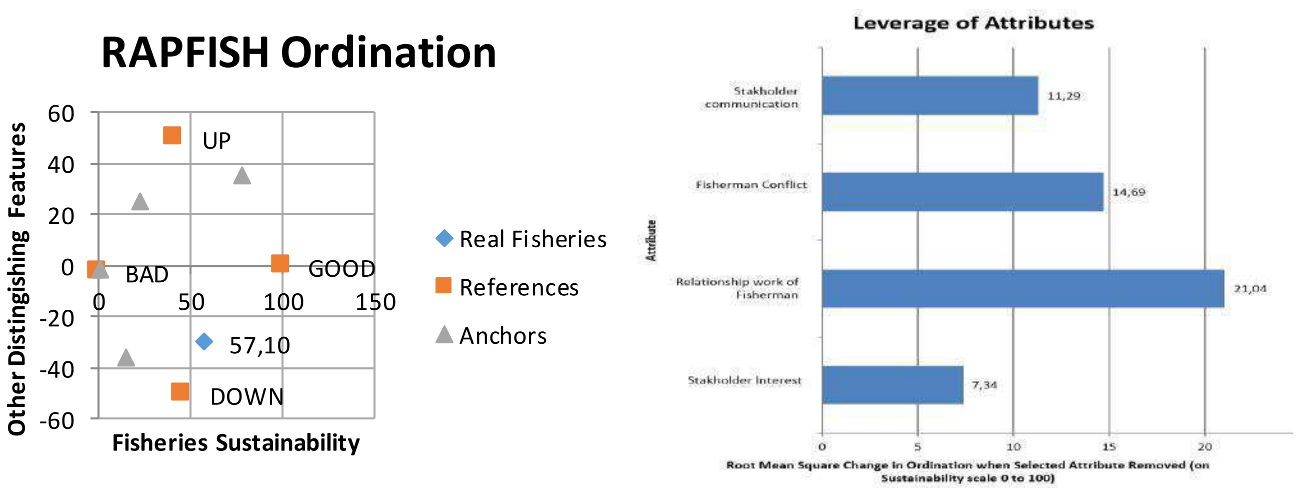

Fig.4: Results of Rapfish Analysis of Social dimensions

e. Economic dimension

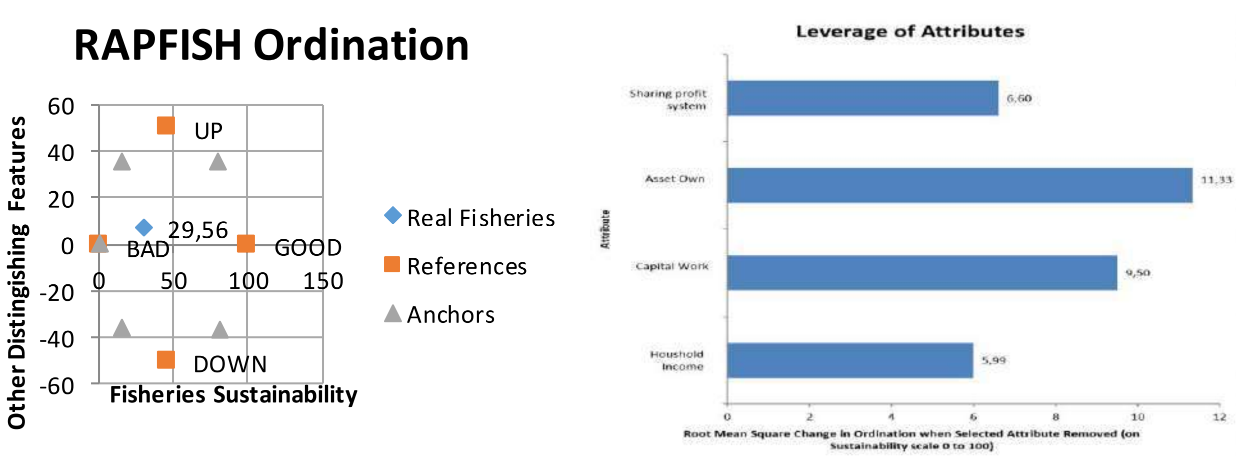

Fig.5: Results of Rapfish Analysis on the Economic Dimension

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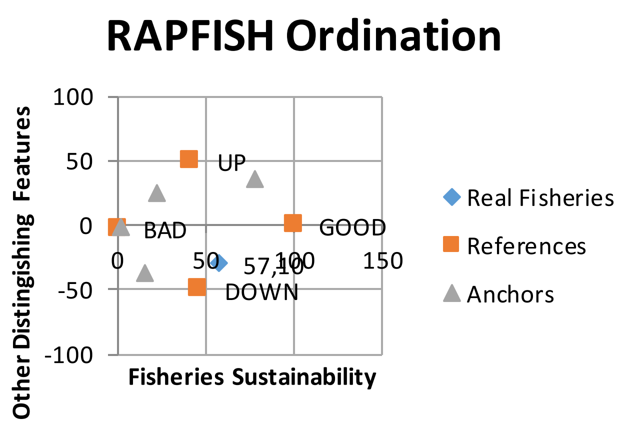
f. Institution Dimension



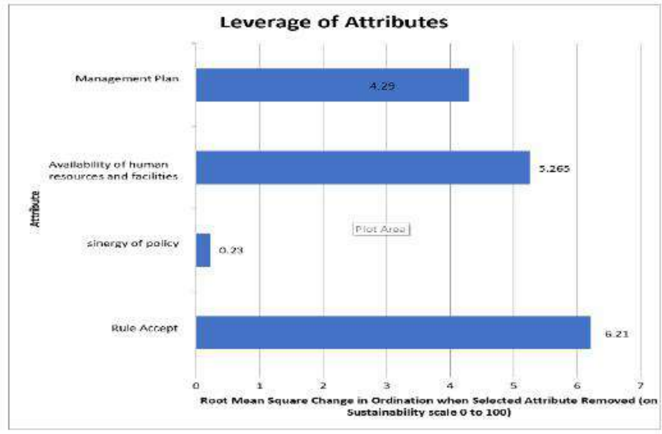


Fig.6: Results of Rapfish Analysis on Institutional Dimensions

3.2. Discussion

In the last 6 years, there have been developments in the number of fleets carrying out tuna loading and unloading activities at Bontotiro PPI so that this affects the optimum effort of catching tuna landed at PPI Bontotiro. Catch per unit effort is the annual fishery catch rate obtained using time series data for a minimum of five years. The following are CPUE results for tuna commodities landed in Bulukumba Regency during the period of 2012 to 2017 based on statistical data from South Sulawesi Province (table 2).

Table 2. CPUE of Tuna based on Production in Bulukumba Regency

Years	Trip	Catch (ton)	CPUE
2012	1548	3309,9	2,138178
2013	2016	1280,1	0,63497
2014	2016	3309,9	1,641815
2015	2052	9803	4,77729
2016	2412	8897	3,68864
2017	2520	2201	0,873413

Source: Primary data after processing, 2019.

Based on the table and graph above shows the value of CPUE for tuna production in Bulukumba Regency experienced fluctuations in the last six years. The highest CPUE value was found in 2015 with a value of 4.77 tons/trip while the lowest value in 2013 was only 0.63 tons/trip. Based on the CPUE value that has been obtained and then continued using regression analysis, the regression equation is obtained as follows:

$$CPUE = -6{,}777 + 0{,}004331F$$

In determining the sustainable products used in this study is to use the Schafer method approach. Based on the results of Schafer's analysis showed that the optimal CPUE value that can be done in 1 year is 782 trips while the amount of sustainable products that can be obtained in 1 year is 2650.1 tons.

Based on the results of the analysis of the dimensions of fish resources shows that the value dimension of fish resources in the management of tuna in Bulukumba Regency is at a value of 51.88 percent or in the good category. In the analysis of each attribute used in the assessment indicators of fish resource dimensions, attributes that have the highest sensitivity (leverage) are in attribute ranges collapse or tuna fishing distance. Based on the ecosystem dimension shows that the value of sustainability in the ecosystem and habitat dimensions is at a value of 57.25% which is in the good category. In the analysis of sensitivity attributes in ecosystem dimensions. The attributes of temperature and salinity are attributes that have the highest value or have a high enough sensitivity in the management of sustainable tuna in Bulukumba Regency. The conditions of temperature and salinity which have a significant change from time to time have a fairly high influence on the presence of tuna commodities in the catchment location which is the place for tuna fishermen production activities in Bulukumba Regency.

On the dimensions of fishing, technology is at a value of 32, 86 or in the bad category. In the sensitivity analysis (leverages) on each of each attribute shows that the highest value is on the attributes of fishing vessel size modification or with a value of 15.52. Modification of fishing vessel size as an attribute that has

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high sensitivity is caused because the fishing fleet used in tuna fishing activities is not in accordance with the condition of the correspondence possessed by the fishing fleet so that exploitation can occur in tuna fishing activities. the social dimension in tuna management is at the value of 57.10 percent or in good condition (good). On the other hand, the value of the raffish ordination analysis is still in the range of the down so that there needs to be an increase in the aspect of the social dimension. In analyzing each attribute used in this dimension, the attributes of the fishermen's work relationship have the highest sensitivity value with a value of 21.04. This indicates that the tuna fishing activities by Bulukumba fishermen who landed their fish in Bontotiro PPI by working in groups and are still traditional are the most important aspects that need to be considered in the sustainable management of tuna in Bulukumba

In the economic dimension that is at the value of 29.56 percent which describes the economic dimension in the bad category. From the results of attribute analysis which is a measurement on the economic dimension, the highest value on attribute sensitivity to be sustainable tuna management is found in the asset ownership attribute with a value of 11.33. Based on the table and the results of Rap Flying Fish analysis above shows that the value of institutional dimensions produces a sustainability index of 39, 1 percent or a poor sustainability index because it is below the 50 percent range. On each attribute that is used as a measuring instrument on the institutional dimension in the Leverages analysis (sensitivity) attributes indicate that the highest attribute is in compliance rules that is equal to 6.21. This shows that in tuna management in Bulukumba Regency, the attribute of regulatory compliance is the most important to be considered in tuna fishing activities. The fishing fleet used by tuna fishermen who landed at Bontotiro PPI is still difficult to be able to easily complete the letters as a condition for carrying out fishing activities in Indonesian waters

The management of fish resources in Bulukumba Regency, especially tuna, is a very important and prominent aspect in the fisheries sector as a determinant in the sustainability of production activities and tuna fishing. The following is an elevated diagram on each dimension used in tuna management in Bulukumba Regency in this study:

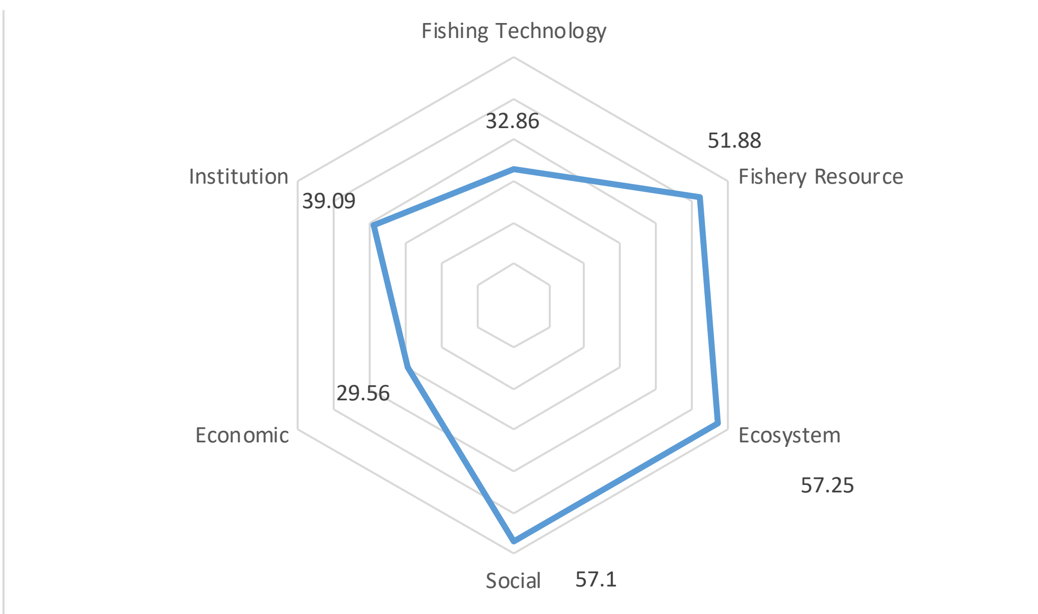

Fig.7: A Layout Diagram of the Overall Dimensions of EAFM in Tuna Management

Based on the elevated diagram above shows that some dimensions have fairly good sustainability value (> 50%), namely on the social dimension (57.1%), Habitat and ecosystem (57.25%) and dimensions of fish resources (51.88%) Tuna fishing activities that focus on the management of fisheries resources must be able to cover the regulation of fish resource use, environmental management and human activities in its management. In the smallest dimension in sustainable management, tuna is in the economic dimension with a value of 29.56% or in the bad category. This needs special attention from the local government of Bulukumba Regency, as well as at the provincial and central levels in raising the economic level of fishing communities working on tuna fishing. There needs to be government policy and innovation in providing assistance and providing alternative new livelihoods and tuna processing which can have a significant impact on improving the welfare of fishing communities in Bulukumba Regency.

IV. CONCLUSION

Based on an analysis of the sustainability of tuna resources in Bulukumba with the raffish method, the dimensions of habitat and ecosystems, the social dimension, the dimensions of fish resources management can continue. While the institutional dimensions, dimensions of fishing technology and the economic dimensions of management cannot continue.

With the description of CPUE value, social conditions and ecosystem conditions in tuna activity in Bulukumba Regency, it can be a recommendation for rules and policies to provide limits on fishing activities to maintain tuna resources in Bulukumba Regency.

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Cauliflower (*Brassica oleracea*var. *botrytis* L.) Production Applied with Carabao Manure: Effects on Growth and Yield

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***Abstract*— Utilization of carabao manure as a sustainable approach on nutrient management for cauliflower production was studied for three months between the months of October 2016 to January 2017 at the University Demo Farm, University of Eastern Philippines, Main Campus, University Town, Catarman, Northern Samar, Philippines. The main objective was to determine the effect of carabao manure on the growth and yield of cauliflower. Carabao manure preparations included dried carabao manure, administered at 1.0 kg and 1.5 kg levels boosted with manure tea.**

Growth and yield performance of cauliflowers were significantly influenced by dried carabao manure applications boosted with manure tea application. Better performance were observed in plants treated with 1.5 kg dried carabao manure than with 1.0 kg was evident on the parameters evaluated, indicative of the nutrient sufficiency of the bio fertilizer.

Carabao manure, a farm waste product, an untapped resource, has been proven to be an effective, safe and an economical bio organic fertilizer. A commodity capable of becoming a promising industry; a lowly resource, but if given enough attention can "turn dust into gold" and effect significant changes in the lives of many sort.

***Keywords*— Animal wastes, Bio-organic fertilizer, Carabao manure tea, Dried carabao manure.**

I. INTRODUCTION

Nutrient management and insect pest control are indispensable in any farming endeavour. Undoubtedly, the use of most appropriate technology suited to a given croplargely contribute to its growth and yield.

The utilization of indigenous farm resources such as farm manure and botanicals relative to crop management as an organic production technology has a good number of assured chain of benefits which are: environmental sanitation or ecological conservation, reduction of production cost resulting to bigger income, and production of genuinely safe food crops to address and promote health and wellness concerns.

Carabaomanure, is a very good bio material for enhancing soil fertility. This bio-organic resource can be collected in every farm. Rosco, 2014, (personal communication), mentioned that a carabao produces ten (10) kilos of manure a day. Chemical analysis shows that carabao manure has 18-20 C:N ratio. It has 24-30% carbon, 0.8-2.2 % Nitrogen, 2.07 Phosphorus, and 0.12-2.0 Potassium (Aganon, et al., 2011). They further cited that manure from ruminants is found to enhance plant growth because of the decomposing microorganisms in the rumen and hormones in their urine.

With these, the study was conceived to test the efficacy of carabao manure as fertilizer as bio fertilizer on the growth and yield of cauliflower grown pots.

II. METHODOLOGY

Experimental Design and Treatments. A randomized complete block design (RCBD) with three replications was used. Three doses of bio-organic fertilizer from animal wastes were evaluated, to wit: No carabao manure (DCMO -control); 1.0 kg dried carabao manure (DCM1) and 1.5 kg dried carabao manure (DCM1.5). The treatments were designated as follows:

T1: DCMO - No Carabao Manure (DCMO-Control)

T2: DCM1 - 1.0 kg Carabao Manure

T3: DCM1.5 - 1.5 kg Carabao manure

Preparation and Application of Carabao Manure as Bio-organic Fertilizer. Carabao manure was processed in two ways: dried (DCM) and manure tea (CMT). Dried carabao manure was collected and air-dried until it was totally dried, while carabao manure tea was processed by submerging a sack-full of partially dried carabao manure in a 200-liter capacity plastic drum filled with ground water for one week before its use.

Dried carabao manure (DCM) was prepared in two levels: 33 and 50 t/ha converted into 1.0 kg (DCM1) and 1.5 kg (DCM1.5), respectively. Application of DCM was done once for DCM1 and twice for DCM1.5. Application of DCM1 was adminstered as basal before planting; while second application for DCM1.5 as top dress was done 10 days after the first application. Carabao manure tea (CMT) at the rate of 100 ml plant was applied in each plant at planting and at weekly interval thereafter throughout the duration of the study. Application was directed in the soil at the base of each plant.

Planting and Harvesting. Hardened cauliflower seedlings (Farmers' Extra Early variety) were transplanted to the plastic pots filled with desired volume of soil medium and bio-organic fertilizer late in the afternoon to reduce transplanting shock. The plants were maintained using recommended cultural management practices. Gowth and yield was measured in terms of plant height, length and width of leaves, leaf area and weight at harvest, weight of whole plant, root-shoot-ratio, number of days to 50% flowering, weight and diameter of curd and yield of marketable curds. Harvesting was done when the curd became compact and firm or about 50 days from transplanting. Data gathered were analyzed employing the analysis of variance (ANOVA) and treatment mean differences were determiend using the Least Significance Difference (LSD) test at 5% level of probability.

III. RESULTS AND DISCUSSION

Growth Characters

Growth characters as influenced by the application of carabao manure as bio-organic fertilizer are summarized in Table 1.

Plant Height at Harvest (cm). Plants applied with 1.0 kg dried carabao manure (DCM1) were tallest, 39.83 cm followed by plants applied with1.5 kg dried carabao manure or (DCM1.5) with 38.35 cm. Plants were shortest in pots without dried carabao manure (DCM0) at 35.05 cm.Although carabao manure is considered a slow release organic fertilizer, its effect might have been enhanced by the application of carabao manure tea (CMT), boosting plant nutrients at early crop stage resulting to the rapid growth of the cauliflowers.Jigmei, N.J., et al., (2015) reported an increase in growth parameters of broccoli applied with chicken and manure tea; and El-Magd, et al., (2016), noted accelerated growth of the plants applied with organic manure.

Number of Leaves per Plant at Harvest. Although the number of leaves produced per plant varied according to carabao manure application, the same was not significant. The production of almost the same number of leaves with or without the application of different levels of DCM indicates that the cauliflower variety used in the study can adapt to local conditions even in soils with low fertility level. This observation is true in almost all vegetable (Brassica) researches in the area where the control (without fertilizer application) plants were able to develop considerable number of leaves but of different length, breadth and weight subject to available nutrients in the soil (Tuan, 2002).

Leaf Length at Harvest (cm). Length of cauliflower leaves was significantly affected by the application of carabao manure. Longest leaves were found in DCM1 (19.55 cm) and DCM1.5 (21.02 cm); shortest leaves were noted in DCM0 (15.32 cm). Higher rates of carabao manure produced bigger and longer leaves. This implies that DCM added with CMT provided adequate nutrients to the cauliflowers. This corroborates the findings of Fayed (2010) who claimed that CMT significantly increased the vegetative parameters of the Roghini olive trees. In addition, El-tantawy (2009) also found out that farmyard compost tea increased the height and leaf area of potato plant.

LeafWidth at Harvest (cm). Plants applied with DCM1 and DCM1.5 produced the widest leaves while those applied with DCMO only had the narrowest leaves.The production of wider leaves in cauliflowers is necessary to support flower/curd formation. Results of this study revealed that formation of bigger and wider leaves is directly related to the application of DCM with CMT as sources of nutrient. Gross et al.(2008), reported that ammonium is the major form of nitrogen present in the extract solutions from all manure types and that the nitrogen released after 14-day extraction by the different methods from the different manures ranged between 50% and 85%. Alo and Tuan (2015) obtained almost similar result in cauliflower applied with chicken dung.

Leaf Area at Harvest (cm). The application of DCM significantly influenced the leaf area of cauliflower plants. Highest leaf area was recorded among plants applied with DCM1 with 654.26 $cm^2$and those with DCM1.5 with 632.84 cm^2. Lowest leaf area was observed in the control plants (DCM0) with 403.71cm^2. No significant difference in leaf area was observed between DCM1 and DCM1.5. The variation in leaf area observed among treatments being bigger in plants applied with

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DCM than those in control plants (DCM), implies that DCM has sufficient nutrients. Nourishment received by the plants enabled the production of bigger and wider leaves; a plant requirement that allow optimum light interception and distribution for efficient physiologic process such as photosynthesis and carbohydrate transport (El-Sawy et al., 200; el-Dissoky, 2008) which contribute to the formation of reproductive parts in cauliflower.

Leaf Weight at Harvest (g).Different rates of DCM had significant influence on the weight of cauliflower leaves per plant. Average leaf weight per plant was heaviest in DCM1 at 381.39 g, and DCM1.5 with 375.55 g, but no significant difference was observed between them.Lightest leaves were observed in plants not applied with DCMO (213.09 g). The variation in leaf weight among treatments is directly related to the size of the leaves (leaf length, width, area) produced by the plants. Based on the other growth parameters, it can be noted that the longest and widest leaves and biggest leaf area were produced by the plants treated with DCM. Gross et al., 2008, mentioned that organic fertilizers have the property to enhance soil aggregation, soilaeration, and water holding capacity; factors which offer good environmental condition to broccoli plants.

Weight of Whole Plant at harvest.Weightof whole plants differed significantly as influenced by the application of DCM. Average weight of whole plants applied with DCM1 was 235.83 g and DCM1.5 with 221.20 g were statistically the same except on plants without DCM with 139.12 g. Weight of whole plant comprises all plant parts including the roots. The results of the study relative to the weight of the whole plant almost follow similar pattern with the other growth parameters evaluated such as the vegetative parts (leaf length, width and leaf area). The increase in vegetative growth can be traced back to the positive effects of DCM with CMT which have contributed to the increase in photosynthetic activity and uptake of soil nutrient. These results are in agreement with the findings of Caser (2009) in cauliflower, Elkhatib, (2009) on common bean.

Shoot-Root Ratio.Shoot-rootratio was highest in plants treated with DCM1.5, 8.33 g followed by plants treated with DCM1.0 with 8.85 g and those without DCM at 6.77 g per plant. Although highest shoot- ratio was highest in plants applied with DCM1.5 followed by plants applied with DCM1 and those without carabao manure (DCMO), in the descending order, the differences were not significant. The higher shoot-root ratio among treatment treated with organic fertilizer is indicative that the plants were receiving sufficient nutrients to support a large vegetative (shoot) growth. Wright *et al*. (1995), observed that maximum root growth and rooting depth of barley crop were higher in treatments, which received animal manures relative to where manure was not applied. The results therefore suggest that the observed response was largely due to increased availability of N and P in Carabao manure and manure tea and consequently enhanced root growth.

Yield Parameters

Yield parameters as influenced by the application of carabao manure as bio-organic fertilizer are presented in Table 2.

Number of Days from Transplanting to 50% Flowering.The number of days from transplanting to 50% flower/curd formation as influenced by the application of the different rates of DCM wassignificant. Flowering/curd formation was earliest, 42.29 days in plants applied with DCM1.5 but delayed for about three days, 45.25 in plants applied with DCM1, and up to five days, 48.54 inuntreated plants. Notably, the cauliflower variety (Farmers' Extra Early) used in this study is an early maturing variety, produces curds which can be harvested within 40 days from transplanting. Based on the results, generally, plants which were organically fertilized flowered earlier compared to those which were not fertilized; possibly due to better nourishment. The lack of nutrients for immediate utilization in control plants may have contributed to the delay in flower/curd formation.

Curd Diameter (cm) at Harvest. Curd diameter considerably differed among the treatments evaluated. Cauliflowers applied with DCM1.5 produced the biggest curd, 11.68 cm, those applied with DCM1 produced smaller curd, 10.06 cm. Plants which did not receive DCM produced undersized curds (7.64 cm. The production of bigger curd in the fertilized treatmentscan be attributed to the cumulative contributions of healthy vegetative plants parts produced in plants receiving organic fertilizer as results of readily available nutrients and better mobilization of plant nutrients translocated by the application of bio-fertilizer.

Curd Weight at harvest. Results of the study relative to the application of different rates of DCM revealed positive impact on weight of cauliflower curd. Consistently, those applied with dried carabao manure (DCM1 and DCM1.5) showed the heaviest curds, while those without carabao manure (DCMO) had the lightest. In harmony with other growth and yield parameters evaluated in this study, treatments administered with DCM and CMTalso registered heavier curds. Better growth and yield performance are manifestations of nutrient sufficiency provided to the plants by the bio organic resources.

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Table 1. Growth characters of cauliflower as influenced by the application of carabao manure.

Treatments	Plant Height (cm)	Number of leaves per plant	Leaf length at harvest (cm)	Leaf width at harvest (cm)	Leaf area at harvest (cm^2)	Leaf weight at harvest (g)	Weight of whole Plant (g)	Root-shoot Ratio
	Mean*							
M0	35.05^b	16.18	15.32^b	9.18^b	134.57^b	71.03^b	19.87^b	6.77
M1	39.83^a	17.06	19.55^b	11.38^a	218.09^a	125.18^a	27.24^a	7.42
M2	38.35^a	17.06	21.02^a	11.83^a	210.95^a	127.13^a	25.58^a	8.33

**Means followed by the same letter are not significant at 5% DMRT.*

Average Yield of Marketable Curd Yield (t/ha).Yield of marketable curd greatly varied as affected by the application of dried carabao manure but failed to register significant differences between treatments. Higher yield in plants applied with carabao manure and carabao manure tea is the concrete manifestation of the overall plant performance given favourable environment (physically conducive and nutritionally sufficient). Expectedly, plants reared in such condition had produced big and heavy curds. Based on the production indices evaluated in this study, the application of carabao manure as an organic bio fertilizer supplemented with manure tea almost resulted to sizable vegetative growth.

Table 2. Yield characters of cauliflower as influenced by the application of carabao manure.

Treatments	Number of Days to 50% Flowering	Curd diameter at harvest (cm)	Weight of marketable curd at harvest (g)	Yield of marketable curd (t/ha)
		Mean*		
M0	48.54^a	7.64^c	74.56^b	2.44
M1	45.25^b	10.06^b	184.26^a	3.05
M2	42.29^c	11.68^a	208.29^a	3.59

**Means followed by the same letter are not significant at 5% DMRT.*

IV. CONCLUSION AND RECOMMENDATIONS

The application of carabao manure complemented with carabao manure tea as source of bio-organic fertilizer for cauliflower production was found to have highly influenced the growth and yield of cauliflowers, evident on the different growth and yield parameters evaluated, such as plant height, length and width of leaves, leaf area and weight at harvest, weight of whole plant, root-shoot-ratio, number of days to 50% flowering, weight and diameter of curd and yield of marketable curds. Carabao manure with manure tea was found to be effective in influencing growth and yield of cauliflower. Higher rates of carabao manure enhanced with manure tea resulted to bigger and heavier plants and eventually higher yield of marketable cauliflowers.

Carabao manure and carabao manure tea, a farm waste, is rich in plant nutrients and beneficial microorganisms is a potential bio-organic fertilizer productive and sustainable organic cauliflower production. A follow-up study is necessary to further verify the performance of cauliflower applied with carabao manure with manure tea under farmers field conditions.

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Diversity of Natural Enemies in Organic Cauliflower, *Brassica oleracea* var. Botrytis Applied with Biopesticides from Plant Extracts

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***Abstract*— Selected botanicals used as foliar bio pesticide as a sustainable approach on insect pest management for cauliflower production was studied for three months at the University Demo Farm, University of Eastern Philippines, Main Campus, University Town, Catarman, Northern Samar to determine their effect on the incidence of natural enemies on cauliflower.**

Presence of natural enemies at the experimental area was not significantly influenced by the introduction of the bio pesticide. Abnormalities in the environmental condition during the conduct of the experiment was the major contributory factor to its effectiveness. Yet, repellant and antifeedant properties of the bio pesticide must have prevented the establishment of pest species. The prevalence of natural enemies and other arthropods in the area is a clear indicator of a clean and safe environment.

***Keywords*— Biofertilizer, Biopesticides, Bio-resources, and Natural enemies.**

I. INTRODUCTION

Utilization of bio resources is a means to meet sustainable agriculture requirements. Plant extracts have long been used to control insects. Botanicals are noted to have broad-spectrum activity, relatively specific in their mode of action and also easy to process and use.

In the recent years, reports revealed that several vegetable farmers have already shunned themselves from adopting the conventional means of pest control. Many of them have shared good testimonies and successful stories about growing crops the organic way.

Among the tried and tested organic farming practices by seasoned farmers are: use of fermented plant juices as soil drench to supply nitrogen to young plants, thorough and patient preparation of the field with organic fertilizer, and use of herbal-based pesticides (Rodriguez, 2012; Samonte, 2012; Samonte, 2013).

Farmers have proven that shifting from conventional to natural farming is economically viable and ecologically sound; that organic farming has not just enabled them to save production cost but more so has restore the natural fertility of the soil, save and promote healthier environment favorable for natural enemies and most of all produce chemical-free food on their table.

This study tried to assess the incidence of natural enemies in organically grown cauliflower in Northern Samar.

II. METHODOLOGY

The study was conducted in pot experiment under protected culture at the University Demo Farm, University of Eastern Philippines, Main Campus University Town, Northern Samar. It was laid out in a Randomized Complete Block Design (RCBD) with 4 treatments (T1-Control , T2-Biopesticide, T3-Biofertilizer+Biopesticide) in three replications.

Research Procedure

A kilogram of chopped fresh leaves of *Akapulko* and guava (combined in equal amount, 1:1 ratio) was added with 1,000 ml of ground water and a kilo of brown sugar. The mixture was kept in a jar and allowed to ferment in a dark and dry place for seven days then strained; fermented foliar bio pesticide was mixed with fresh extract of 100g ground hot pepper (*siling labuyo*) and was allowed to stand for at least 6 hours then was ready for use.

Daily scouting to monitor presence natural enemies in the cauliflower field experimental area was done through visual observation above the ground parts of cauliflower plants. Plants were visited from 6:00 am to 9:00 am since insects come out at this time to feed. Data were recorded in observation sheets. Species richness and evenness index was computed to assess the diversity of

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natural enemies in the experimental area using Simpson's index, Ds= 1-Σ(n_i-1))/ (N (N-1)) where Ds = Simpson's index of diversity; N = total number of individuals of all species; n_i = total number of the species i.

Care and management practices on cauliflower production were followed throughout the duration of the experiment. Weeding and earthing up was regularly done to prevent food competition, exposure of the shallow roots and formation of soil crust on surface.

III. RESULTS AND DISCUSSION

Incidence of Natural Enemies

The presence of a sizable number of different species natural enemies in the experimental area is evident of a conducive, clean and safe environment. Non utilization of toxic and harmful chemicals allows them to hover in the area. Prevalence of these beneficial creatures in the experimental area was observed in all the growth stages of the crop, Table 1. Natural enemies present in the field was dominated by different species of spiders.

Wasps (Hymenoptera), dragonfly and damselfly (Odonata) and praying mantis (Orthoptera) were also recorded. Their presence must have controlled the establishment of small insect pests like aphids and mealybugs. Pedigo, 1988, emphasized that established pests as damaging as they may be can cause even more damage if it were not for the presence of natural enemies.

Table.1: Natural enemies, other arthropods and vertebrates observed during the different growth stages of cauliflower in UEP, Catarman, Northern Samar, Philippines.

Crop developmental stage	Name of insect	Class/Order	Life stage of the insect	Plant parts located
Transplanting to plant establishment	Flies	Diptera	Adult	Leaves , soil
Vegetative stage	Wasp	Hymenoptera	Adult	Leaves
	Praying Mantis	Orthoptera	Adult , nymph, egg	Leaves
	Dragon fly & damsel fly	Odonata	Adult	Leaves
	Lacewing	Homoptera	Adult	leaves
	Daddy longlegs	Opiliones	Adult	Leaves
	Spider	Aranaeae	Adult , nymph	Leaves, stem, web
Curd initiation and development stage	Wasp	Hymenoptera	Adult	Leaves
	Flies (different species)	Diptera	Adult	Leaves
	Spider(different species)	Aranaeae	Adult , nymph	Leaves, stem, web
	Green lizard	Reptilian	Adult, egg	Soil

Other organisms recorded were several species of Dipterans (blowfly, housefly, Tabanus fly, green fly and orange fly), daddy longlegs (Opiliones), lacewing (Neuroptera), black ants (Hymenoptera), mite (Acari) and green lizard (Reptilian). Existence of these organisms in cauliflower field is indicative of species diversity. Bio resources and carabao manure utilization of must have contributed to the species richness.

Effect of the Bio Pesticide on the Incidence of Natural Enemies

The effect of the bio pesticide on the natural enemies (NE) was significantly different among the treatments. This finding means that bio pesticides contain substances with insecticidal property, however, is less toxic than synthetic pesticides, hence, categorized as an eco-friendly alternative in pest management.

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Foliar biopesticide from fermented plant extracts did not show significant effect on the natural enemies on cauliflower plants. The use of bio pesticide from botanicals (*akapulko*, guava and hot pepper) had a positive influence on the incidence/diversity of natural enemies of cauliflower, a welcome strategy to promote and realize a clean and safe environment;

Based on the results of the study, the following recommendations are made:

1. Advocate adoption of bio resources in the farm to combat hazardous effects of using conventional farm inputs.
2. Perform experiment on improvement of the preparation and processing of the bio pesticide to increase its potency and effectiveness.

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3. Conduct further verification studies on dosage and manner of application of the bio pesticides.
4. Perform the same study during the dry months to confirm efficacy and effectiveness of the bio pesticides and the incidence of natural enemies.

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Water Quality Assessment Using a New Proposed Water Quality Index: A Case Study from Morocco

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***Abstract*—Excellent or very poor water quality depends of its physicochemical and biological parameters. However, the assessment of water quality relies on the water quality index (WQI) used, because some indices in their form of application may underestimate or overestimate the overall water quality. For instance, to avoid the problem of underestimation of water quality index, a new WQI is proposed in this study. In order to develop this new WQI, data from 29 water quality monitoring stations, including 3 surface water stations and 26 groundwater stations, spanning over1988 -2017 , were collected from the Sebou Hydraulic Basin Agency (ABHS).The water quality parameters were standardized and then aggregated into a composite water quality index, using Moroccan water quality standards. The application of this new WQI showed that 37.9% of the stations have bad or very bad water quality, 13.8% have medium quality, 41.4% have good quality and that only 6.9% have excellent quality. The poor surface water quality, characterized by high levels of BOD_5 and COD, low dissolved oxygen and high levels of fecal coliforms is mainly due to industrial and domestic activities. The poor groundwater quality marked by nitrate leaching from agricultural lands is chiefly due to industrial and domestic activities. The comparison between this new WQI and the method used by ABHS showed a satisfactory agreement of the results (R^2 =0.70, at the 95% confidence level) for the 26 groundwater stations.*

Keywords*— WQI, Water Quality Index, Sebou Basin, Physicochemical Parameters, Water Quality Parameters.

I. INTRODUCTION

In the daily lives of living things, water resources play a very important role in keeping the body alive. This precious resource is present in all human activities. However, water quality can quickly deteriorate, following human activities and become unusable for consumption. In a world where climate change is affecting all sectors, water resources are not spared and are increasingly vulnerable. Recently, throughout the world, several cases of problems related to water quality or scarcity due to drought must alert all global stakeholders in water resources management. Among other things, water problems have been reported all over the world: In 2014, the city of Sao Paulo (Brazil) could have been deprived of water because of drought and pollution of the reservoirs supplying the city. In 2016, the city of Ouagadougou (Burkina Faso) experienced a very severe water shortage, where districts stayed 3 to 4 days without seeing a drop of water in the taps, and even when water is available, it is so turbid. In 2014, the city of Zinder (Niger) experienced a severe water shortage to the point of depriving the population of food since there is no water for cooking. In 2016, the government of Bolivia declared a state of emergency due to the severe drought in the country. The City of Cape Town in South Africa have experienced the so called " Day Zero" in June 2018, the day when the army would take over the distribution of water, which would be limited to 25 liters per day per person.

In Morocco, in addition to the spectra of water scarcity profiling, it is one of the African countries most threatened by water resource pollution [5]. For example, the Sebou basin, being the study site, is considered the most polluted in the country [3, 9]. The origins of pollution are diverse and several researchers report 3 to 4 main sources of pollution. Agricultural practices, urban and industrial development through the induction of nutrients and toxic elements [9] are the sources of pollution of water resources. Domestic water discharges are often injected directly into rivers and spread on land without any treatment [14, 9, 5], and only 20% are treated before being discharged into rivers [20]. Industrial activities are also considered as one of the sources of pollution in this watershed. The main branches of this activity are agro-food industries such as sugar factories, paper mills and olive oil mills generating large quantities of organic matter that degrade dissolved oxygen in the water. Agricultural activities are also very important in the area and represent the main economic activity.

The use of fertilizers and phytosanitary products causeleaching of some 900 T/year of nitrogen, 220 T/year of phosphates according to the Sebou Watershed Agency (ABHS) in 2013. Landfills also generate leachate to surface water and groundwater [2, 5, 13]. In this basin, several researchers [14, 2, 6, 3, 9,5] have attempted toassess the quality of water resources,using different water quality parameters and different methods. Beyond the parameters elected for water quality assessment, the methods used to assess overall water quality may also affect the outcome of the assessment. In regard to this, several researchers have listed a number of problems related to the application of water quality assessment methods. Kanga et al. (2019)[12] report that some water quality index methods may either overestimate the deterioration of water quality or underestimate the best water quality due to the forms of aggregation of water quality parameter values. The purpose of this study is to assess the quality of water resources in the Sebou basin,usingthe water quality parameters proposedby the Sebou hydraulic Basinagency (ABHS) and to propose a new water quality index to avoid underestimation or overestimation of water quality using Moroccan water quality standards.

II. METHODS

2.1. Study Area

The study area is located in the large Sebou catchment area and extends over two aquifers: the Fez-Meknes aquifer and the aquifer of the Barren limestone plateau. It covers an area of 5,849 Km2 and spans over7 provinces and 64 municipalities. The economy of the area is mainly based on agriculture and industry. Water resources are used for drinking water supplies and for irrigating crops. The study area is composed of agricultural lands in the northern part of the area. A large part is covered by forested lands in the extreme south of the area. There are approximately 208,860 farms in the study Area, operating overmore than 2 million hectares of agricultural lands. The use rate of agri-inputs is very high and averaged 66.5% of farms in 1996. There are 51 potential sources of pollution in the study area, namely 9 quarries, 18 landfills, 8 industries, 13 liquid discharges and 3 industrial areas. Much of the study area laysonclayey soil texture, especially in the northwest, north and northeast parts. The eastern and central parts are made up of sand-clayey textures. The western part of the study area consists of sand-clay textured soils. The western part of the study area consists of sand-silt textured soils and rock outcrop. The deep aquifer of Fez-Meknes includes dolomitic limestone formations of the Lias, which are highly fractured. The thickness of this aquifer varies from a few meters inthe center to 760 m north of the study area. However, the water level is 50 m deep on average in the captive part of the aquifer and 250 m deep in the non-captive part. The aquifer of the Barren limestone plateauis juxtaposed with the Fes-Meknes water tableand consists of the calcareous-basaltic aquifer of Lias and the basaltic aquifer of the Quaternary. Groundwater rechargeof is provided by the infiltration of rainfall. Wells and boreholes are the means of exploiting groundwater in this area. Annual precipitation in the study area is highly variable and mean annual rainfall between 1988 and 2017 ranged from479 mm in the north and northeast to 800 mm in the south. The inventory of water bodies in the study area shows some natural riversand lakes: Fez river, Guigou river (flow rate: 0 to 54 m3/s), Boufekrane river, Tizguit river, Agay river, and Aoua, Ifrah and hachlaf lakes.

2.2. Data sources

Data on water quality, over 30 years were collected at the Sebou Hydraulic Basin Agency and the Secretariat of State for Water (SEE), two water resources management bodies in Morocco. These data includes29 water quality-monitoring stations that were sampled twice a year from 1988 to 2017. Figure1 shows the localization of water quality station and surrounding cities in the study area. Some stations are older than others are, so the data may show discontinuities in the recording. The 29 stations are composed of 3 surface water-monitoring stations and 26 groundwater stations.

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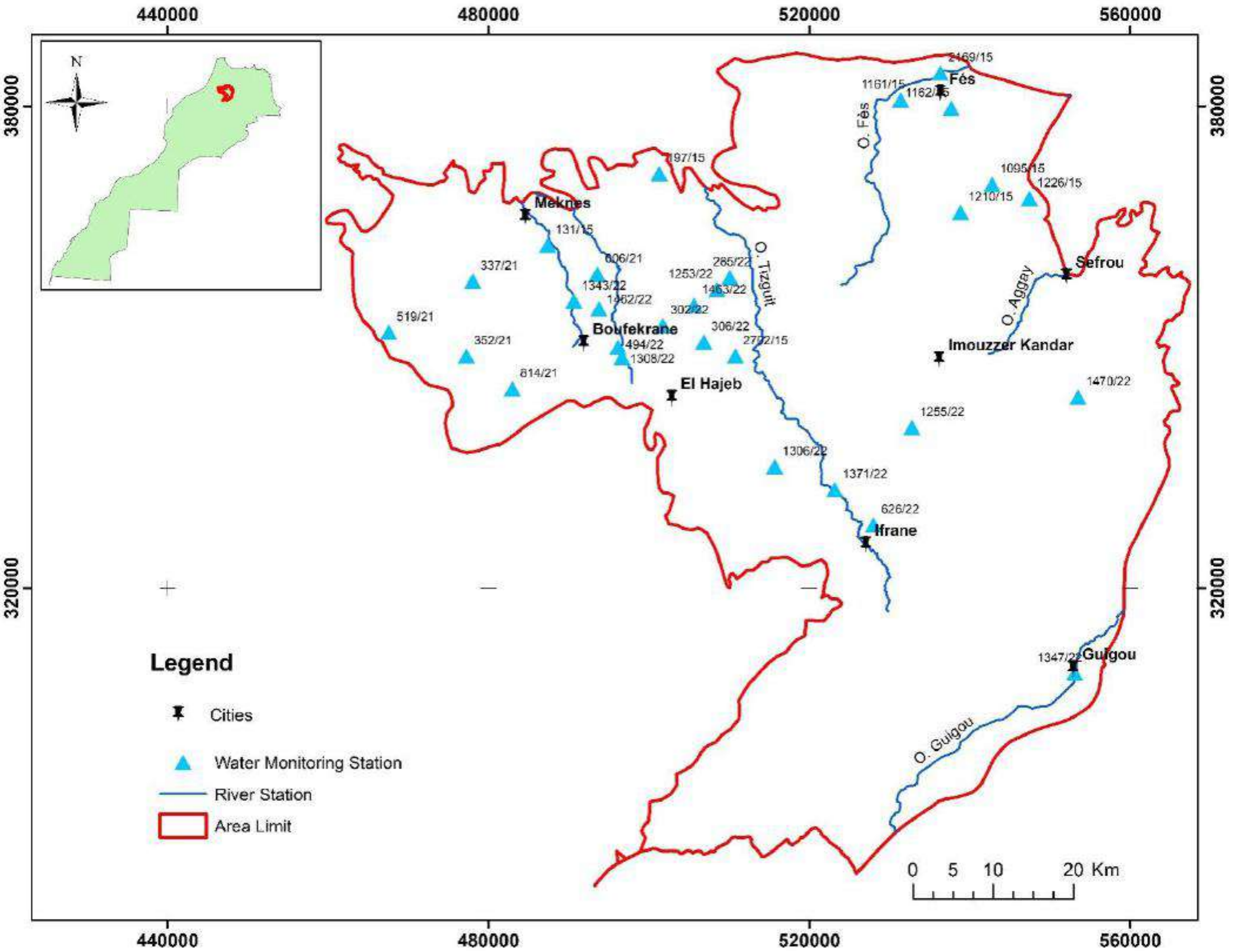

Fig.1: Localization of monitoring water quality stations in study area

A land cover map has been developed to understand the environmental characteristic and the surrounding area of water sources that can influence the water quality. The Secretariat of State for water provided the inventory of potential point sources of pollution. Land use map was established using supervised classification of a Sentinel A2 image with high resolution (10 m X 10 m), dated December 10, 2018.The sentinel 2 image is multispectral imager that provides images featuring 13 spectral bands with high resolution vary from 10 m to 60 m depending on the band using. A Kappa index (K) [4] of 0.68 (meaning strong agreement)was achieved using the XLSTAT statistical tool. The map was validated by creating randomized points on Google Earth, which were imported into the ArcGIS environment to find the classes.

2.3. Calculation of WQI

The ABHS uses a water quality assessment method (Act 10-95 of 16 August 1995, Act 36-15 of 6 October 2016 and Decree 1275-02 of 17 October 2002). This method consists of subdividing water quality into 5 different classes (Excellent, Good, Average, Poor, and Very Poor). According to the standards set out in Order 1275-02, the samples of the various water quality parameters, i.e. the measured values, are classified into their corresponding classes. The overall class at a station tends to be the most deteriorated class in terms of quality. Several water quality parameters are measured in a water sample; however, ABHS uses 6 parameters for both groundwater and surface water quality assessment. These parameters are, for surface water: dissolved oxygen (O_2), biochemical oxygen demand for 5 days (BOD_5), chemical oxygen demand (COD), ammonium (NH_4^+), total phosphorus (P) and fecal coliforms (CF). For groundwater, these parameters are considered: Electrical conductivity (EC), Chloride (Cl), Nitrate (NO_3^-), Ammonium (NH_4^+) and Fecal Coliforms (CF). Yet, ABHS method has some disadvantages when it comes to determining water quality over a given period because of the appreciative nature of the overall water quality. In other words, the overall water quality is in the form of qualitative classes, which makes

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any addition or multiplication operation difficult. For this reason, themethod we are proposingto assess water quality uses the same water quality standards to normalize the values of the various water quality parameters. Two main steps characterize the new method: normalization of water quality parameter values into sub-indexes and aggregation of sub-indexes into water quality index (WQI).

2.3.1. Normalization of water quality parameters

The normalization is the transformation of variables that are in different units and dimensions into a common scale [1, 8, 22]. Water quality parameters are not measuredinthe same unit. For example, the unit of $BOD_5$is expressed in milligrams per liter (mg/l), fecal coliforms in number per 100 ml of water, electrical conductivity in micro or milli Siemens per cm (µS/cm or mS/cm). This difference in units results in the failure to aggregate parameter values without normalizing them. In addition, often the variables do not have the same effect on water quality. While other variables are proportional to water quality, others are inversely proportional to water quality [22]. In other words, variables such as dissolved oxygen,variesin the same direction as water quality, the higher the value, the better the water quality.Unlikely, fecal coliforms have the opposite effect, the higher the value, theworsen the water quality. It is therefore mandatory to standardize these values so that the final water index couldrepresent all the parameters chosen with the relative contribution of the strength of each parameter. According to Abbassi and Abbassi,(2012)[1], there are 4 ways to normalize the values of the quality parameters into sub-indices: linear function sub-indices, segmented linear function sub-indices, non-linear function and segmented non-linear function. The normalization of parameter values into sub-indices was implemented basedon Moroccan water quality standards (decree 1275-02) and segmented linear functions. The general equation for normalizing a parameter [1] is described as follows:

$I_i = (x - a_i)\left(\frac{b_{i+1} - b_i}{a_{i+1} - a_i}\right) + b_i,\ a_i \leq x \leq a_{i+1}$ and$b_i \leq ClasseI \leq b_{i+1}$. (1)

With I_i, the sub-index of the ith parameter, $a_i$the measured value of the ith parameter, b_i the ith corresponding a class according to the simplified grid of the decree 1275-02 in this context. Five (5) classes are determinedto classify water quality in Morocco: Excellent, good, medium, bad, very bad. For each value of a water quality parameter, the sub-index transformation is performed using the linear equation above and has a value between 0 (Very Poor) and 100 (Excellent). Table 1 shows the distribution of classes with numerical values as follows:

Table 1: Classification of water resources based on the proposed WQI

Numerical Value	Description of the Class	Color Code
90-100	Excellent	
63-90	Good	
50-63	Medium	
38-50	Bad	
0-38	Very Bad	

For example, BOD5 measurements that are strictly less than 3 mg/l are considered "Excellent" in terms of water quality description and correspond to the range of numerical values {90 to 100}. To normalize this class, simply do:

$\begin{cases} 0 \leq x \leq 3\ mg/l \\ 100 \geq I_{DBO_5} \geq 90 \end{cases} I_{DBO_5} = (x - 0)\left(\frac{90-100}{3-0}\right) + 100$;

$I_{BOD_5} = -3.33x + 100$, (2)

$\forall\ x, 0 \leq x \leq 3$

Table 2 displays the sub-indices of the water quality parameters. For each class, a linear equation was developed to quantitatively estimate water quality instead of a qualitative description.

Table 2: Normalization equations of water quality parameters

Dissolve Oxygen (DO) (mg/l)	Biochemical Oxygen Demand for 5 days DBO_5 (mg/l)	Chemical Oxygen Demand (DCO) (mg/l)
$I_{OD} = 11.366x\forall, 0 < x \leq 8.8$ (3) $I_{OD} = 100, six > 8.8$ (4)	$I_{BOD_5} = -3.33x + 100\forall\ x, 0 \leq x \leq 3$ (5) $I_{BOD_5} = -13.5x + 130.5\forall\ x, 3 < x \leq 5$ (6) $I_{BOD_5} = -1.85x + 72.28\forall\ x, 5 < x \leq 10$ (7) $I_{BOD_5} = -0.8x + 58\forall\ x, 10 < x \leq 25$ (8) $I_{BOD_5} = 0, \forall\ x > 25$ (9)	$I_{COD} = -0.5x + 100$ $\forall x, 0 < x \leq 20$, (10) $I_{COD} = -5.4x + 198\forall\ x, 20 < x \leq 25$, (11) $I_{COD} = -0.86x + 84.66\forall\ x, 25 < x \leq 40$, (12) $I_{COD} = -0.3x + 62\forall\ x, 40 < x \leq 80$(13) $I_{COD} = 0, \forall x \geq 80$ (14)
Ammonium ($NH^+{}_4$) (mg/l)	Total Phosphorus TP (mg/l)	Fecal Coliforms (CF) (number/100 ml)

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$I_{NH_4^+} = -100x + 100\ \forall x, 0 \leq x < 0.1$ (15) $I_{NH_4^+} = -67.5x + 96.75\ \forall x, 0.1 \leq x \leq 0.5$ (16) $I_{NH_4^+} = -8.67x + 67.33 \forall x, 0.5 \leq x \leq 2$(17) $I_{NH_4^+} = -2x + 54 \forall x, 2 \leq x \leq 8$(18) $I_{NH_4^+} = 0, \forall\ x > 8$(19)	$I_{TP} = 100 - 100x \forall x, 0 \leq x < 0.1$ (20) $I_{TP} = -135x + 103.5 \forall\ 0.1 \leq x \leq 0.3$ (21) $I_{TP} = -65x + 82.5 \forall\ 0.3 \leq x \leq 0.5$ (22) $I_{TP} = -4.8x + 52.4 \forall\ 0.5 \leq x \leq 3$ (23) $I_{TP} = 0, \forall\ x > 3$(24)	$I_{FC} = -0.5x + 1000 \leq x < 20$ (25) $I_{FC} = -0.005x + 90.120 \leq x \leq 2000$(26) $I_{FC} = -0.0007x + 64.442000 \leq x \leq 20000$(27) $I_{FC} = 0, \forall\ x > 20000$ (28)
Nitrate (NO^-_3) (mg/l)	Chloride (Cl) (mg/l)	Electrical conductivity (CE)(µS/cm)
$I_{NO_3^-} = -x + 100\ \forall\ 0 \leq x < 10$(29) $I_{NO_3^-} = -1.8x + 108\ \forall\ 10 \leq x \leq 25$(30) $I_{NO_3^-} = -0.52x + 76\ \forall\ 25 \leq x \leq 50$(31) $I_{NO_3^-} = 0, \forall\ x > 50$(32)	$I_{Cl} = -0.05x + 1000 \leq x \leq 200$ (33) $I_{Cl} = -0.27x + 144200 < x \leq 300$ (34) $I_{Cl} = -0.028x + 71.67300 < x \leq 750$ (35) $I_{Cl} = -0.48x + 86750 < x \leq 1000$ (36) $I_{Cl} = 0, \forall x \geq 1000$(37)	$I_{CE} = -0.013x + 1000 \leq x < 750$ (38) $I_{CE} = -0.049x + 126.81750 \leq x < 1300$ (39) $I_{CE} = -0.0093x + 75.071300 \leq x < 2700$ (40) $I_{CE} = -0.04x + 1582700 \leq x < 3000$ (41) $I_{CE} = 0, \forall x \geq 1000$(42)

2.3.2. Aggregation

The normalized sub-indices are aggregated to form a composite water quality index. Researchers use several types of methods for aggregating sub-indices. Kanga et al.(2019) [12] report 6 aggregation methods: the arithmetic mean, geometric mean, square root function, logarithmic function, fuzzy inference function, and minimum or maximum operator. The methods for aggregating the sub-indices are diverse: additive methods (linear sum-index, weighted linear sum-index, sum index at root power), multiplicative methods (weighted product), logic methods (maximum operator, minimum operator) [1]. To avoid problems encountered in other indices related to the aggregation of sub-indexes such as eclipsing, ambiguity, compensation and rigidity [12], the multiplicative form especially the product to power has been adopted. The following equation is the form used to aggregate the different values of the water quality parameters.

$$WQI = \prod_{i=1}^{n} (I_i)^{\frac{1}{n}} (43)$$

Where I_i, represents the sub-index of the i^{th} parameter, and n, the number of parameters, WQI, the overall water quality index.

To apply the WQI aggregation formulae on data, a Microsoft excel spreadsheet is used. In addition, the statistical analyses (correlation matrices, regression equation, graph plotting and curve fitting, etc.) were conducted under a Microsoft Excel.

III. RESULT AND DISCUSSION

In this study, water quality was assessed for human consumption purposes. In accordance with the legislative framework for water management governed by the country water management agencies, this WQI has been developed for human consumption purposes. Data from 29 water quality-monitoring stations (surface and groundwater) showed variations in water quality as a result of land use. For each station, this developed WQI was applied using the above steps. Each water quality parameter was transformed into a sub-index with values between 0 (very bad) and 100 (Excellent). Once the parameters normalized, a water quality index was calculated for each sampling. In addition, the average values of the parameter sub-indexes were calculated as well as the average values of the overall water quality for each station, based on multiple years of water quality analyses. Table 3 shows the 31-year average quality status for the 29 water quality monitoring stations within the study area. Fig.2 displaysthe spatial distributionof water quality interpretation of the 29 monitoring stations.

Table 3: Water quality status of the 29 stations

Water Resources	Station ID	WQI	Interpretation
Surface Water stations	1343/22	63.79	Good
	2169/15	52.86	Medium
	1371/22	80.08	Good
	197/15	41.17	Bad
	1210/15	48.93	Bad

Groundwater stations	1095/15	80.99	Good
	131/15	30.51	Very Bad
	1161/15	55.60	Medium
	1162/15	69.41	Good
	1226/15	49.04	Bad
	2702/15	20.12	Very Bad
	352/21	58.16	Medium
	519/21	77.95	Good
	814/21	38.88	Bad
	337/21	27.53	Very Bad
	606/21	81.17	Good
	285/22	8.21	Very Bad
	1253/22	66.35	Good
	302/22	26.28	Very Bad
	1462/22	68.13	Good
	1463/22	67.14	Good
	306/22	28.67	Very Bad
	1308/22	73.55	Good
	494/22	62.81	Medium
	1306/22	49.77	Bad
	626/22	95.93	Excellent
	1347/22	70.93	Good
	1470/22	79.54	Good
	1255/22	94.20	Excellent

Table 4 shows the ratios of different water quality classes according to their locations. The figure 2 displays the land cover and surrounding of the water monitoring sites. The stations are located mainly in forester area, urban area and agricultural land.

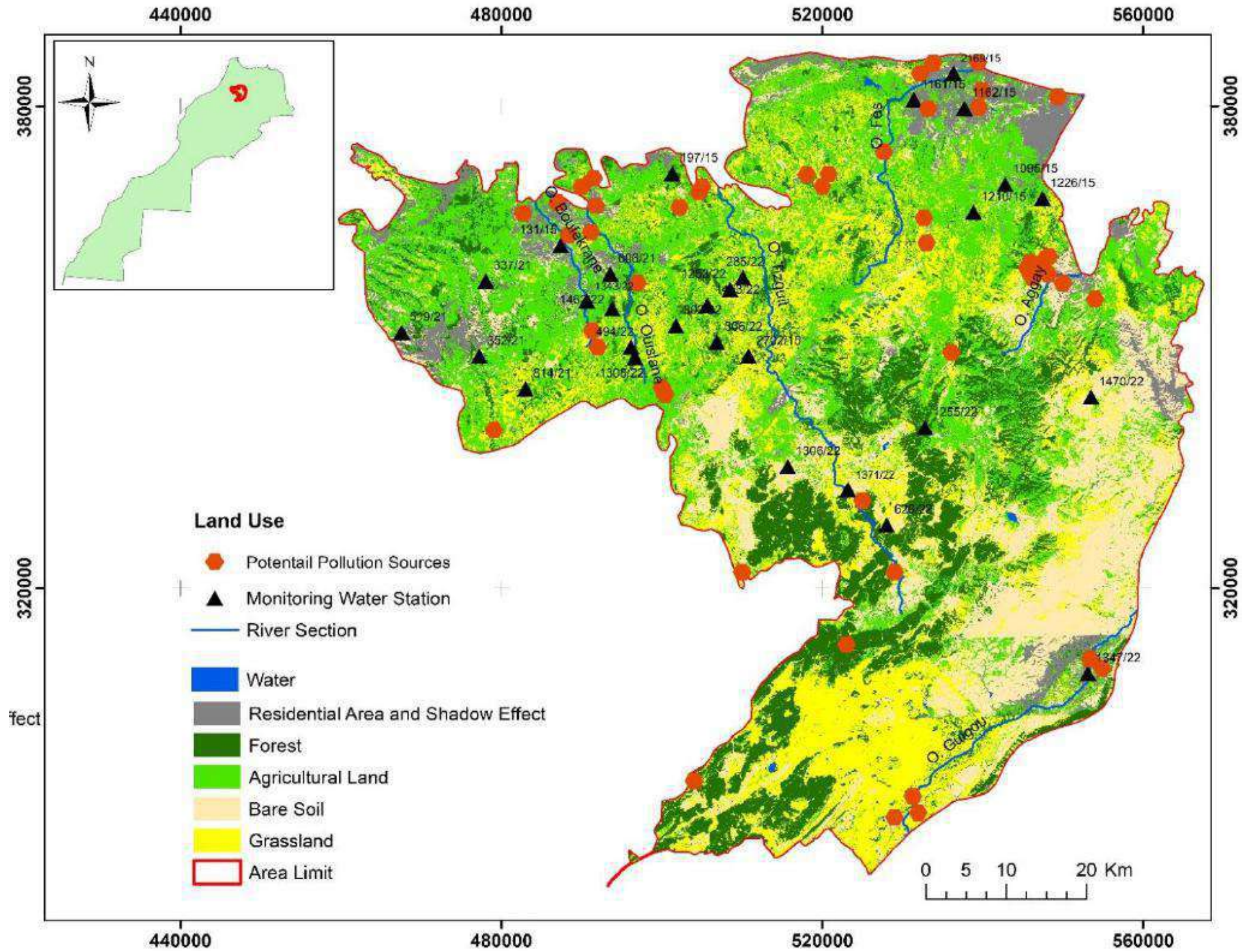

Fig.2: Land use classes, monitoring water quality stations and potential sources of pollution in study area

Table 4: Water quality status as a function of land use

	Forested land	**Agricultural land**	**Urban Area**	**Total**
Monitoring sites	3/29 (10.34 %)	23/29 (79.32%)	3/29(10.34 %)	100 %
Excellent	2/29 (6.90 %)	0 (0 %)	0 (0 %)	6.90 %
Good	1/29 (3.45 %)	10/29 (34.48 %)	1/29 (3.45 %)	41.38 %
Medium	0 (0 %)	2/29 (6.90 %)	2/29 (6.90 %)	13.79%
Bad	0 (0 %)	6/29 (20.69 %)	0 (0 %)	20.69 %
Very Bad	0 (0 %)	5/29 (17.24 %)	0 (0 %)	17.24 %

The water quality of the stations in the forested areas varied from good to excellent. Out of the 3 stations in the forested area, 2 have excellent qualities. Forests have a positive effect on water quality because of their purification ability [24]. Frequent deforestation in Brazil on the river banks has deteriorated the quality of the Murucupi and Parà rivers [17]. The majority of monitoring stations are located in agricultural areas (79.3%). In addition, 47.8% of the water quality of these stations in the agricultural zone has qualities ranging from bad to very bad; moreover, 8.7% have medium qualities. Only 43.5% of these stations have good water quality. Due to the abusive application of fertilizers in the study area, agriculture stands up as the main sources of water pollution due to nitrate and phosphorus leaching [5, 19]. Water quality in urban areas varies from medium to good. Of the 3 stations located in urban areas, 2 exhibit medium qualities. Landfills and domestic wastewater discharges constitute the causes of water quality degradation [18, 6] due to large quantities of leachate and ETMs contained in wastewater [2, 14].

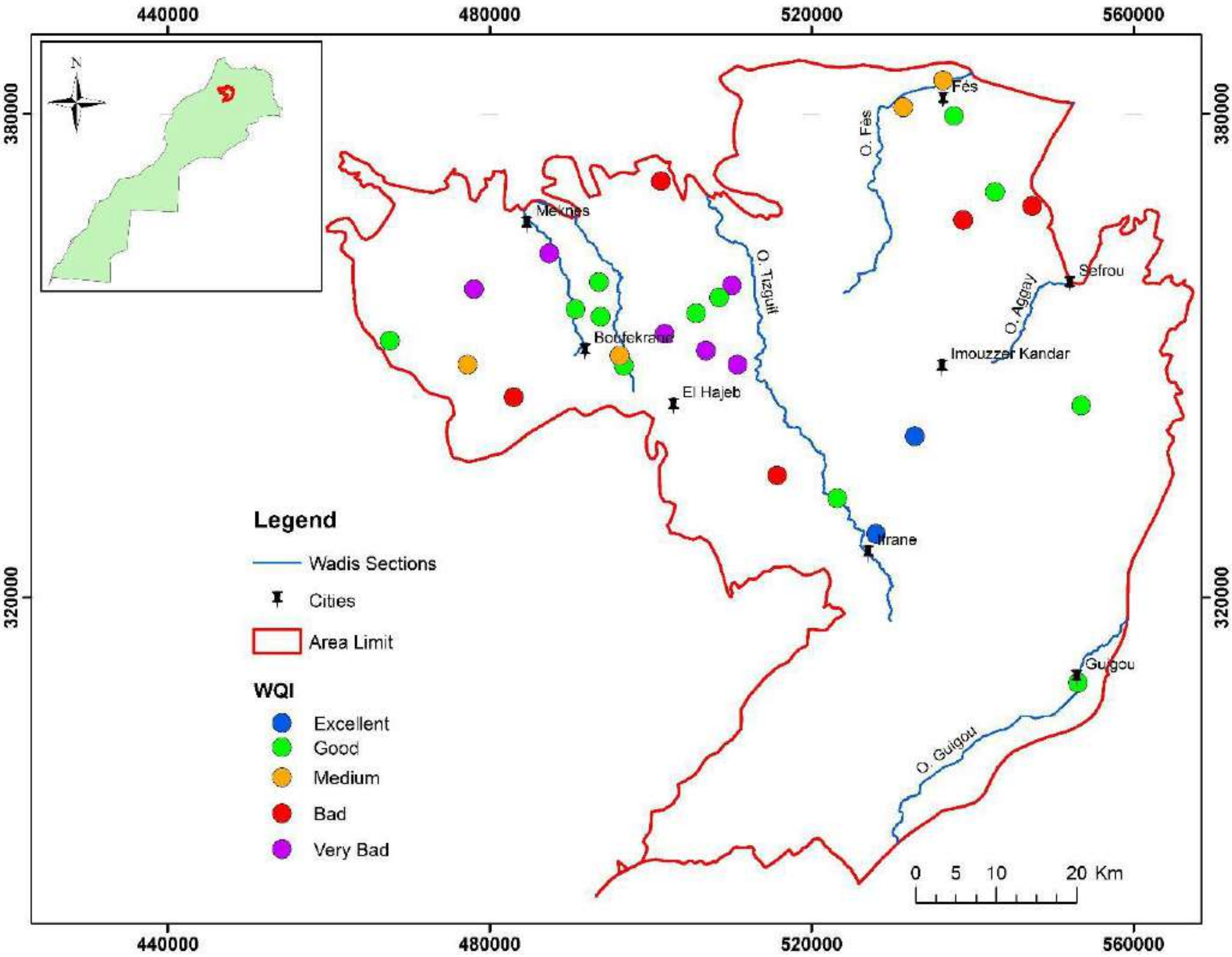

Fig. 3: Mapping of water quality status of 29 stations in the study area

3.1. Surface water monitoring stations

3.1.1. Station 1343/22 (Boufekrane River)

The different values of water quality parameters transformed into the corresponding sub-indices were aggregated into a final water quality index (fig. 4).Results at this station show a resemblance in the variation of the curves of WQIand fecal coli form sub-index. Over time when the water wasof poor quality, the fecal coli form sub-index dropped to zero, indicating that its value exceeded the acceptability limit. In addition to fecal coli form, total phosphorus sub-indexhas varied following the same pattern as the final water quality index. The correlation matrix between these parameters and the final water quality index shows a high correlation (r=0.84 at 95% confidence level) between the total coliform sub-index and WQI. The poor water quality at this station, lobserved in summer samples, is mainly due to the high quantity of fecal coliform. In contrary water is of good quality during winter of the same year. This station is located upstream Boufekrane Riverat about 5 kilometers north of the cityof Meknes. The proximity to the town of Boufekrane to the river streamisat the root of these high levels of fecal coliforms. El Ouali et al. (2011)[5] observed moderate to significant bacterial contamination in this area, particularly due to fecal coliforms of human and animal origin. Norat-Ramírezet al. (2019)[19] showed ina study conducted, in a Southern California watershed, that the concentration of bacteria in runoff water increases as a function of land use. In this sense: they affirm that a horse barn emits more bacteria than an agricultural area with animal fertilizer, and that the latter emits more than an urban area and more than a green space.

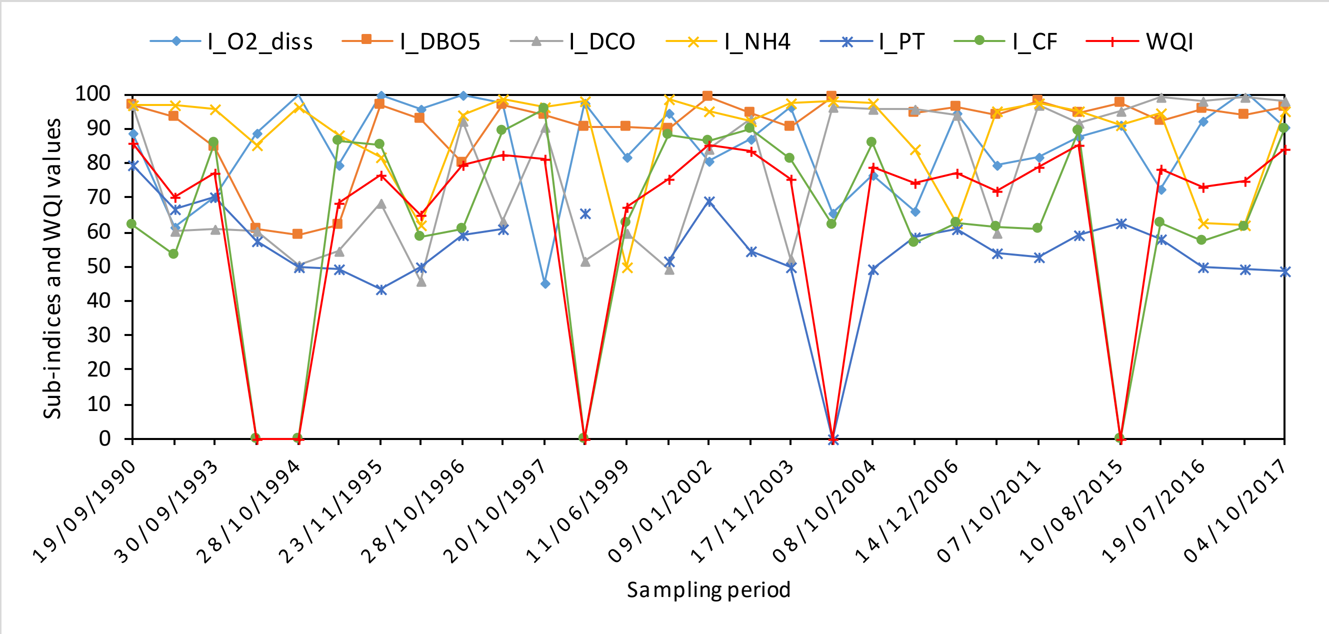

Fig. 4: Variation of water quality in station 1343/22 during the period 1990-2017.

I_O2: Dissolved oxygen sub-index; I_BOD5: bub-index pf biochemical oxygen demand for 5 days, I_COD: chemical oxygen demand sub-index; I_NH4: ammonium sub-index, I_TP: total phosphorus sub-index; I_CF: fecal coliforms sub-index; I_EC: Electrical conductivity sub-index; I_CL: Chloride sub-index; I_NO3: Nitrate sub-index.

Table 5: Correlation matrix of water quality parametersat station 1343/22

	I_O2_diss	I_DBO5	I_DCO	I_NH4	I_PT	I_CF	WQI
I_O2_diss	1						
I_DBO5	-0.14	1.00					
I_DCO	-0.21	0.48	1.00				
I_NH4	-0.25	-0.06	-0.02	1.00			
I_PT	0.11	-0.02	-0.08	0.07	1.00		
I_CF	-0.25	0.39	0.18	0.08	-0.09	1.00	
WQI	-0.11	0.41	0.25	-0.08	0.31	0.84	1

3.1.2. Station 2169/15 (Fès River)

Located downstream and north ofthe city ofFez, this stationis placedon Fez River. Figure 5 presentsthe variation ofwater quality atthis station. The analysis of results shows low values for sub-indexes of dissolved oxygen, total phosphorus, ammonium, and biological and chemical oxygen demand. Over time, the variation in water quality is chiefly explained by the levels of quality parameters. The correlation matrix of water quality parameter sub-indexes and the final quality index shows a high correlation between BOD_5sub-indexes and WQI(r=0.85), COD and WQI(r=0.71),NH_4^+ and WQI(r=0.59), PT and WQI(r=0.53). The evolution of these sub-indexes shows the same trend, especially when thefinalwater quality index was of poor water quality. In addition to being within the urban area of Fèz, this station is also bordered by farms. The high correlation between BOD_5 and COD sub-indices and WQI revealssignalsof organic pollution from industrial and domestic wastewater discharges. Dissolved oxygen sub-index has shown low values, especially in summer when temperatures are high. The dissolved oxygen content in water decreases when temperatures are high [5, 11]. Poor water quality isobserved during summer sampling periods [16, 10, 21, 23].

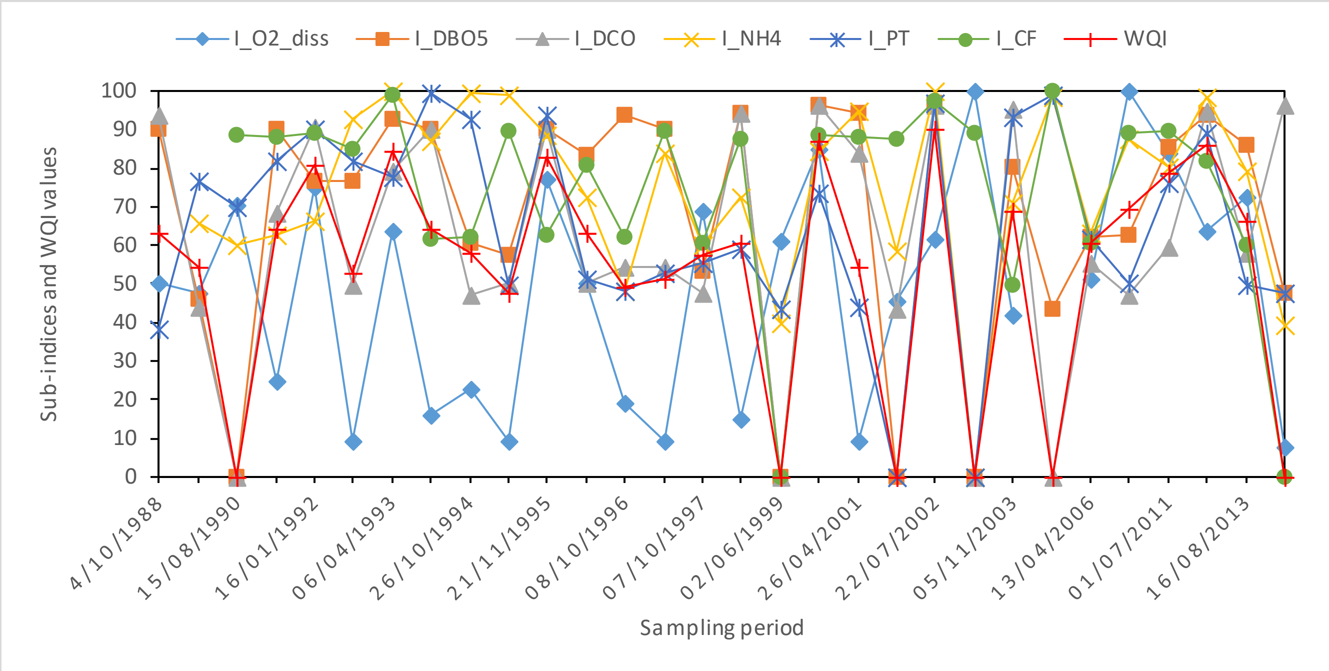

Fig. 5: Variation of water quality in station 2169/15 during the period 1988-2016

Table 6: Correlation matrix of water quality parameters at station 2169/15

	I_O2_diss	I_DBO5	I_DCO	I_NH4	I_PT	I_CF	WQI
I_O2_diss	1.00						
I_DBO5	-0.22	1.00					
I_DCO	-0.22	0.78	1.00				
I_NH4	-0.19	0.60	0.39	1.00			
I_PT	-0.06	0.49	0.34	0.62	1.00		
I_CF	0.17	0.25	0.00	0.43	0.11	1.00	
WQI	0.15	0.85	0.71	0.59	0.53	0.32	1.00

3.1.3. Station 1371/22 (Tizguit river)

Located in the mountains of the middle Atlas at 10 Km northwest of the town of Ifrane, analysis of the results at this station has generally shown good water quality over time. From 1990 to 2016, the water quality index value dropped to zero only twice in the winter of 2004 due to high levels of total phosphorus and BOD_5, and in the summer of 2016 due to high levels of fecal coliform. Overall, water quality is good at this station. The correlation matrix shows a very high correlation between the values of the PT and WQI sub-indexes (r=0.85), this is due in the fact that the sub-index of PT exceeded the permissible level on October 2004. The correlation is high between the CF and WQI (r=0.71) because the sub-index of CF exceeded the permissible level on Jun 2016. The correlation is also high between the BOD_5 and WQI (r=0.65) because the sub-index of BOD_5 exceeded the permissible level in October 2004. And the sub-index of the dissolved oxygen and WQI (r=0.68) showed a high correlation. That said, the different variations in water quality at this station are explained by the contents of these different water quality parameters. Fig.6 shows the water quality variation in this station.

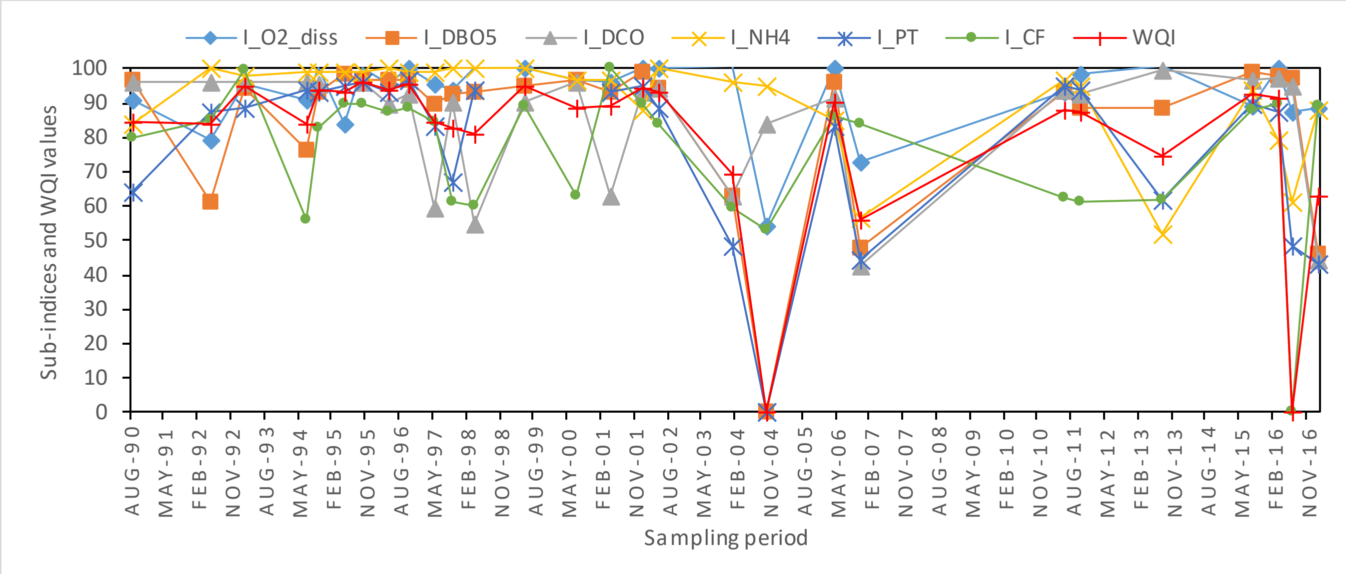

Fig. 6: Variation of water quality in station 1371/22 during the period 1988-2016

Table 6: Correlation matrix of water quality parameters at station 1371/22

	I_O2_diss	I_DBO5	I_DCO	I_NH4	I_PT	I_CF	WQI
I_O2_diss	1.00						
I_DBO5	0.80	1.00					
I_DCO	0.21	0.44	1.00				
I_NH4	0.16	0.11	0.09	1.00			
I_PT	0.68	0.80	0.35	0.44	1.00		
I_CF	0.20	0.16	-0.11	0.34	0.43	1.00	
WQI	0.68	0.65	0.22	0.46	0.85	0.71	1.00

3.1.4. The average values at the 3 stations: surface water

The average for the data for each sub-index was performed for each station to estimate the average water quality over the 30 years (1988-2017). Water quality varies from medium to good for the 3 stations. The fig.7 shows the average values of the WQI and the values of sub-indices for the stations. The station of the Fez river (2169/22) has water of medium quality but must be monitored by the water management authorities since this water is close to poor quality (WQI = 52.83 while the interval for poor quality water is {50 -38}). Perrin et al. [20] have already observed severe pollution at some measurement points in the Fez River, particularly high levels of total nitrate, total phosphorus, and chromium due to the influence of domestic and industrial wastewater discharges. Koukal et al. (2004)[14] report that the poor quality of Sebou river is mainly due to the low dissolved oxygen content in water and high turbidity, ammonium, organic matter, and severe chromium and copper pollution from industrial plants and urban public and domestic landfills. The station on Boufekrane river (1343/22) has approximately good quality water (WQI = 63.79) while the range for medium water quality is {63 - 50}). Finally, the station located on Tizguit river (1371/22) presents good quality water with a WQI = 80.08 close to excellent ({90 -100}). The application of the ABHS method showed medium water quality for the station (1343/22), poor quality for the Fez river station (2169/22) and good quality for the Tizguit river station (1371/22). This difference at the two stations is that the ABHS method consists in averaging the values for all samples over a period and classifying the parameters into different classes based on the simplified Moroccan standards grid. Then the final water quality index tends towards the worst class. As a result, if only one measure has absurd data, the final water quality index would be affected. This was the case for the Fez river station where the sample for the summer of 2016 showed a value of 2 million/100 ml for fecal coliforms.This was the same for the Boufekraneriver station where some parameters showed absurd data that affected the averages for the 31 years. The analysis of the mean value correlation matrix showed strong correlations between the dissolved oxygen sub-indexes (r=0.89), the ammonium sub-index (r=0.89), and the COD (r=0.94) with the final WQI. This means that variations in water quality at these different stations are explained by variations in the concentrations of these parameters. Koukal et al. (2004) [14], Perrin et al. (2014) [20], El Ouali et al. (2011)[5] have identified these parameters as the main pollutants in the Sebou basin.

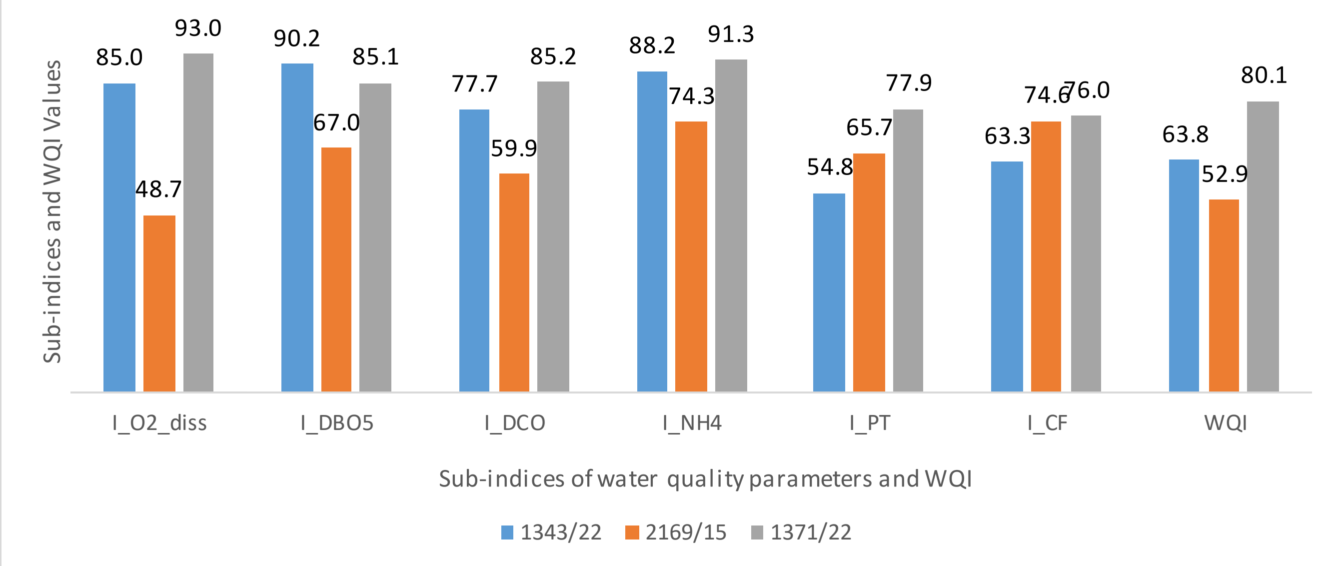

Fig. 7: Variation of water quality inthe 3stationsof surface water during the period 1988-2017

Table 7: Correlation matrix of water quality parameters at the 3stations of surface water

	I_O2_diss	I_DBO5	I_DCO	I_NH4	I_PT	I_CF	WQI
I_O2_diss	1.00						
I_DBO5	0.93	1.00					
I_DCO	0.99	0.88	1.00				
I_NH4	1.00	0.93	0.99	1.00			
I_PT	0.20	-0.17	0.32	0.20	1.00		
I_CF	-0.25	-0.59	-0.13	-0.25	0.90	1.00	
WQI	0.89	0.66	0.94	0.89	0.62	0.21	1.00

3.2. Groundwater stations

The average for the data for each sub-index was performed for each station of the 26 stations to estimate the average water quality over the 31 years (1988-2017). A ratio of 42.3% of the stations have very poor to poor water quality and all are located in agricultural areas. The inventory of point sources (fig. 2) of pollution shows that these stations are also close to potential sources of pollution such as liquid discharges, industrial waste, public landfills, and industrial areas. Only 38.46% of the stations show good water quality, 7.69% excellent quality and 11.53% have medium quality. The establishment of the correlation matrix for the 26 stations (Table 8) between the sub-indices of the various parameters and the final water quality index showed a very high correlation between the nitrate sub-index and the final WQI for all stations where water quality varies from very poor to poor. The correlation of the nitrate sub-index with the WQI for water stations is r=0.96. Nitrates have agricultural origins, resulting from the application of fertilizers and livestock breeding, reaching groundwater after leaching [5]. The presence of nitrates in groundwater is generally from agricultural, landfill and industrial sources [13]. However, nitrate is not the only cause of the degradation of the quality of these stations. At 5 stations, the sub-index of electrical conductivity with WQI is high: 197/15 (r=0.59), 1210/15 (r=0.56), 1226/15 (r=0.79), 2702/15 (r=0.56), 1306/22 (r=0.62). In addition to electrical conductivity, the chloride sub-index showed a strong correlation with WQI at 2 stations: 1210/15 (r=0.60), 1226/15 (r=0.68). The high content of electrical conductivity shows the presence of salts in groundwater [5]. Salts can be of natural or anthropogenic origin through irrigation in agricultural areas. Three stations

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presented water of average quality. The variation of the chloride sub-index with the WQI showed a high correlation for station 352/21. Chloride can be naturally occurring or present in groundwater through industrial activities, wastewater discharges, and landfills. Since most groundwater, pollution comes from surface water pollution [5]. Fig. 8 and 9 show the variation in the values of the quality parameter sub-indexes and the WQI for the 26 stations. Nitrate curves and WQI have the same variations for stations, including those with good to excellent water quality. The high nitrate content due to agricultural activities explains this variation in the overall water quality.

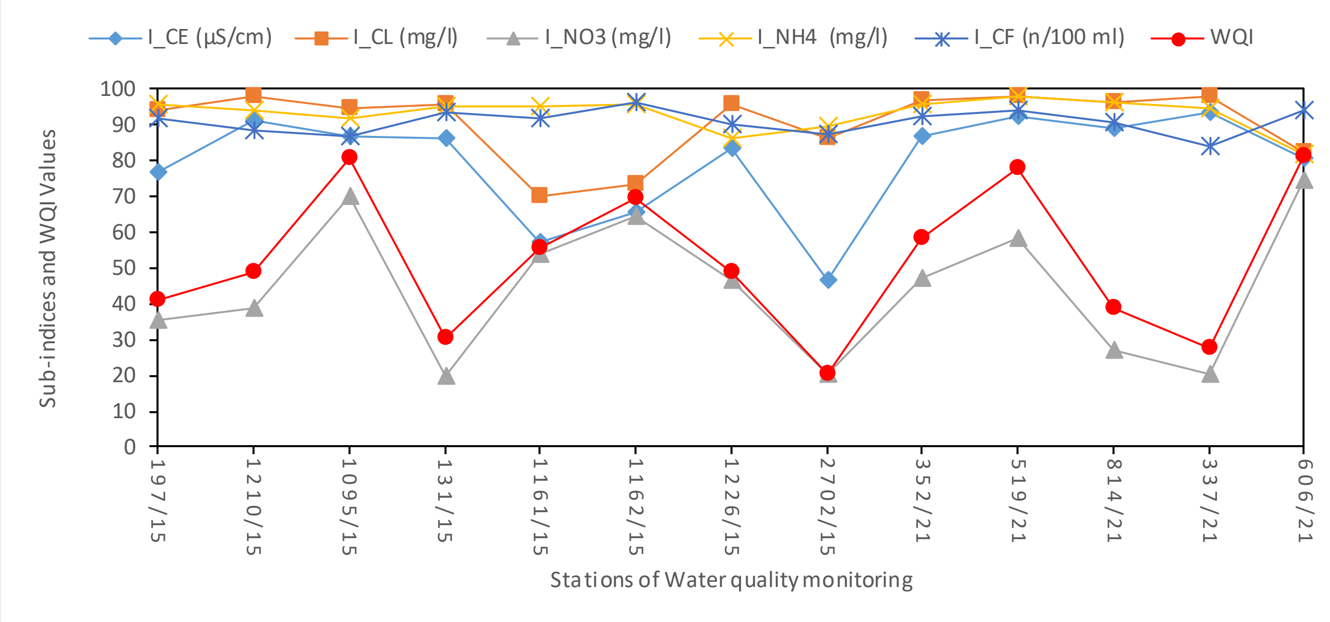

Fig. 8: Variation of water quality in26 stations of groundwater during the period 1988-2017

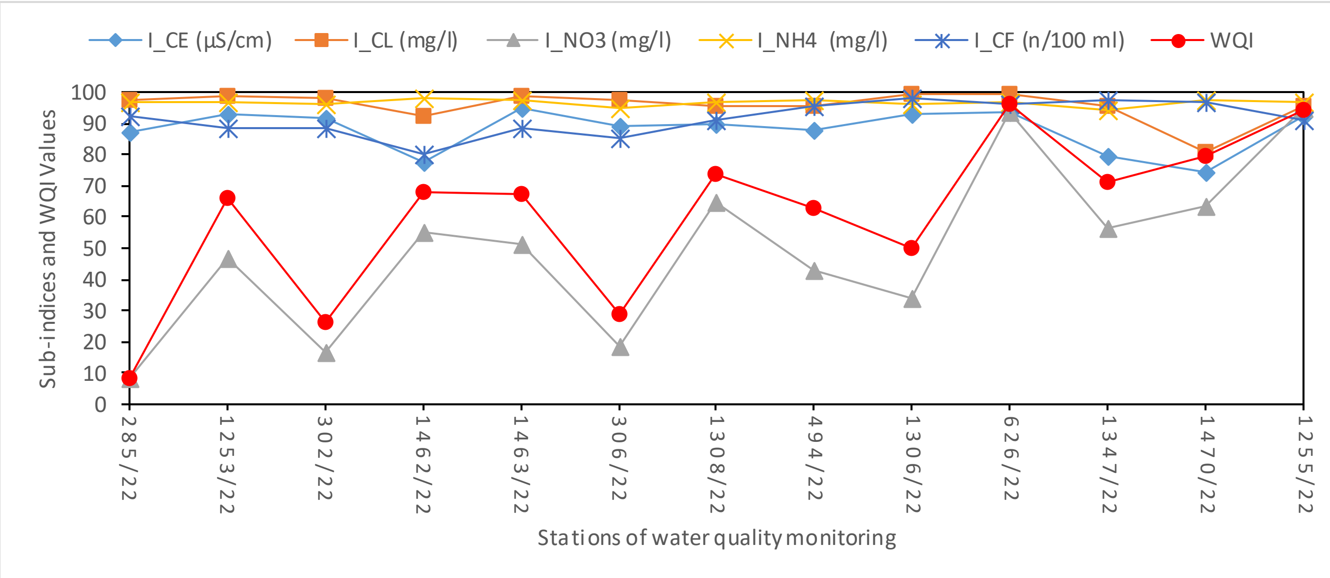

Fig.9: Variation of water quality in26 stations of groundwater during the period 1988-2017

Table 8: Correlation matrix of water quality parameters at the 26 stations of groundwater

	I_CE (µS/cm)	I_CL (mg/l)	I_NO3 (mg/l)	I_NH4 (mg/l)	I_CF (n/100 ml)	WQI
I_CE (µS/cm)	1.00					
I_CL (mg/l)	0.80	1.00				
I_NO3 (mg/l)	0.04	-0.24	1.00			

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I_NH4 (mg/l)	0.28	0.24	-0.05	1.00		
I_CF (n/100 ml)	-0.02	-0.20	0.29	0.06	1.00	
WQI	0.14	-0.15	**0.96**	0.05	0.31	1.00

3.3. Comparison between the ABSH method and the proposed WQI

Fig. 10 shows the comparison of the ABHS method and this proposed WQI for the 26 stations for the 5 water quality classes. Other researchers such as Lermontov et al. (2009)[15], Gharibi et al. (2012)[7] have made comparisons with one of the other methods to validate proposed water quality indices. Mathematically, the ABHS method is expressed as follow: $water\ quality\ index = \min\{class_1, class_2, \ldots, class_i\}$ (44), with min: the most deteriorated class of the ith parameter; class$_i$, the water quality class corresponding to the ith parameter.

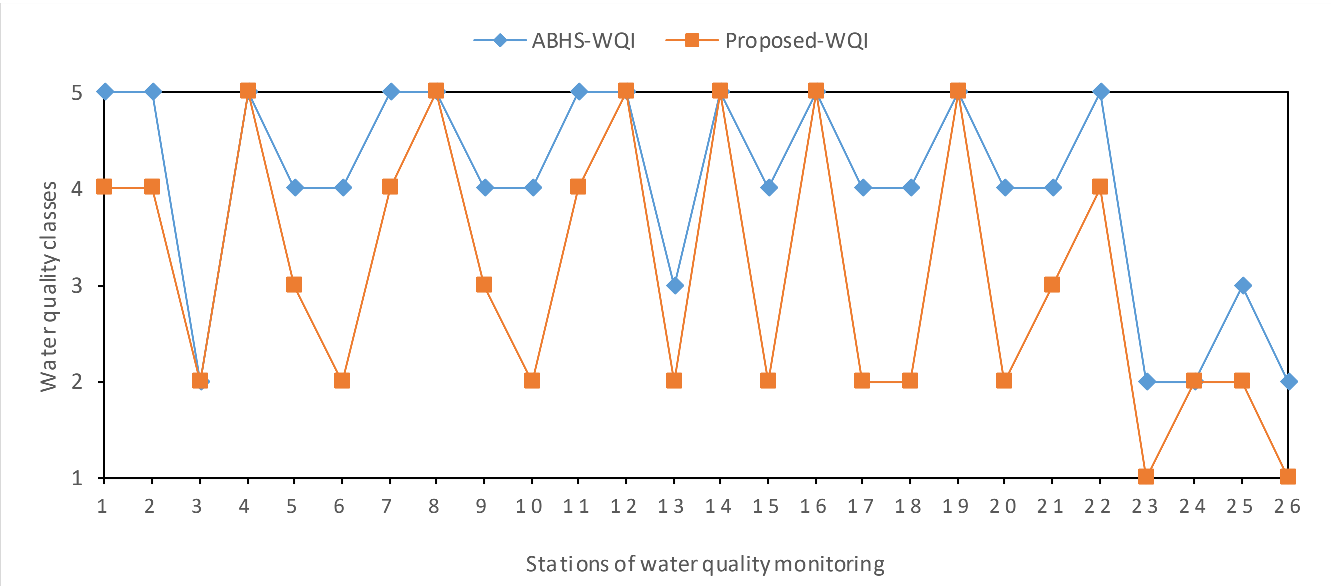

Fig. 10: Comparison of ABHS method and this method proposed for the 26 stations of groundwater. 1: excellent, 2: good, 3: medium, 4: bad and 5: very bad.

Analysis of this curve shows that the ABHS method tends to overestimate the deterioration in water quality. For example, for stations 1 and 2, the proposed method indicates that they are of class 4 quality, which means poor water quality, while the ABSH method indicates that they are of class 5, which means very poor water quality. In addition, this is also the case for station 26, where the proposed method indicates excellent water quality; the ABHS method indicates good water quality. This is because the ABHS WQI always tends towards the most deteriorated class in terms of water quality, i.e. the worst or very bad class, etc. In other words, if all the parameters have shown very good water quality, in the application of the simplified grid standards (Moroccan standards), with the exception of one quality parameter which has shown water of medium quality, the overall water quality is indicated as medium. While the proposed method uses the contribution of all sub-indices, i. e. the normalized values of the various parameters to determine the final water quality index. For stations where both methods indicate the same class, this means that at least one parameter has exceeded the permissible water quality limit, i.e. the limit at which if this parameter is present in water, the water is no longer usable for consumption, for example, this limit is 50 mg/l for nitrate (Moroccan standards and WHO). This proposed method is more flexible than the ABHS method because it does not tend towards the bad or the excellent of the parameter classes that compose it, unlike the ABSH method, which always tends towards the minimum of the classes of the parameters that compose it.Determining water quality for a time series of data may be difficult by applying the ABHS method because of the qualitative nature of the overall water quality. In other words, unless the data are averaged for each water quality parameter, it is impossible to determine a mean class for the quality time series. In addition, if there is only one outlier for a quality

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parameter during any sampling, this will affect the entire assessment, as it would mean averaging over a given period, and therefore affect overall water quality, although for the same station the concentration of a parameter can vary significantly between two sampling points. The proposed method is the contribution of all water quality parameters and has the advantage of presenting the values of the different variables quantitatively before being presented in classes because of the forms of normalization and aggregation of the WQI. Figure 11 shows the regression equation between the ABHS water quality index and the proposed WQI using the same data and water quality parameters. Moreover, it shows that there is a positive correlation between the two methods at r = 0.84 at a 95% confidence level.

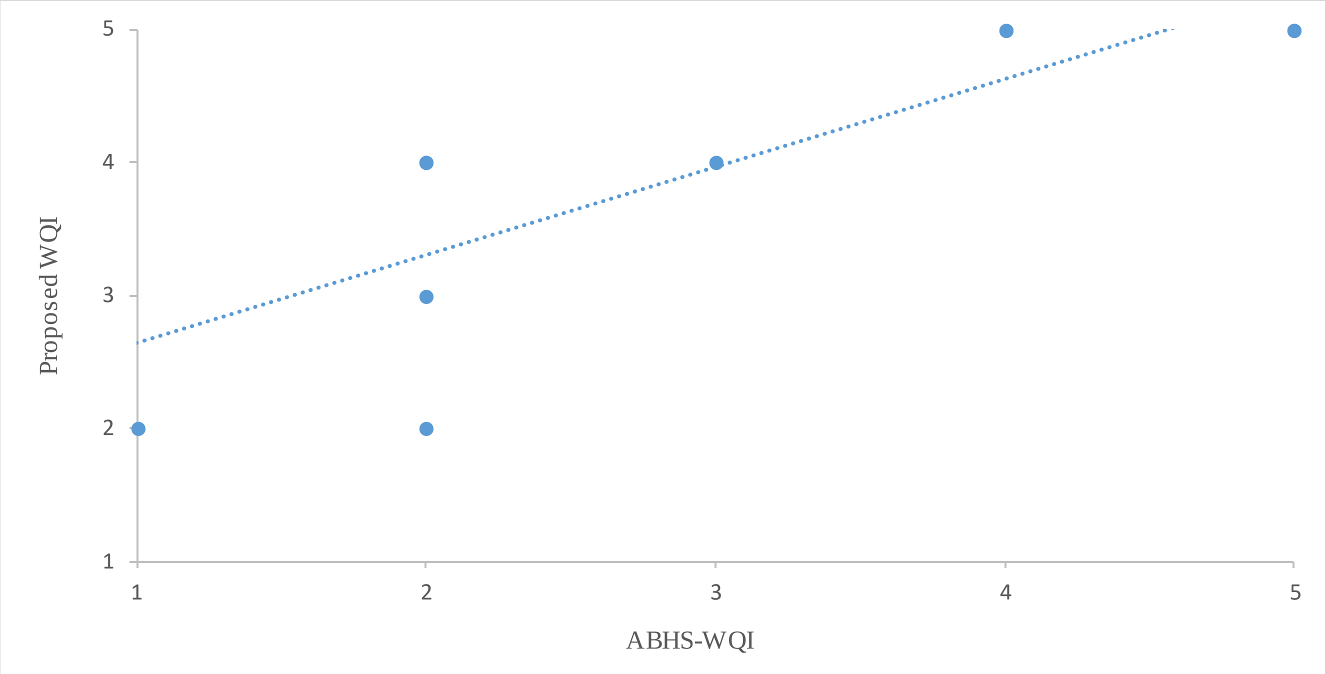

Fig. 11: Regression fitbetween results of the ABHS method and results of theproposed WQI (R^2=0.7, at the 95% confidence level) for the 26 groundwater stations.

IV. CONCLUSION

A water quality index is a practical tool for appreciating the general status of water quality. The proposed WQI was developed to remedy the observed gaps in the Sebou Hydraulic Basin Agency index, although the comparison of the two methods showed a positive agreement for the studied stations. The new WQI is different from those used in Morocco because it uses mathematical equations to normalize water quality parameters and presents it quantitatively instead of using a simplified grid that gives classes and always tends towards the minimum value, i.e. towards the most deteriorated class. The flexibility of operation with the proposed WQI is a great asset for water resource managers since it will facilitate for them the interpretation of results, especially if it is necessary to calculate water quality over multiple campaigns. This WQI could be further developed into smartphone or laptop application that will directly determine water quality and interpret results, thus facilitating water resource management. The proposed WQI uses Moroccan standards to normalize the observed values of water quality parameters. Therefore, its use in another locality, outside Morocco would need the upgrade of normalization equations of parameters using the standards values of water parameters of this locality.

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Performance of Solid Waste Services in Sampit City

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***Abstract*— This study aims to determine the performance of waste management services in the city of Sampit with the study locations in MentawaBaruHilir Village and Ketapang Village, MentawaBaru Village, District Ketapang, Baamang Hulu Village and Baamang Tengah Village, Baamang District. The factors studied are the completeness of waste management facilities (X1); household garbage collection (X2); frequency of garbage transportation (X3); community participation (X4); and socialization activities on household waste management (X5). This research was conducted by distributing questionnaires to 100 people in the study area. After that, multiple linear regression analysis was carried out with the SPSS program. From the factors studied, the results are obtained factor of frequency factor of garbage transport the value of regression coefficient 1.348 and probability value 0.007; socialization of household waste management with regression coefficient value of 1.348 and 0.033 probability value; the garbage collection factor of the household regression coefficient value is 1.182 and the probability value is 0.001; factor of completeness of waste management facilities the value of regression coefficient of 0.985 and probability value of 0.021; and community participation factors the value of regression coefficient 0.955 and probability value 0.019.*
***Keywords*— Solid waste service performance, Waste management facilities, community participation.**

I. INTRODUCTION

Kotawaringin Timur Regency with 16.496 km^2 land area with the capital of regency is placed in Sampit City, The Sampit City itself consists of 3 sub-districts which are Baaman sub-districts, Mentawa Baru Ketapang Sub-Districts, and Seranau Sub-Districts with 155.853 total population (BPS, 2018). While to cover the waste management services, until recent day, Department of Environment in Kotawaringin Timur regency can only serve 2 Sub-Districts which are Baamang Sub-Districts and Mentawa Baru Ketapang Sub-Districts with 145.853 total population (BPS, 2018).

According to EHRA's study reports in 2013, the questionnaire results showed that 59,1 % of household waste management is still burned, 18,4% is thrown into the river, and 1,9 % is thrown into the hole inside the soil and the hole with a pile of garbage is not covered. Meanwhile for the sorting waste from household activities, 89,7% of the waste is not sorted but directly thrown into a waste bin while the rest 10,3 % of it is sorted before it is thrown.

As mentioned above, it is needed to give environmental information and to do a study about waste management services in Sampit City which can be used as reference in planning and budgeting the waste management services. This environmental information system is aimed to help people understand about garbage generation and waste management services in Sampit city.

Problem Outline

Problem outline of this study is to determine the performance of waste management services with studied factors such as waste management facilities (X1); waste collection from household (X2); waste transportation frequency (X3); Community's participation (X4); and socialization of household waste management (X5).

Objectives

The objectives of this study are:

1. Analyzing the correlation degree between the variable of waste management facilities, the variable of household waste collection; the variable of community's participation; and the variable of socialization of household waste management.
2. Analyzing the most dominant correlation degree between the variable of waste management facilities, the variable of household waste collection; the

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variable of community's participation; and the variable of socialization of household waste management.

II. METHOD STUDY

Respondent calculation method

Generally, the number of sample size that needed to be taken can be measured by using *slovin* formulation

$$n = \frac{N}{N\,x\,(e)^2 + 1}$$

Information :

n =number of samples

N = total population

e =critical number / error tolerance (10 %)

Based on *Slovin* formulation up above, the calculation of total resposdentsis :

$$n = \frac{145.853}{145.853\ x\,(0{,}1)^2 + 1}$$

= *99,93* = 100 respondents

Based on the calculation as mentioned above, 100 respondents are obtained, thus, for each regency the calculation of total respondents are:

a. Total respondents in MentawaBaruKetapang Sub-Districts
   Total respondents
   = 100 respondents x ($\frac{86.839}{145.853}$ x 100 %)
   = 59,5 = 60 respondents
b. Total respondents in Baamang Sub-Districts
   Total respondents
   = 100 respondents x ($\frac{59.014}{145.853}$ x 100 %)
   = 40,4 = 40 respondents

Data Analysis Method

The data collection is shown in table and charts, based on the score calculation obtained from each variable score as mentioned down below:

a. 4 score = all criteria are met;
b. 3 score = 3 (three) criteria are met;
c. 2 score = 2 (two) criteria are met; and
d. 1 score = 1 (one) criteria is met.

Performance analysis of waste management services is using multiple linear regression analysis with SPSS program to determine the factors that affect waste management services. Specificity formula of multiple linear regression are :

$$Y = \alpha + \beta1.X1 + \beta2.X2 + \beta3.X3 + \beta4.X4 + \beta5.X5 + \varepsilon i$$

Information :

Y = Waste management service performance

α = Intercept

β = Regression coefficient

εi = Error Factor

X_1 = Waste management facilities

X_2 = Household waste collection

X_3 = Waste transport frequency

X_4 = Community participations

X_5 = Socialization of household waste management

III. RESULTS AND DISCUSSIONS

Based on the study results of waste management performance that has been carried out by Raharjo (2016) with a case study of Pangkalan Bun City, Kotawaringin Barat Regency, it has been said that the performance of waste management services is influenced by the most dominant factors which are community's participation. The study was conducted with data collection techniques for analyzing the performance of waste management services by using respondents through questionnaires. The results of this study analyze the factors that affect the performance of waste management, which are Organization and management; operational techniques; financing; regulations; and community participation.

Based on the studies related to the factors that influence waste management which has been done in a case study of the Tangerang Regency by Widyarsana and Zafira (2015), the following results are:

a. Waste disposal needs to be separated into 3 (three) types of sorting and placed in community housing
b. Laws and regulations, this is seen as very influential in the waste management system because there is no strict action for people who do not obey the regulations, it is difficult to implement the rules that have been made to the whole society and also lack of socialization.
c. Institutional structure of the organization that has not been supported by the number and the quality of human resources and the lack of cooperation between the Regional Government and NGOs in the household waste management.
d. Financing needs to be optimized both from private investment and regional budgets for the costs of operational activities and maintenance of waste management facilities and infrastructure.
e. The active participation of the community in the household waste management is very necessary, such as providing trash bins for each house, reducing the source (household) and anticipating public awareness to pay contributions or waste retribution to support waste management operations.

Statistical tests on the regression coefficient of waste management service performance in Sampit City use multiple linear regression analysis and are processed through the SPSS program. This analysis is used to predict the value of non-independent variables (Y) if the independent variables are more than 2 (two) variables. This study is using 5 (five) independent variables, which are the completeness of waste management facilities (X1), waste collection from household (X2); waste transportation frequency (X3); Community's participation (X4); and socialization of household waste management (X5), the non-independent variable is the performance of waste management services (Y).

Hypothesis Testing

Hypothesis testing in this study is conducted by testing the significance of regression coefficient. To determine the collective effect of independent variables using the F test and to determine the effect of each independent variable partially by using the T test.

1. Simultaneous Influence Test (F Test)

Simultaneous test (F test) aims to determine whether there is a simultaneous effect (together) given by the independent variable (X) on the dependent variable (Y). The results of the simultaneous test (Test F) are shown in Table 1.

Table 1. F Test Result Analysis

Model	**Number of Squares**	**df**	**Average Squares**	**F**	**Sig**
Regresi	22,476	4	4,495	42,383	0,001 a
Residual	0,424	5	0,106		
Total	**22,900**	**9**			

Source : Result Analysis, 2019

Based on Table 1, it can be explained that the fifth level of significant independent variables is 0.001. Therefore the probability is far less than 0.05 (0.001 <0.05). F-table value of 5.05 is obtained at a significance level of 0.05 then F-count (42.383)> F-table (5.05). Thus H_0 is rejected and H_1 is accepted, so that it can be concluded that the independent variables in this study can collectively have a great and significant impact on the non-dependent variable, which is the performance of waste management services.

2. Partial Influence Test (T-Test)

The t test aims to determine whether or not there is a partial (own) influence given by variable (X) on non-independent variables (Y). The results of the t test of the five independent variables can be seen in Table 2.

Table 2. T-Test Results

Independent Variables	**Coeff.**	**T-table**	**T-test**	**Sig**
The completeness of waste management facilities	0,985	2,776	3,673	0,021
Waste collection from household	1,182	2,776	9,827	0,001
Waste transportation frequency	1,348	2,776	5,029	0,007
Community participation	0,955	2,776	3,777	0,019
Socialization of household waste management	1,348	2,776	3,196	0,033

Source : Result Analysis, 2019

Based on Table 2 above it can be explained that the partial effect of each independent variable (X) on the performance of Waste Management Service (Y), as follows:

a. The effect of variable completeness of waste management facilities.

Table 2 shows the level of significant for the variables completeness of waste management facilities is 0.021 <0.05 with a t-count value of 3.673> t-table 2.776, so that the variables completenessof waste management facilities have a great and significant impact for the performance of waste management services. The results showed that the completeness of the waste management facilities was the fourth factor influencing the performance of waste management services as shown in the coefficient of 0.985.

b. The effect of variable waste collection from household

Table 2 shows the level of significant for the variable completeness of waste management facilities is 0.001 <0.05 with a value of 9,827> t-table 2,776, the variable of waste collection from households has a great and significant impact for the non-independent variable (performance ofwaste management service). The results showed that the waste collection factor from the household was the third factor affecting the performance of solid waste services as shown in the coefficient of1,182.

From the results of interviews with respondents, the community has already sorted the waste from households. So far, the community has sorted out economically valuable waste such as plastic bottles, glass bottles and sorts that can be sold back to garbage collectors. In an interview in Baamang Hulu Urban Village, Baamang Sub-District there were 7 (seven) households that were members of an independent Environmentally Aware Waste Bank. Those who are members of the Waste Bank actively sort out economic-value waste to be submitted to the Environmentally Aware Waste Bank.

Based on research conducted by Selomo, et al (2016) with the case study of PelitaHarapan Waste Bank in Makassar City, that the knowledge level of the community influences participation in the membership of the Waste Bank. The results of the study determined the factors of community participation in saving at PelitaHarapan Waste Bank, which are the number of family members, income factors and knowledge level factors. Where respondents with sufficient knowledge about Waste Bank participated in the Waste Bank as many as 89 respondents or 76.1% and 28 respondents or 23.9% did not participate in the Waste Bank.

Related to the Waste Bank research conducted by Nugraha, et al (2018) with a case study of Rajawati Garbage Bank in South Jakarta, that from the results of the recommendations of Waste Bank customers, it was agreed that Waste Bank management would be carried out continuously as much as 96.77%. Respondents stated that the accumulated waste can have a negative impact on the environment, waste must be sorted before being disposed of in the trash bin. By sorting the waste from the source, it will ease the waste management. Household waste management is influenced by internal factors, which are age, sex, education, employment, income, knowledge, and practice. Whereas external factors are the role of government and infrastructure.

Based on the results of study conducted by the author and in line with studies conducted on Waste Banks in Makassar City and South Jakarta, that community participation in sorting waste activities from their sources (households) and the participation of local governments which also complemented by supporting Waste Bank equipment also affect the waste management process. By sorting economically valuable waste sources that can be reused, it can reduce the amount of waste entering the landfill.

c. Effect of variable waste transportation frequency

Table 2 shows the level of significant for the variable completeness of waste management facilities amounting to 0.007 <0.05 with a calculated value of 5.029> t-table 2.77645, the variable waste transportation frequency has a great and significant impact for the non-independent variable (performance of waste management service). The results showed that the waste transportation frequency was the most dominant factor that influence the performance of waste management service as shown in the coefficient value of 1.348.

d. Effect of variable community participation

Table 2 shows the level of significant for the variable completeness of waste management facilities amounting to 0.019 <0.05 with a t-count value of 3.777> t-table 2.77645, the role of community participation has a great and significant impact for the non-independent variable (performance of waste management service). The results showed that the factors of community participation were the fifth influencing factor in the performance of waste management service as shown in the coefficient of 0.955.

e. Effect of Variable socialization household waste management

Table 2 shows the level of significant for the variable completeness of waste management facilities amounting to 0.033 <0.05 with a t-count value of 3.196> t-table 2.77645, then the variable socialization of household waste management has a great and significant impact for the non-independent variable (performance of waste management service). The results of the study showed that the factors in the socialization of household waste management were the second influencing factor in the performance of waste management service as shown in the coefficient value of 1,348.

3. Coefficient of Determination (R *square*)

To determine how great the independent variables (X) affect the dependent variable (Y), which is Waste Management Service Performance, as shown in the coefficient of determination (R2). The coefficient of determination can be seen in Table 3.

Table 3 R squareResult Analysis

Model	**R**	**R^2**	**Adj.R^2**	**Std.Estimasi Error**
1	0,991 a	0,981	0,958	0,326

Source : Result analysis, 2019

To determine the accuracy of the independent variable in explaining the non-independent variable can be known from the value of the coefficient multiple determination (R2). The value of R square (coefficient multiple determinations) is used to see how close the relation between all the independent variables towards the non-independent variable. The value of R square in this study was 0.981. This shows that 98.1% of the variables are from waste management facilities (X1), waste collection from households (X2), waste transportation frequency (X3), community participation (X4), and socialization of household waste management (X5) while the remaining 1.9% is explained by other factors outside the model.

IV. CONCLUSION

Based on the explained study results, the conclusions can be taken as follows:

1. The variables that affect the performance of waste management services start from the first to the fifth dominant influence, respectively the frequency factor of waste transportation with the regression coefficient value of 1.348 and the probability value of 0.007; Factor of socializing of household waste management value of regression coefficient 1.348 and probability value 0.033; the waste collection factor of the household regression coefficient value is 1.182 and the probability value is 0.001; factor of completeness of waste management facilities the value of regression coefficient of 0.985 and probability value of 0.021; and community participation factors the value of regression coefficient 0.955 and probability value 0.019.
2. Variables that have the most dominant level in relation to the performance of waste management services in Sampit City are the variable frequency of waste transportation.

RECOMMENDATIONS

Based on the explained study results, recommendations can be taken as follows:

1. This study results can become a recommendation for technical institution in order to improve the service performance of waste management.
2. This study results can be continued to further study to optimize the retribution collection in waste management service.

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Vibrio Bacterial Concentration in Vaname Shrimp Pond Super Intensive Technology in Takalar District, Indonesia

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Abstract— *Research on the concentration of vibrio bacteria in super-intensive shrimp farms has been carried out in August to December 2018 at shrimp pond located in Takalar District, South Sulawesi, Indonesia.This study aims to determine the concentration of vibrio bacteria found in internal shrimp pond system and the dynamics that occur. The results of the study showed that the concentration of vibrio bacteria improved during the day of culture period in the ponds and outlet of the pond. However, the presence of water treatment installation at the location can reduce the concentration, so the concentration of vibrio bacteria is not a problem if released into coastal waters after being processed in water treatment.*
Keywords— Vibrio Bacteria, Vaname Shrimp, Super Intensive, Takalar District.

I. INTRODUCTION

Aquaculture business activities have undergone system development which includes the application of various methods and innovative technologies to achieve profit incentives and fulfill the targets of the aquaculture development authority. The goal of fulfilling food for local consumption has shifted towards meeting global food needs, one of which is for export.

The variety of current and future challenges faced by the producer sector such as fisheries including aquaculture are the rapidly increasing population needs, the impact of climate change, and environmental degradation on the natural resource base. These three things were revealed in "State of World Fisheries and Aquaculture FAO" in 2018. The increase in population is described as rapidly increasing more than 9 billion people in the mid-twenty-first era. This serious increase will certainly affect the principle of supply and demand for fishery products.

One of the developments in the present time is to increase aquaculture production, especially shrimp farming in ponds, namely the development of super intensive technology shrimp pond systems. Shifting development of a conventional system of brackish water aquaculture towardsthe direction of super intensive, have consequence on the use of inputs that are larger than the basic pattern of a pond as a semi-open aquaculture system. A common feature of semi-open aquaculture systems is that they are still dependent on nature for the provision of 3 ecological services: temperature, oxygen, assimilation of waste (Tidwell, 2012).

According to RachmanSyah (2014) that this system is the orientation of future shrimp pond systems with a characteristic volume of small cultivation containers, high stocking density, high productivity, minimal waste load and high product competitiveness. In principle, the scope of this technology can be applied to all water sources, namely fresh, brackish and sea water. However, at present, significant developments have been made in coastal ponds with the sea water source.

But on the other hand, the empirical evidence that the application of super intensive shrimp pond technology in addition to producing output in the form of fish / shrimp biomass, also produces waste loads that have the potential to trigger diseases caused by bacteria and viruses . According to Rachman Shah et al (2014) reported the results of his research that the waste of superintensivevaname shrimp

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pondswith a total production of 6-8 tons has exceeded the standard of pond waste load. This has the potential to have an impact on decreasing the quality of the aquatic environment. Furthermore as an undesired output, the decreasing quality of the environment will trigger the emergence of pathogenic bacteria and viruses that can cause shrimp disease and result in mass death. Anshary (2016) argues that the main trigger factors for stress in fish in cultivation systems are high stocking densities, limited land conditions, lack of nutritional standards in supplementary feed, and a tendency to decrease the quality of the aquaculture environment along with maintenance time. Especially in high stocking densities which are the main characteristics of super intensive technology, that will trigger pathogens whose life cycle can immediately spread rapidly to individual fish / shrimp cultivation commodities.

Vibrio harveyi bacteria are found in almost all habitats, such as freshwater, estuary, sea water and soil. These bacteria are disease-causing agents in humans, fish and crustaceans. The entry of pathogenic Vibrio in shrimp farming can be derived from sea water and fries used. Vibrio harveyi Adala h ng kuna disease-causing pathogens lightning strike many aquaculture commodities which caused huge losses in the aquaculture industry (Austin & Zhang, 2006). Boer et al. (1993) reported that broodstock originating from positive seawater carried fluorescent bacteria so that it spread to fries (larvae) and eventually carried into the ponds.

Based on the problems of the empirical facts from the results of the above research, this paper reports the results of research on the concentration of vibrio bacteria which became *undesired output* of super intensive technology of vaname shrimp farming in Takalar District, South Sulawesi , Indonesia .

II. MATERIAL AND METHOD

This research was conducted in August - December 2018 at the location of vaname shrimp farming which applied super intensive technology in Takalar Regency, South Sulawesi Province, Indonesia (Figure1). In that location, two samples of ponds were taken with different densities. In each plot of the farm a bacterial biology sample was taken. In addition, sampling points for bacteria are also taken in parts: (1) clean water reservoirs (as intake water inputs for maintenance); (2) outlets / dumps on pond plots (consisting of plot outlets 1 and 2); (3) outlets / disposal at wastewater treatment installation.

Vibrio bacteria and common bacteria were isolated from sea water, pond water, pond wastewater and wastewater treatment installation. Water samples were taken using a sterile bottle and then taken to the laboratory.The isolation of Vibrio bacteria is carried out by taking 1 mL of water then diluting it in stages in 9 mL of physiological solution (Benson, 1985) and culturing on TCBSA (Thiosulfate Citrate Bile Salt Sucrose Agar) media for Vibrio bacteria and on TSA (Trypric Soy Agar) media for general bacteria. The culture method used is the pouring method on the agar plate. The plate method can be used to calculate microorganisms in the sample. A total of 0.1 ml of the sample was taken using a micropipette and using a sterilized glass spreader by dipping it in alcohol & burning it. Water samples are spread on the surface of the agar with a circular motion on the entire surface of the agar plate. After spread, TCBSA and TSA media were incubated at 35 ^{0} c for 24-48 hours. After 24 hours an observation of bacterial colonies was grown on the media.

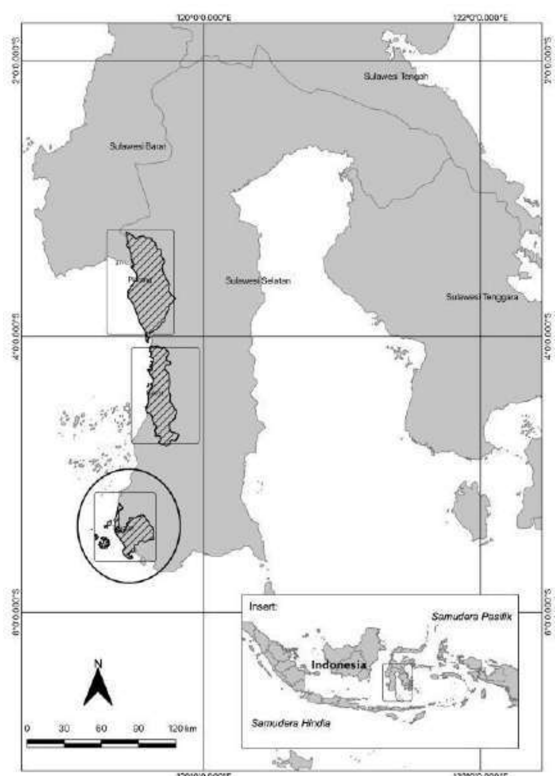

Fig.1: Map of the research location

Calculation of bacterial colonies that were successfully cultured from water samples can be carried out the following day (Azzizunnisa & Sree ramulu, 2013).

Bacterial colonies can be calculated using the formula:

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$$\frac{Number\ of\ bacteria\ colony}{Number\ of\ plate}\ x\ \frac{1}{Dilution\ factor}\ x\ \frac{1}{Sample\ volume\ (cultured)}$$

Whereas to get the ratio of vibrio bacteria to bacteria commonly used formulas:

$$\frac{Total\ Bacteria\ Vibrio}{Total\ Bacteria}\ x\ 100\%$$

III. RESULTS AND DISCUSSION

From the graph of Total Vibrio Bacteria (TBV) at the study location (Figure 2), there was a tendency that there was an increase during the days of culture (DOC) of vaname shrimp. In pond 1, the coverage area of 1000 m^2 was stocked with 200,000 shrimp fries, while in pond 2, the same pond area was stocked with 400,000 fries. During the 10 day DOC period at the pond, the total concentration of vibrio bacteria was found in pond 1 and its outlet with a value of around 10^3 CFU/ml. This needs to be watched out in cultivation because there is already a concentration of vibrio bacteria even though it is still below 10^4 CFU / ml. However, at pond outlet 1, bacterial concentration was found to increase during DOC of 30 days and tended to decrease during the subsequent maintenance period and a slight increase occurred at the end of the maintenance period of 77 days. The trend is the same for farm 2, where the concentration tends to increase in the ponds during the maintenance period, even at the outlet it is found that the concentration jumps more than 10^4 CFU / ml during the maintenance period 44 until harvest time. The threshold on Vibrio concentration which can endanger cultivation animals is 10^4 CFU/mL (Defoirdt, 2007). According to Taslihan et al., (2004) which states that the minimum limit of common bacteria in waters is 10^6 CFU / mL.

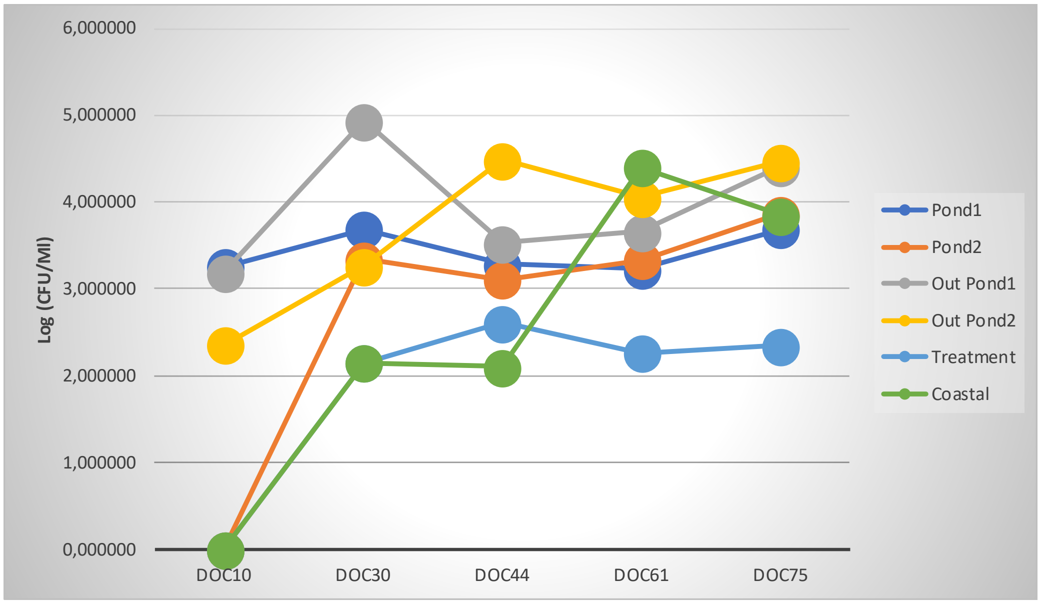

Fig.2: TBV chart at the research location.

There are quite interesting facts, namely the decrease in the concentration of Vibrio bacteria coming out of installation water treatment compared to those coming out of farm outlets 1 and 2. This decrease occurred during the DOC period of shrimp vaname. This illustrates the performance of the water treatment installation at the research site which significantly reduces the concentration of Vibrio bacteria. In September it was seen that the Vibrio concentration in the sea was quite low even lower than the Vibrio concentration from the IPAL outlet. But in October there was a very significant increase in Vibrio concentration in the Sea. This increase in concentration can be information for farm managers not to temporarily withdraw water from the sea for cultivation needs. This is for the efficient use of aquaculture inputs, especially the use of desinfectants to reduce the vibrio concentration which turns out to already exist in marine waters.

In Figure 3, you can see the Total Ratio of Vibrio Bacteria with Total Bacteria. The highest trend ratio in the research location was obtained at the farm outlet. This shows that the output of wastewater from farm ponds is quite high concentration of vibrio bacteria compared to total bacteria in general. This information provides the fact that the high concentration of vibrio bacteria at the disposal of ponds will have an environmental impact that receives these waste wastes in this case coastal waters. The optimal function of wastewater treatment is one solution to reduce the waste load including the concentration of the vibrio bacteria. The TBV and TB ratio values indicate that the general bacterial population is higher than the population of Vibrio sp. This means that conditions are better because of the diversity of types of bacteria in the cultivation environment so that cell communication of pathogenic bacteria can be inhibited and not reach the quorum. According to Defoirdt, (2007) that Vibrio sp bacteria is one of the triggers for the emergence of diseases in ponds. The existence of this bacterium must always be monitored during the maintenance period because if the population has reached quorum sensing it can result in the emergence of vibrio or vibriosis disease.

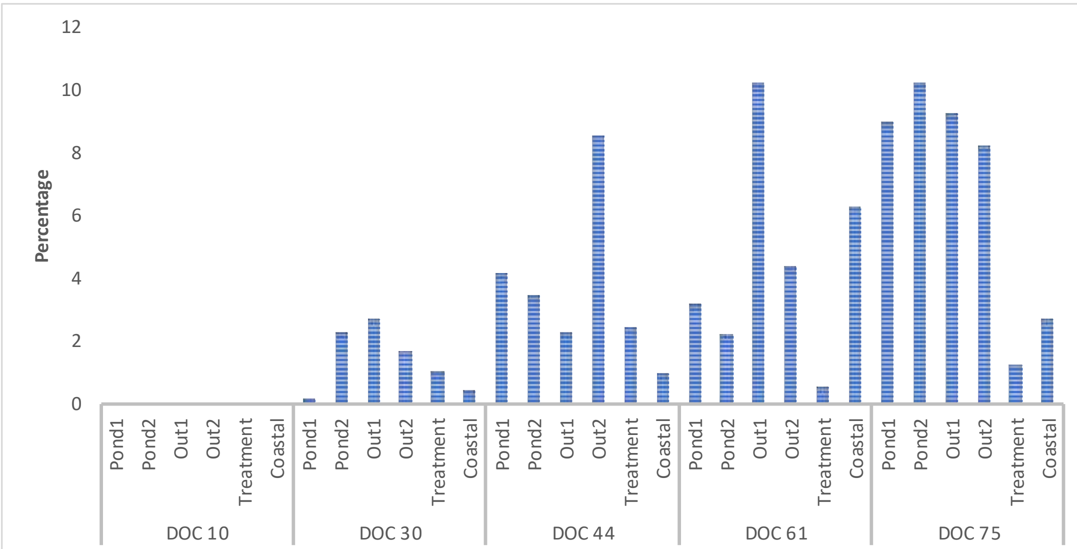

Fig.3: The ratio of TBV and TB at the Research Location

Whole cultivation management should have thought about how to minimize the risk of increasing the incidence of disease attacks including those caused by bacterial. The bacterial disease that causes death in the larval phase and post-penaid shrimp larvae is vibriosis. Vibriosis is a disease caused by one or several strains of vibrio pathogenic bacteria such as *V. alginolyticus, V. damsela, V. parahaemolyticus, V. vulnicus, V. penaecida* (Lightner, 1992; Anderson et al., 1988; Song et al., 1993; Lee et al., 1996).

In figure 3, even though the TBV and TB ratio at the farm outlet is quite high, it is still below 10% so that it can be said that the concentration of Vibrio bacteria is not dangerous for the cultivated shrimp. Based on the TBV and TB ratio data obtained during the maintenance period, it is seen that the ratio of the IPAL outlets is the lowest compared to the TBV and TB ratios at farm outlets. This shows that the performance of water treatment installation proved to be quite significant in reducing the ratio during the sampling period. According to Atmomarsono et al., (2013), if the TBV and TB ratio increases by more than 10%, then some Vibrio pathogens will be dangerous for cultivated shrimp.

IV. CONCLUSION

The existence of super intensive ponds for vaname shrimp cultivation in Takalar Regency shows the dynamics of the concentration of vibrio bacteria which has the potential to cause disease in shrimp . The high density of cultivation shows an increase in the concentration of vibrio bacteria in ponds, but with the presence of water treatment installation can reduce the concentration of vibrio bacteria from the pond before discharge of water is released back to coastal waters. Super intensive technology cultivation management requires water treatment installation to minimize the concentration of vibrio bacteria.Decreasing the concentration of vibrio bacteria through WWTP can be labeled well .

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Analysis of Marketing Kampung Super Strategy in Grobogan District

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***Abstract*— *Indonesia's natural wealth is very abundant and various kinds of biodiversity become one of the supporting factors in fulfilling protein needs in the livestock subsector. Farmers choose the type of Super Village Chicken because the harvest period is faster (45-60 days), provides sufficient income, relatively low mortality rates, savings in maintenance and feed costs. The large population of Kampung Super Chicken farms in Grobogan Regency causes breeders difficulties in marketing chicken, so the sale price in the farm is unstable. This price instability does not dare to take larger scale chicken seeds. The method used in this study is the survey method. The number of samples is 60 respondents. The reason for the sample is 60 because there are 6 farmer groups in Grobogan Regency, each with 10 members. Tracer traders use the snow ball method from farmers and the marketing institutions involved.*

The data analysis included descriptive analysis to determine the business income at the farmer level and SWOT Analysis to find out the Super Village Chicken Marketing Strategy in Grobogan Regency.

Based on the results of the discussion, conclusions can be drawn as follows: (1) Marketing efficiency below 50% is said to be efficient, (2) Factors that encourage and inhibit marketing of Super Village Chicken are fluctuating chicken prices, difficult marketing efforts, capital business is relatively limited, lack of knowledge of farmers, (3) Marketing strategy that should be done to improve the marketing of super chicken in Grobogan Regency is to cooperate with other parties in partnership, conduct transactions directly with buyers, make breakthroughs by selling in supermarkets, providing business cutting chicken, selling to big collectors, innovating various chicken products.

***Keywords*— *Kampung Chicken Super, SWOT, Marketing Strategy.*

I. INTRODUCTION

Indonesia's natural wealth is very abundant and various kinds of biodiversity become one of the supporting factors in fulfilling protein needs in the livestock subsector. Meeting the needs of animal protein from poultry products must be balanced with an increase in the population of poultry, so that products from livestock, especially poultry, are able to meet the needs of animal protein of all Indonesian people. Poultry farming in Indonesia has an important role in livestock development as fulfilling animal food needs. At present poultry in Central Java contributes to meat production, which is 16.13% then followed by beef at 6.28%. Of the total number of poultry, around 9.05% is provided by broiler chickens and only around 7.08% is provided by local chickens, the remainder is by other poultry types (Statistics of Animal Husbandry and Animal Health in Central Java Province, 2017). High demand for poultry is due to the price of chicken meat which tends to be cheap and easy to obtain.

Many people today choose products that are ASUH (Safe, Healthy, Whole, and Halal) by choosing local poultry as a fulfillment of animal protein needs, but the high demand is not comparable with the existing population. This inadequate population is due to a long maintenance time for local chickens. At present in addition to broiler chicken, which has a short maintenance time, there are also native chickens, which have a short maintenance time, namely Super Chicken. Super hens are native chickens originating from the cross between laying hens and native chickens. The innovation of the discovery of super chicken was due to the large number of farmers who complained about the length of time they enjoyed the results of native chicken farming. In addition to a short maintenance time of only 2 months, Super Chicken Chicken is also low in cholesterol like ordinary kampung chicken with 4 months maintenance. At present Grobogan

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Regency produces Super Village Chicken with its marketing still in the local area. The Super Village Chicken Business faces strong competition, because almost every sub-district has a Super-Chicken Village breeder. Farmers choose the type of Super Village Chicken because the harvest period is faster (45-60 days), provides sufficient income, relatively low mortality rates, savings in maintenance and feed costs. The large population of Kampung Super Chicken farms in Grobogan Regency causes breeders difficulties in marketing chicken, so the sale price in the farm is unstable. This price instability does not dare to take larger scale chicken seeds

The marketing process that is too long makes farmers become anxious in chicken farming because the prices obtained by farmers are getting lower. This increasingly fierce competition requires farmers to implement appropriate marketing strategies in competition in order to obtain high marketing efficiency. This is based on a strategy to maximize strength and business opportunities, while at the same time minimizing existing weaknesses and threats so as to obtain higher income.

Research needs to be done with the aim to find out what factors drive and hinder the marketing of Super Village Chicken and what marketing strategies should be done to improve the marketing of Super Village Chicken. The results of the study will be obtained by factors that encourage and inhibit and what marketing strategies are carried out to facilitate marketing of Super Village Chicken in Grobogan Regency, so that it can be beneficial for farmers to improve marketing. The right marketing strategy is useful for overcoming increasingly fierce market competition, therefore research will be carried out with the title "Analysis of the Super Village Chicken Marketing Strategy in Grobogan Regency".

II. LITERATURE REVIEW

2.1. Super Chicken Village

Super Kampung Chicken is a result of a crossbred chicken (male) using Bangkok Chicken, Pelung Chicken, Kedu Chicken, with laying-type chicken (female). The crossing aims to get the type of Kampung Chicken which has high productivity of meat and eggs, thus the cultivation of Super Village Chicken is more profitable because it can be harvested with a shorter time.) so as to produce fertile eggs then Super Kampung chickens are hatched by using incubators (hatching machines). According to Jarmani et al. (2016) said that silangan chicken (F1) from local roosters (free-range chicken, kedu chicken, pelung chicken, and bangkok chicken) with laying hens had criteria according to consumer demand, namely weight 0.9-1.0 kg can be achieved at the age of 12 weeks, it looks like a real local chicken with black feathers and yellow skin.

2.2 Super Chicken Maintenance System

The success in raising or running a Super Kampung Chicken is influenced by the effective and efficient maintenance system of Kampung Ayam. Maintenance for 2-2.5 months with an average weight of 0.9-1.5 kg must choose quality seeds and mixtures at affordable prices.`

2.3. Business Costs for Super Chicken Village Business

Production costs are costs of compensation received by the owners of production factors, or costs incurred by farmers in the production process, both in cash and non-cash (Daniel, 2002). Soekartawi (2014) states that production costs are the value of all production factors used, both in the form of objects and services during the production process. Some concepts about costs such as: variable costs, fixed costs, and total costs. Variable costs are variable costs caused by changes in the amount of results. If the amount of goods produced increases, the variable cost also increases. Variable costs charged to each unit are called average variable costs (Herlambang, 2002). Fixed costs are constant costs for each level / number of results produced. Fixed costs charged to each unit are called average fixed costs.

2.4. Marketing channel

Suharno (2017) stated that marketing channels at chicken farms, both chicken and domestic chicken, are generally long. This is because the marketing channel starts from collectors' breeders, chicken bases to cutters, retailers and new customers. Every stage of the distribution has a fee, so that the thinner the possibility of the farmer to get a reasonable profit. The marketing channel needs to be shortened to minimize the difference in prices that occur at the farmer level and at the consumer level. The size of marketing costs is very dependent on the size of the activities of marketing institutions and facilities needed. Marketing costs also depend on the length of the marketing chain involved. The size of the marketing margin is influenced by changes in marketing costs, profit from intermediary traders, prices paid by end consumers and prices received by producers. Besides these factors the magnitude of the marketing margin is also influenced by the distance between the producer region and the consumer and the nature of the goods as a whole will increase marketing costs (Purmantono, 1993).

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2.5. Marketing strategy

Current competition makes business people / companies must use marketing strategies that are truly appropriate to achieve their intended goals or to maintain the continuity of their business. The purpose of this marketing activity is to influence consumers to be willing to buy goods or services produced by a company when they need it. Companies must be able to understand the desires or demands of the needs of consumers, and know the marketing strategies that must be done in order to achieve the desired goals.

According to Wawan (2016) marketing strategy is the organization of all the resources owned to market a product which is then mentioned in the marketing strategy that must be done by taking into account the marketing mix, product life cycle, and maintaining or extending the stage of market maturity.

III. RESEARCH GAP

The results of this study support or in accordance with the research conducted by Novianto (2015) on Analysis of Marketing Strategies to Increase Sales of Super Village Chicken (Jambon Village, Jambon District, Ponorogo Regency). thesis, Muhammadiyah Ponorogo. University. Increasingly intense business competition requires every entrepreneur to maintain its existence. With the increasingly fierce competition, it is now demanded to implement appropriate marketing strategies that can be used as weapons in the competition war between entrepreneurs. Marketing strategy is a plan that describes the company's expectations of the impact of various activities or marketing programs on the demand for products or product lines in certain target markets.

It also supports the research conducted by Turnip (2016) which states that the IE matrix results show that the business is in Hold and Maintain (V) position and the strategy that is suitable for this position is the strategy of market penetration and product development. The SWOT Analysis of the Indonesian Christian Community Development Training Center institution produced seven alternative strategies related to the company's position in the IE matrix. The order of priority strategies is (1) Carry out creative advertising and sales promotion (TAS value 6.64), (2) maintain product quality (TAS value 6.50), (3) Increase production volume (TAS value 6.23), (4) Trying an organic certificate label (TAS value of 5.75), (5) Market penetration (TAS value of 5.43), (6) Product development (TAS value of 5.40), (7) Improving product image (positioning) (TAS value of 5.28).

IV. RESEARCH METHODS

The method used in this study is the survey method. The number of samples is 60 respondents. The reason for the sample is 60 because there are 6 farmer groups in Grobogan Regency, each with 10 members. Tracer traders use the snow ball method from farmers and the marketing institutions involved. The data analysis included descriptive analysis to determine the business income at the farmer level and SWOT Analysis to find out the Super Village Chicken Marketing Strategy in Grobogan Regency.

V. THINKING FRAMEWORK

Kampung chicken has a very important role in improving community nutrition and in increasing income. Currently the production of Kampung Super Chicken in Grobogan Regency is highly developed, but as the production of Super Kampung Chicken grows, chicken farmers experience difficulties in marketing. The marketing process that is too long makes the farmers become anxious in their chicken business because the prices of farmers are getting lower . Research on what factors are driving and inhibiting the marketing of Super Village Chicken and marketing strategies needs to be done to find out what should be done to improve the marketing of Super Village Chicken. From this it will be obtained the factors that encourage and inhibit and what marketing strategy is done to facilitate marketing of Super Village Chicken in Grobogan Regency, so that it can be beneficial for farmers to increase marketing.

VI. RESULTS AND DISCUSSION

The marketing pattern that has been used by the super chicken farmers in Grobogan Regency is a marketing pattern in general, which is sold to end consumers (live chickens) with farmer marketing, one trader, two traders, three traders and consumers. The results of the calculation show that:

MP = Consumer Price (Rupiah) - Buy Price of Breeder (Rupiah)

MP= 32.300-21.200

MP= 11.100

Farmer Share =

$$\frac{\text{Price of Buy Breeder (Rupiah)}}{\text{Consumer Price (Rupiah)}} \times 100\%$$

$$\text{Farmer Share} = \frac{21.200}{32.300} \times 100\%$$

= 65,63%

(complete calculation see Appendix)

Because the value is above 50% it is said to be efficient.

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Discussion

Based on the results of the analysis it can l seen that the EFAS matrix shows that weakness weakness is higher than strength, so it is necessary to u: strategies to overcome them. From the results of tl SWOT analysis several strategies can be combined su as strategies that combine:

1) Strengh and Opportunity (strategy) t implementing a maintenance system and effectiv maintenance time will make various groups like to meet the high demand for using low choleste in super chickens that will benefit livesto business.
2) WO strategy (a combination of weakness opportunity), namely the availability of superfoc raw materials that will adequately increa: demand, the grade of super chicken will produ low cholesterol that many consumers like an become an added value, the marketing system f super chicken is preferred by various groups .
3) ST strategy, namely a combination of strength ar threat, such as supply from outside the distri which will smoothly increase the availability super chicken market, continuous production substitute male chickens will replace super chicken, with the presence of marketing institutions can facilitate mileage and improve roads the bad, profitable business will improve information on the results of processing technology research, coaching and mentoring that will effectively improve the maintenance system.
4) Weak-threat combination strategy, which is a super chicken chicken marketing system that can supply from outside the regency, guidance and assistance must be maximized so that there is product innovation development, improving information technology research results so that raw chicken and chicken feed are available. super village is increasing. Besides that, it can also use social media as a promotional event so that the sales of super chicken will increase because now is the era of globalization that uses all-sophisticated internet, so that with minimal promotion costs it will be able to reach an increasingly broad market share.

ANALYSIS SWOT	*STRENGTH* 1. Characteristics of super chicken 2. Availability of shelter markets 3. Availability of marketing institutions 4. Continuous production 5. Profitable business 6. Availability of poultry markets 7. The spirit of raising 8. Maintenance system 9. When raising chickens	*WEAKNESS* 1. Availability of feed for super chicken 2. Availability of raw materials for super chicken 3. There are no product standards 4. There is no development of product innovation 5. Grade super chicken 6. Pricing 7. Fluctuations in production costs 8. Marketing system for super chicken
OPPORTUNITY 1. High demand 2. Like various groups 3. Low cholesterol 4. The existence of a business group	**STRATEGY SO** 1. The characteristics of super chicken will increase consumer demand (S1, O1). 2. The maintenance system and effective maintenance time will make various people like it (S8, O2). 3. To meet the high demand for using low cholesterol in super chickens that will benefit the livestock business (O1, S5). 4. The existence of business groups makes farmers enthusiastic to raise suPer chicken (O3, S7).	**STRATEGY WO** 1. Availability of sufficient superfood chicken material will increase demand (W1, O1). 2. Super chicken chickens will produce low cholesterol (W5, O3) 3. The marketing system of super village chicken favored the circle (W8, O2).
THREAT 1. Supply from outside the district 2. The substitute male can replace Super Chicken 3. Long distance and poor road conditions 4. Guidance & assistance that has not been maximized 5. Minimum information on the results of processing technology research 6. Depreciation of body weight and death in transport marketing	**STRATEGY ST** 1. Supply from outside the district area that will smoothly increase the availability of the poultry market (T1, S3). 2. Continuous production of substitute male chickens will replace super chicken (S4, T3). 3. With the existence of marketing institutions can facilitate mileage and can improve the bad roads (S3, T3). 4. A profitable business will improve information on the results of processing technology research (S5, T5). 5. Effective coaching and mentoring will improve the maintenance system (T4, S8).	**STRATEGY WT** 1. The marketing system for super chicken is good and can be supplied from outside the district (W8, T1) 2. Distant mileage and poor road conditions can be used to determine the price of free-range chicken (T3, W6). 3. Coaching and assistance must be maximized so that there is a development of product innovation (T4, W4). 4. Increasing information on the results of processing technology so that the availability of raw materials for super-chicken and superfood of super chicken is increasing (T5, W1, W2)

This is in line with the marketing strategy through SWOT analysis (Rangkuti, 2009) because with the SWOT analysis (Strength, Weaknesses, Opportunities, Threats) can evaluate opportunities and challenges in the agribusiness environment. The results of the SWOT matrix will make it easier to formulate various strategies that need to or should be carried out by super chicken farmers.

The results of this study support or in accordance with the research conducted by Novianto (2015) on Analysis of Marketing Strategies to Increase Sales of Super Village Chicken (Jambon Village, Jambon District, Ponorogo Regency). thesis, Muhammadiyah Ponorogo University.

Increasingly tight business competition requires every businessman to maintain its existence. With the increasingly fierce competition, it is now demanded to implement appropriate marketing strategies that can be used as weapons in the competition war between entrepreneurs. Marketing strategy is a plan that describes the company's expectations of the impact of various activities or marketing programs on the demand for products or product lines in certain target markets. There are marketing programs (such as advertising, sales promotions, personal selling, customer service, or product development) that have different effects on demand. For this reason, super chicken entrepreneurs in Jambon

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Village, Jambon District, Ponorogo Regency must have new strategies to find out the positive and negative aspects, namely by using a SWOT analysis to formulate a new marketing strategy. The SWOT analysis is an identification of external and internal factors and strategies that reflect the comparison between the two.

This is based on the logic that an effective strategy is to maximize strength and business opportunities, but at the same time minimize existing weaknesses and threats. The workings of the SWOT analysis here use a matrix by including internal environmental factors (IFAS) and include external environmental factors in vertical cells in the form of opportunities and threats that can be known from the results of external environmental analysis (EFAS). Then from the remaining cells that meet iv between internal and external factors, we can find out the alternative strategies produced by the SWOT analysis. Aggressive strategies or expansion (based on SWOT analysis) and super chicken business in Jambon Village, Jambon District, Ponorogo Regency have alternative hold and design strategies or maintain and maintain strategies (based on IE Matrix analysis). This strategy can be carried out by maximizing internal and external strengths and taking advantage of existing opportunities.

It also supports the research conducted by Turnip (2016) which states that the IE matrix results show that the business is in Hold and Maintain (V) position and the strategy that is suitable for this position is the strategy of market penetration and product development.

The SWOT Analysis of the Indonesian Christian Community Development Training Center institution produced seven alternative strategies related to the company's position in the IE matrix. The order of priority strategies is (1) Carry out creative advertising and sales promotion (TAS value 6.64), (2) maintain product quality (TAS value 6.50), (3) Increase production volume (TAS value 6.23), (4) Trying an organic certificate label (TAS value of 5.75), (5) Market penetration (TAS value of 5.43), (6) Product development (TAS value of 5.40), (7) Improving product image (positioning) (TAS value of 5.28).

Table 4.7. The average selling price of farmers, traders and consumers and MP

Respondents	Selling Prices of Farmers I	Selling price of trader I-Trader II	Selling price of trader II-trader III	Selling prices of traders III-consumers	Average
AVERAGE	21.200	Rp 23.800	Rp 26.600	Rp 32.100	Rp 25.925
Difference (Marketing Margin)		Rp2.600	Rp2.800	Rp5.500	Rp3.633

Based on table 4.7, it is known that the price of the farmer, the purchase price of the trader I and the purchase price of the trader II and the consumer the average selling price of the farmer is Rp.21,200 and for the purchase price I is Rp23,800, and the average purchase price is Rp.26,600 to consumers in the amount of Rp. 32,100. The survey was conducted on 60 respondents and from the data it was found that the marketing margins of each trader averaged Rp3,633.

In addition, it is also consistent with the research conducted by Ekapriyatna (2016) which aims to determine the internal conditions, external conditions of broiler farms and strategies that must be determined by employers based on SWOT analysis. This research uses qualitative research design. The subject of this study was the owner of the Ananta Guna broiler farm in Sidan Village, and the object of this study was a business development strategy. Data collection techniques used the interview method, then analyzed using the IFAS and EFAS methods. The results of the study show that internal environmental conditions in the form of strength, namely high-quality products, affordable prices, use direct distribution channels. The results of this study are also consistent with the research conducted by Aedah et al (2016) which states that the poultry industry in Indonesia has often experienced ups and downs in recent years. The vulnerability of broiler businesses to various turmoil opens opportunities to develop local poultry businesses such as free-range chicken, which is currently increasing in popularity compared to other poultry meat. Also consistent with the research conducted by Haryono et al. (2015) which states that the Java Super Chicken Business Industry can increase income and is a new business opportunity that is prospective to be developed, super chicken livestock business can fulfill chicken meat as a need for local animal protein.

Conclusion

Based on the results of the analysis and discussion, conclusions can be drawn as follows:

1. Marketing efficiency above 50% is said to be efficient.
2. Factors that encourage and hinder the marketing of Super Kampung Chicken are fluctuating chicken prices, difficult marketing efforts, relatively limited business capital, lack of knowledge of farmers.
3. The marketing strategy that should be carried out to improve the marketing of super chicken in Grobogan Regency is to work with other parties in partnership, conduct transactions directly with

http://dx.doi.org/10.22161/ijeab.4414 ISSN: 2456-1878

buyers, make breakthroughs by selling at supermarkets, provide chicken slaughter business, sell to large collectors, innovating various chicken products

Recomendation

Suggestions that can be put forward in this study are:

1. It is best for farmers to apply the right marketing strategy through social media, work with big collectors, make a breakthrough by selling in supermarkets, providing chicken slaughter business, innovating various chicken products to increase sales.
2. In future research with similar topics can be compared with chicken farmers in other locations or using quantitative analysis.

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Hotspots of Bony Flying fish (H. Oxycephalus) Distribution Constrained by Physical Oceanographic Condition in the central of Makassar Strait during Boreal Winter

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Abstract— *This study performed descriptive and qualitative approach to identify favourable Bony Flyingfish (H. Oxycephalus) distribution using primary data from gillnet flyingsih catches and multisensors satellites oceanography of sea surface temperature (SST) and chlorophill-a (Chl-a) during boreal winter of 2016 (September 2016 – February 2017) in the central of Makassar strait. Emperical Cumulative Distribution Function (ECDF) has been used to analyze the suitability of physical oceanographic parameters with Bony Flyingfish catch. The results show that during boreal winter transition (September to October 2016) hotspot of Bony flyingfish distributed in the coastal water off of Pinrang region and then moved to the north at the frontal water between coastal and off Majene region during the rest of boreal winter (November 2016 – February 2017) with corresponding SST and Chl-a of 29.5 – 31.0C and 0.1 – 0.9 mg/m m3., respectivelly. ECDF analysis indicated that SST has stronger association than Chl-a contributed on the increase of Bony flyingfsih catch in the hotspots areas. The movement of hotspot from off water of Pinrang in September at the south of central Makassar to the north in the off water of Majene during the peak of boreal winter was analysed due to the Indonesian throughflow generated eddy which is still stronger during transition boreal winter and became favourable condition for the hotspot of flyingfish in the Pinrang water.*
Keywords— **physical oceanographic parameters, Bony flyingfish (H. Oxycephalus), Indonesian throughflow generated eddy.**

I. INTRODUCTION

Flyingfish catches in Majene water in the central of Makassar strait generaly use Gillnet as fishing gear. This technique is considered having high selectivity to ensure sustainable flyingfish catches ([1],[2]).

Based on several studies of catches of flyingfished types in the Indonesian waters, [3] found that Makassar strait and Flores sea have 11 types and then central Maluku (Ambon and surrounding waters) 8 types.

Flyingfish (H. *oxycephalus*) is most dominant catch using gillnet in the Majene water, central of Makassar strait [2]. H. *oxycephalus* species are most dominant catched in Naku water, south of Ambon island [4], in the Seram water [5], and also in the south china sea water associated with Kuroshio current [6].

Satellite oceanography is a remote sensing technology that is now efficiently exploiting ocean and fisheries aspects in term of natural resources management. This technology could monitor all physical aspects in the sea regionally and synoptically, so that useful for any benefit to look for favourable conditions of fishing catches and many purposes such as biological hotspots [7] a potential area favourable for fishing catches associated with certain conducice oceanographic conditions (upwelling, front and eddy).

In physical perspective, the Makassar strait is the main pathways on the Indo-Pacific feature what so called the Indonesian throughflow (ITF) [8]. This strait is known with very dinamic water affected by water masses and current exchanges between Pacific and Indian Ocean, the ITF, and monsoonal current) [9]. Interctions between two different monsoon (wet and dry) and the ITF will influence current circulation and variability of SST and Chl-a in the Makassar strait [10], besides the regional climate change could affect the structure and transformation of physical and chemical properties in this region [11].

Dynamics of physical oceanographic processes will impact on pelagic fish distribution in some certain waters and will find favourable contion for spawning, migration

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and protection [12]. [13] showed that flyingfish is associated with favourable SST, so that accurate prediction of high potential catch of flyingfish (H. *oxycephalus*) could be implemented using other oceanograhic parameters, such as Chlorphyll-a, current, and salinity. Meanwhile traditional fishermen still do fishing with intuitive feeling without any support of this technology using satellite remote sensing.

Flyingfish data from Majene local government fisheries deparmentt (Dinas during last decade showed catch decreasing trend. One factor is our less knowledge on the hotspot diribution of flyingfish changing by season and regional climate variations. In the Makassar strait. This study is intending to use descriptive and qualitative method applying multisensor satellite remote sensing of SST and Chl-a together with flyingfsih (H. *oxycephalus*) catch to see the hotspot areas during the boreal winter in the central of Makassar Strait.

II. DATA AND METHODS

Descriptive and qualitative method will be applied to use mutisensor satellite oceanography that can derive sea surface temperature and chlorphyll-a, and will be related to flyingfish catches using emperical cumulative distribution funtion analysis. All the data are set from September 2016 until February 2017 to accommodate boreal winter.

2.1 Research Area

In order to get flyingfish catch data, we determine Somba in Sendana, one of the coastal sub-districts in Majene Regency, West Sulawesi Province, as the fishing base . The research area is located at coordinates 03º 22' 51.8" S and 118º 50' 47.8" E. The fishing area of drifting gillnets for the capture of H *oxycephalus* is in the central of Makassar Strait, in area with coordinates of 2º 57' 50.40 "- 3º 53' 45.60" S; 118º 7' 4.8" - 118º 46' 19.20" E and 3º 53' 28.68"- 4º 16' 48.24"S; 119º 6' 43.08" – 119º 20' 48.43"E as shown in Figure 1.

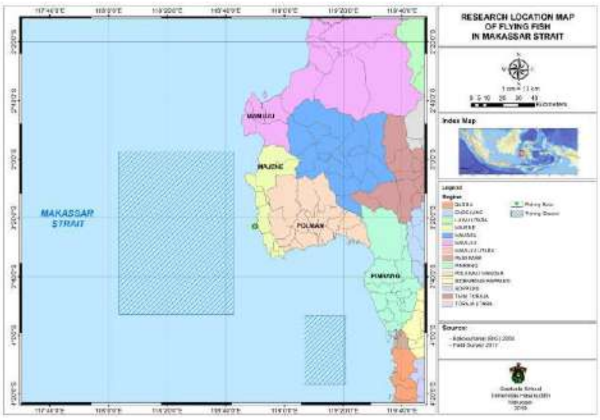

Fig.1: Fishing area of drifting gillnet in the central of Makassar Strait

2.2 DATA

This study utilizes primary data of gillnet flyingfish catch (H. *oxycephalus*) per trip (Catch Per Unit Effort/CPUE) and secondary data of monthly sea surface temperature (SST) and monthly chlorophyll-a (Chl-a) from Aqua/MODIS satellite images. All the image data are free cloud coverage and had been atmospheric and geometrically corrected. The SST and Chl-a data are taken from the MODIS web (www.oceancolor.gsfc.nasa.gov). Catch data are analysied by counting weight per hauling that can represent catch fluctuation spatially and temporally before further analysis to see the relation with SST and Chl-a. In order to increase the quality of flyingfish catch data, interview had been applied to the fishermen.

2.3 Empirical Comulatif Distribution Function (ECDF)

The study applies emperical cumulative distribution function (ECDF) method to see the relationship between oceanographic parameters (SST and Chl-a) and highest flyingfish catch (CPUE) using 3 functions [14,15] as follow:

$$f(x) = \frac{1}{n}\sum_{t=1}^{n} l(xi) \qquad \text{.................. (1)}$$

With indicator function

$$l(xi) = \begin{Bmatrix} 1, if\,(xi \le t) \\ 0, otherwise \end{Bmatrix}$$

$$g(t) = \frac{1}{n}\sum_{t=1}^{n} \frac{yi}{y} l(xi) \qquad \text{............................ (2)}$$

$$D(t) = \max\left| f(t) - g(t) \right| \qquad \text{.................. (3)}$$

where:

f (t)	:	Emperical cumulative frequency distribution function
g (t)	:	Catch-weighted cumulative distribution function
l (xi)	:	Indication function
D (t)	:	Absolute value of the difference between two curves f (t) and g (t) at any point t and assessed by standard Kolmogov-Smirnov test
n	:	The number of fishing trips
xi	:	The measurement for satellite-derived oceanographic variables in a fishing trip.
t	:	An index, ranging the ordered observation

http://dx.doi.org/10.22161/ijeab.4415 ISSN: 2456-1878

from lowest and highest value of oceanographic variables.

yi : The CPUE in a fishing trip i and averaged estimate of all CPUE fishing trips.

max : Certain number of variable where difference between 2 curves $|g(t)-f(t)|$ is maximum.

III. RESULTS AND DISCUSSIONS

3.1 RESULTS

Flyingfish CPUE in the research area during boreal winter (September 2016 – February 2017) indicated abundant hotspot around off of Pinrang water in September 2016 and spread to the north around Majene water in October 2016 with catches in the ranges of 65 kg and 107.89 kg, respectively (Fig. 2a and 2b). During November 2016 – February 2017, the flyingfish CPUE reduced significantly and located in the off water of Majene with catch around 86 kg. In general, flyingfish CPUE has the highest catch during transtion period of boreal winter in September and October compared to the rest of boreal winter during November 2016 – February 2017.

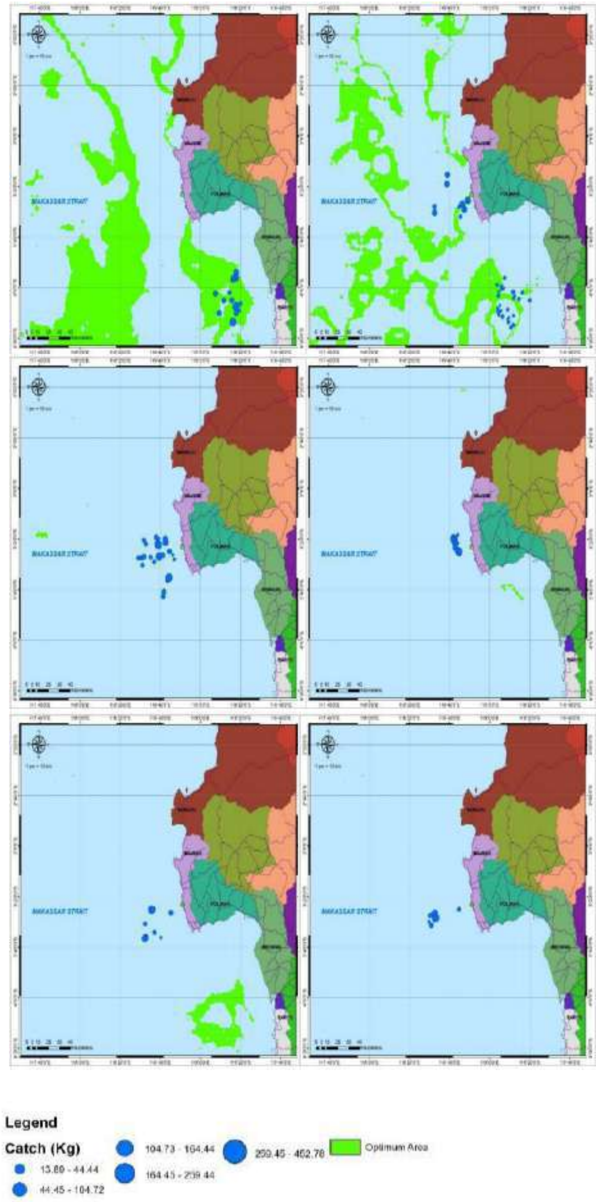

Fig.2: Distribution of optimum area (green zone) and catch of flyingfish (H. oxycephalus) (kg) in September 2016 - February 2017

Sea surface temperature (SST) distribution during boreal winter (September 2016 – February 2017) was dominated by high SST feature stronger in September and October 2016 in the range of 30.5 – 31^{0}C and decreased significantly around the main pathway of the Indonesian throughflow (ITF) from November 2016 until February 2017, in the range of 29.0 – 29.30 ^{0}C. Figure 3 shows the SST distribution superimpose with the flyingfish catch during boreal winter in the central of Makassar strait

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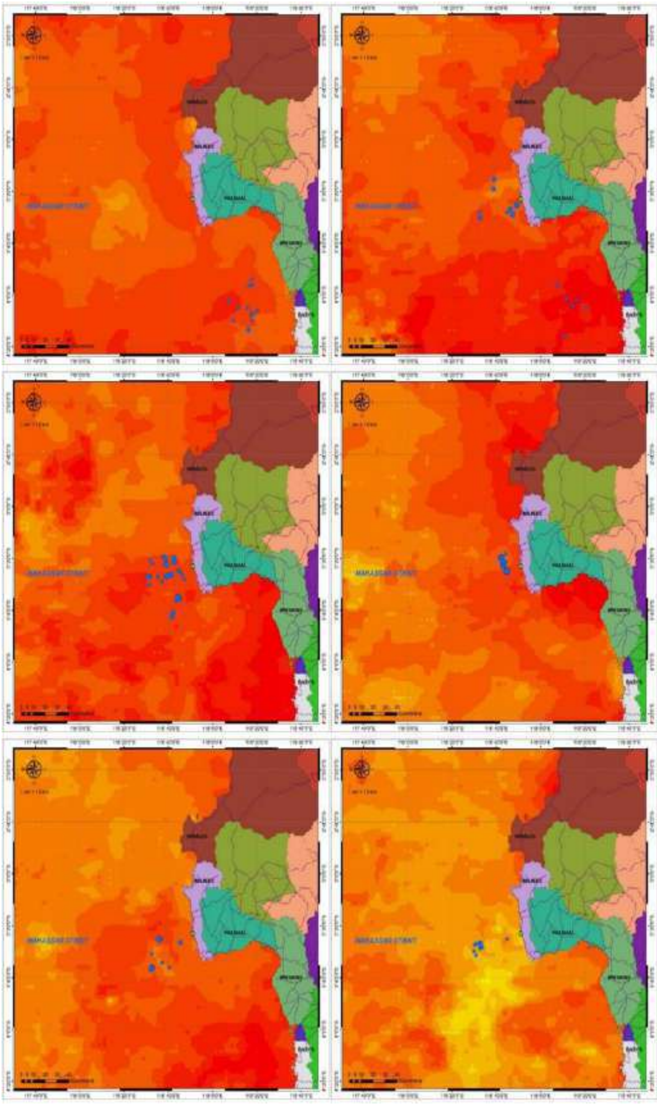

Fig.3: Distribution of SST (°C) and catch of flying fish (H. oxycephalus) (kg) in September 2016-February 2017

Chlorophyll-a (Chl-a) concentration during boreal winter (September 2016 – February 2017) revealed less productivity in most central of Makassar strait, except in the coastal region around Majene bay duriing September – October 2016 in the range of 0.1 - 0.9 . mg.m^{-3}. Chl-a expanded broadly along the main pathway of ITF and coastal areas in the west Sulawesi province with Chl-a concentration increase in the range of 0.1 – 1.3 . mg.m^{-3}. Figure 4 introduces the Chl-a concentration superimpose with the flyingfish catch during boreal winter in the central of Makassar strait.

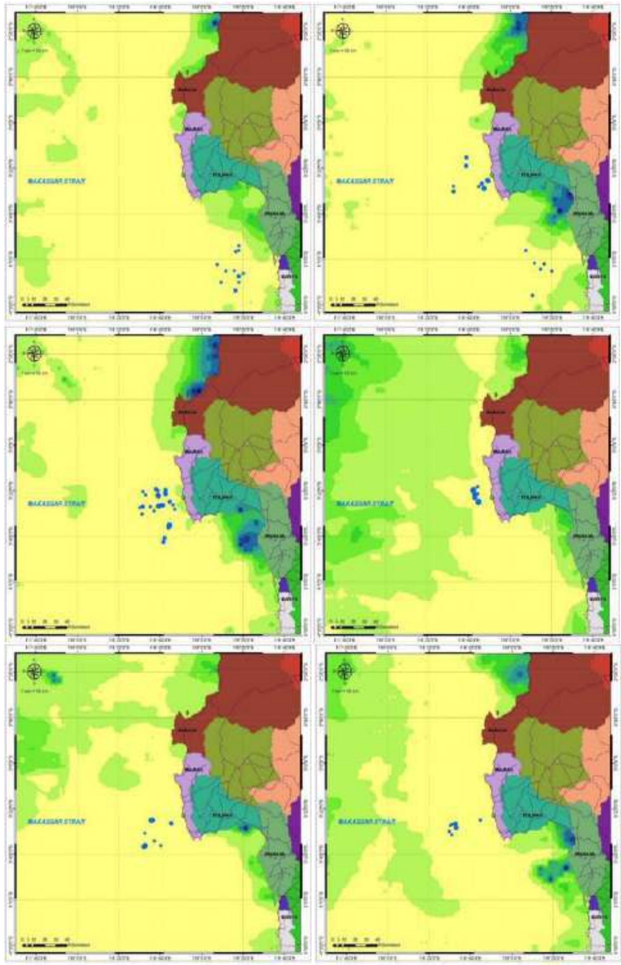

Fig.4: Distribution of CHL-a (mg.m^{-3}) and catch of flying fish (H. oxycephalus) (kg) in September 2016-February 2017

3.2 DISCUSSIONS

High flyingfish CPUE occured in September and October 2016 located off Pinrang water surrounding with relatively homogeneous high temperature distribution in that region. In the following month at the rest of boreal winter during November 2016 – February 2017, the flyingfish CPUE moved to the north in the central of Makassar strait around off Majene water where the hotspots associated with frontal areas. The high flyingfish catch is likely favorable on higher temperature in the range of 30.5 – 31^{0}C during September – October 2016 in the off Pinrang water and reduces to less temperature in the range of 29.5 – 30^{0}C in the rest of boreal winter during November 2016 – February 2017 constrained by frontal areas oround the hotspots in the Majene water.

Less Chl-a concentration during September – October 2016 infers that high flyingfish CPUE during that transition period to boreal winter does not favorable to high flyingfish catch off the Pinrang water. Frontal region

http://dx.doi.org/10.22161/ijeab.4415 ISSN: 2456-1878

revealed by SST distribution around hotspots consistent also seen on the Chl-a distribution during the rest of boreal winter from November 2016 until February 2017 around Majene water.

Figure 5 shows ECDF analysis to identify oceanographic variable of SST favorable to potential high flyingfish catch in the central Makassar strait. The cumulative dustribution curved fifference between two functions has confident level of 95%. The result suppoted the qualtitative analysis on the stronger association of high flyingfish CPUE with the SST in the range 29.5 – 31.0 ^{0}C as shown on Fig. 5 for September 2016 ECDF analysis.

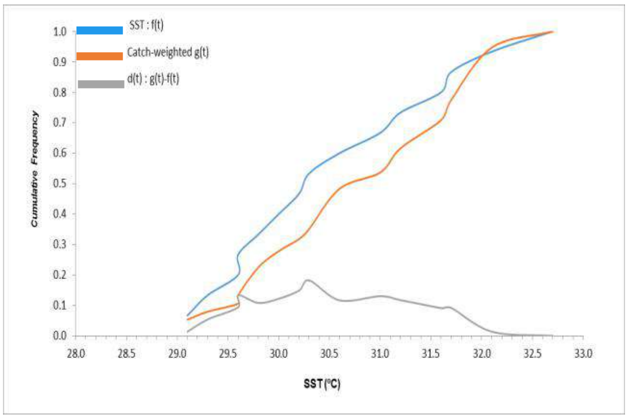

Fig.5: Empirical Cumulative Distribution Function for the SST as weighted by flyingfish catch and also absolute difference of the two curved functions in September 2016.

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High flyingfish CPUE in September and October 2016 was associated with high temperature and had stronger favourable condition with SST compare to Chl-a (ECDF analysis figure is not shown). What cause this strong relatioship occurred around off Pinrang water compare to the less flyingfish CPUE around Majene water during the rest boreal winter from November 2016 until February 2017. Figure 6 is taken from Metzger et. al., 2010 performing mean current system during 2004-2005 simulated by HYCOM in the Makassar strait. There is eddy around hotspot in the off Pinrang water. It is analysed that the high flyingfish catch during September was due to eddy in that associated region.

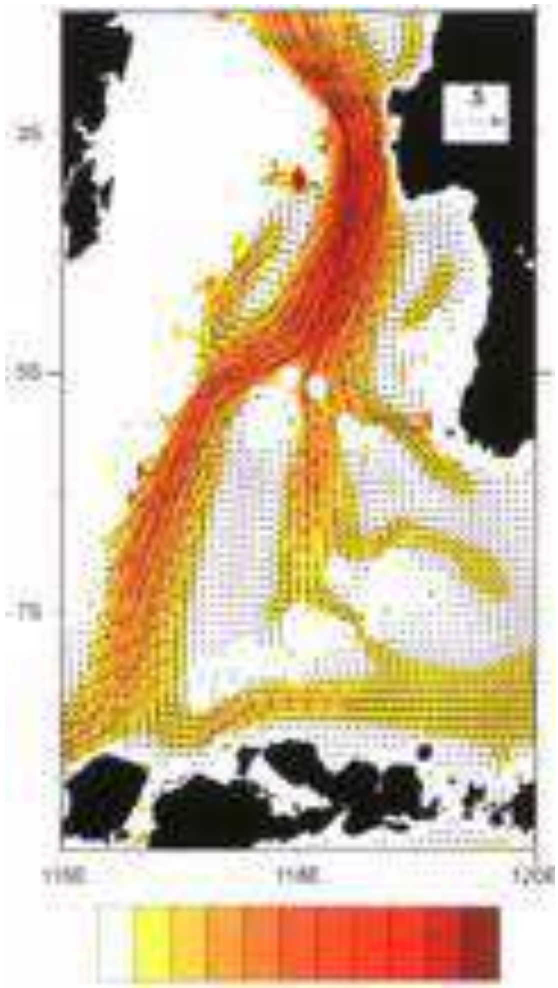

Fig.6: HYCOM mean simulated circulation in the Makassar strait during 2004-2005 (Fig. Taken from [16]).

IV. CONCLUSION

There are two prominent hotspots for the potential flyingfish catches in the central of Makassar strait: firstly in the coastal water off Pinrang region during boreal winter transition (September to October 2016) and secondly in the Majene water during the rest of boreal winter from November 2016 until February 2017. High potential flyingfish catch in the coastal water off Pinrang region was analysed due to eddy in that region, meanwhile around Majene water caused by frontogenegis as shown by SST and Chl-a in the renges of 29.5 – 310C and 0.1 – 0.9 mg.m-3. ECDF analysis indicated that SST has stronger association compare to Chl-a on the increase of flyingfish catch.

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Herbicides and its role in Induction of Oxidative Stress- A Review

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***Abstract*— *Herbicides are one of the most extensively used classes of pesticides, which provide a convenient, economical and effective way to manage weeds. However the regular and endless use of herbicides affects environmental, ecological, and human health. Herbicides can be classified in several ways but the most common method of classifying herbicides is by their mode of action and target site. Several stress events generated upon the herbicide action can lead to oxidative dis-balance in various non-target species. Most of the perturbations caused by herbicide treatment in plants are related to ROS generation. Overproduction and accumulation of ROS result in metabolic disorders and can lead to oxidative destruction of the cell. This review provides a brief overview of alterations in enzymatic antioxidants on exposure to different herbicides in various experimental models.*

***Keywords*— Herbicides, Antioxidants, Oxidative stress.**

I. INTRODUCTION

Pesticide is defined as any substance or a mixture of substances (chemical or biological) that deters, incapacitates or kills pests. Pesticides are generally used to eliminate or hinder the growth of a variety of agricultural pests that can damage crops, livestock and reduce farm productivity. There are many different types of pesticides, each is meant to be effective against specific pests and minimize the losses. Besides their widespread use and as a friend to farmer, these agricultural pesticides create an imbalance in the ecosystem and add to that most of the pesticides are broad spectrum, resulting in affecting other organisms including humans directly or indirectly. According to Kumar et al. 2013 extensive use of pesticides has a harmful impact on biological diversity resulting in biodiversity loss. Pesticide use raises a number of environmental concerns. A report (Miller GT 2004) says that over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. A recent study (Fan 2017) found nearly 3000 children were poisoned by pesticides in eastern China's Zhejiang province between 2006 and 2015, with most cases occurring during the farming season. As the substituent of chemical pesticides (Jafarbeigi et al. 2014), bio-pesticide use is quickly increasing and they are expected to become the predominant pesticides in the future. Herbicides are one class of pesticides used to prevent or eliminate weeds. Herbicides can be broadly classified into 2 types, Contact and Systemic herbicides. Contact herbicides kill only, whereas the systemic herbicides are absorbed by the roots or foliage and trans-located throughout the plant. Herbicides ensure a convenient, economical, and effective way to help manage weeds. Weeds reduce the yield and originality of valuable commercial crops, ornamentals, forestry, and turf grass. Weeds also damage crops and other landscapes in a secondary way, serving as hosts for a variety of insects and fungi. However, the regular and endless use of herbicide carries risks that include environmental, ecological, and human health effects. It is important to understand both the benefits and disadvantages associated with chemical weed control before selecting the appropriate control.

Herbicides can be classified several ways, including by weed control spectrum, labelled crop usage, chemical families, mode of action, application timing/ method, and others. Many factors determine when, where, and how a particular herbicide can be used most effectively. A common method of classifying herbicides is by their mode of action and target site. Herbicide mode of Action is related to herbicide treatment and is a step by step process. Each herbicide mode of action (MOA) has a specific target site (TS) which is referred to as a mechanism of Action (MA). This is usually an enzyme/protein which is inhibited by the herbicide at a molecular level. The MOA for some herbicides induces the generation of ROS in plants as secondary effects after the specific TS are sufficiently inhibited. Caverzan et al. 2019 reports that after the active herbicide reach and inhibit the TS, a series of stress events are initiated by the signalling of plant defense systems against perturbations. In this case, the oxidative stress generated is responsible for an important part of cellular and tissue damage**.** From total known groups of herbicides classified according to the mode of action, 71% of them are known to cause ROS overproduction after their target site inhibition.

Globally, (Heap 2014) herbicides are the predominant method for controlling weeds in modern crop production, contributing to protecting the crop yield and economic profit. Cobb AH and Reade PHR et al. 2010 reports that despite the inherent selectivity mechanisms that facilitate crop production, herbicides can cause some phytotoxicity to crop plants and cause reductions in leaf area index (LAI), shoot dry weight (SDW), plant height, and alterations in plant metabolism by generating ROS. Most of the perturbations caused by herbicide treatment in plants are related to ROS generation. Overproduction and accumulation of ROS results in metabolic disorders and can lead to the oxidative destruction of the cell. They also pointed that the response time for oxidative stress occurrence and visible plant damage varies with the herbicide mode of action, type of herbicide and formulation, plant species, development stage, and environmental conditions. For example, paraquat (photosynthesis inhibitor—PSI) damage could be observed from 2 hours after treatment under light conditions, and susceptible plants die from 3 to 7 days after. On the other hand, the first visible plant symptoms from glyphosate and plant death for susceptible species may occur around 5 days and 7 to 15 days, respectively. Herbicide Resistance Action Committee (HRAC 2019) has classified some of the herbicides which show ROS production at some phase of their mechanism of action. Some of the herbicides kill plants by direct ROS production while others cause ROS production as a secondary effect. Table 1 gives the list of Herbicide chemical family which directly produce ROS upon action and which produce ROS as a secondary effect.

Global Herbicide usage

Herbicides are used to destroy weeds and are still the largest product type accounting for 47.6 % of global pesticide sales (Vats 2014) followed by insecticide 29.4 %, fungicide 17.5 % and others (5.5 %). According to Wenjun Zhang 2018, Global insecticides, herbicides, and fungicides & bactericides use and cost / benefit declined with time since 2007. Conversely, the cost/benefit of triazoles/diazoles and the use of triazoles/diazoles, plant growth regulators, and amides, have significantly increased since 2007. In his survey, he concluded that in case of herbicides the use of amides and other herbicides have continually increased since 1990. The use of triazines, urea derivates, uracil and bipiridils increased with time during 1990 and 2007, but bipiridils use declined since 2007. According to the Linear regressions and projection of global pesticide use made by him it shows that Tones of active ingredients of herbicides have been increased till 2014. Ascending trend was seen in herbicides Triazines, Amides, urea derivatives, Bipridils, uracil and other herbicides. Statistically significant regression was seen in amides and other herbicides during 1990-2007 and during 2007-2014. In the survey conducted in 2014, it was reported that amides is the most used herbicides, followed by phenoxy hormone products, bipridils, triazines, urea derivatives. In 2016, the registrations of the three major types of pesticides accounted for 92.4% of the newly registered in the year, and the registrations of fungicides & bactericides and herbicides exceeded that of pesticides, of which 774 were fungicides & bactericides, 749 were herbicides and 560 were insecticides. Fan 2017 reported that only 30-40% of pesticides directly act on target crops and pests. Therefore, if pesticides fully function without any waste, by using various accurate tools and methods, ~0.18 to ~0.24 g pesticide use (total) / kg crop production, or ~0.81 to ~1.08 kg / ha of pesticide use (total) are the most ideal indices for pesticide use (total) at the present crop yield levels and production conditions. From their report, the estimated cost / benefit (g herbicides use / kg crop production) for Brazil, Canada, France, Germany, Japan, Mexico, UK, and USA during 2017 -2020 are ~1.05, ~0.80, ~0.30, ~0.25, ~0.41, ~0.35, ~0.20, and ~0.45, respectively, and the estimated herbicides use during this period are ~3.4, ~2.1, ~2.1, ~2.1, ~4.1, ~1.6, ~1.6, and ~2.0 kg / ha, respectively.

II. EFFECT OF HERBICIDES ON NON TARGET SPECIES AND ENVIRONMENT

Herbicides are the most widely used class of pesticides, accounting for more than 60 % of all pesticides applied in agriculture (Kniss AR 2017). An increasing number of epidemiological studies have suggested that current levels of exposure are associated with risks to human health, including chronic diseases, cancers, neurological deficits, birth defects, and reproductive disorders. Pesticides can produce adverse physiological or biological effects, with a variety of biochemical changes at the molecular, cellular, or tissue level. McCauley LA et al. 2006 states that the most common biomarkers used to assess pesticide effects are related to DNA and RNA damage, modulation of gene expression, and oxidative stress. Study by Benbrook CM, 2016 reports that the widespread application of glyphosate to crops has spurred the spread of tolerant and resistant weeds in the US, and worldwide, which in turn has created the need for more frequent applications at higher concentrations. In 2015, IARC classified glyphosate as a "probable human carcinogen" (IARC 2016), although in the same year EFSA (European Food and Safety Authority) declared that "glyphosate is unlikely to pose a carcinogenic hazard to humans" (EFSA 2016) based on typical, expected exposures to the general public. Among the general population, the information available (Curwin BD et al. 2007; Kruger M et al. 2014), suggests that mean levels of glyphosate in urine samples are generally below 4 µg/L. However, Acc to Varona M et al. 2009 in areas where aerial spraying is administered, mean urinary concentrations in the population above the LOD can reach as high as 7.6 µg/L. Studies like Kongtip P et al. 2017 shows that even expectant mothers, a population that typically avoids excess chemical exposure, can have serum glyphosate levels as high as 189 µg/L. Curwin BD et al. 2005 detected glyphosate in the dust of both farming and non-farming households, indicating that this exposure extends beyond occupational settings. According to the EPA (Environmental Protection Agency) assessment the residues in food ranged from 100 µg/L in vegetables like tomatoes and pepper to 200,000 µg/L in peppermint and peppermint oils.

Some herbicides may have lethal or sublethal, direct and/or indirect effects (Moffett JO et al. 1972), on pollinators, whereas others do not appear to cause any effects. Herbicide such as paraquat is highly toxic to honeybees when applied topically Whereas when fed to honey bee colonies (Morton HL et al. 1972), the herbicides 2,4-D and 2,4-trichlorophenoxyacetic acid do not appear toxic to adult bees but can negatively influence brood development. Study done on microalgal species (Prado et al. 2009) also reports adverse effects caused by paraquat on common fresh water green microalga. They have reported that paraquat induces alterations in the elemental and biochemical composition of non-target microalgal species. Despite the limited use, herbicide dicamba and 2,4-D are often responsible for injury to non target plants but effects of these herbicides on insect communities are poorly understood. Study by Bohenblust EW et al. 2016 reports that sublethal doses of dicamba approximating particle drift events can delay, reduce, or prevent flowering of plant species found in agricultural landscapes and lead to reduced visitation by pollinators. Sublethal doses of dicamba (0.1–1% of the field application rate) caused delays and reductions in flowering of susceptible and agro ecologically significant plant species.

Phenoxy acid (PA) herbicides often persist in the soil environment under natural conditions leading to leaching (Baelum J et al. 2012), in groundwater reservoirs. The herbicides reach the groundwater even though PA degraders are commonly found in natural soil environments. Silveyra GR et al. 2018 hypothesized that atrazine (a pre and post emergent weed controller) reduces the ovarian growth of Procambarus clarkii (female red swamp crayfish), presumably by interfering with the hormonal regulation of gonadal growth in females. The results indicate a clear inhibition of ovarian growth in crayfish exposed to atrazine, especially at the highest concentration used. Supporting the above results, Alvarez et al. 2015 reported a delay in ovarian rematuration of N. granulata with atrazine exposure, during the reproductive period. They have shown that atrazine was able to inhibit vitellogenin production in Procambarus clarkii females, via inhibition of its expression in both ovary and hepatopancreas, therefore reducing ovarian growth. On the other hand, atrazine produced higher titters of estradiol, which could have counteracted some of the inhibiting effects mentioned above, particularly in the hepatopancreas. Wetzel LT et al. 1994 also reported Atrazine as a cause of formation of mammary gland tumours in female Sprague-Dawley rats, which implies that it may be carcinogenic. Remera, a French national birth defect agency, recently identified clusters of children born with malformed limbs in 3 rural regions in france. When they looked into the causes, they proposed that the limb malformations could result from exposure to environmental pollutants and toxins, which include pesticides & herbicides that are used in nearby farms (report by French national registry, March 2019). A study (Helen et al. 2018) on black grass reports that herbicides can no longer control the weeds that threaten the crop productivity and food security in UK because plants have evolved resistance and they found that the extent of herbicide resistance was primarily dictated by the historical intensity of number of herbicide applications.

III. HERBICIDES AND INDUCTION OF OXIDATIVE STRESS

In crops field, many herbicides are used to control weed, however, these toxicants can remain in the soil for long periods and can contaminate rivers and subterranean waters. Thus, these chemicals can promote several ecotoxicological and environmental effects (Carla A et al. 2018), as they elicit alterations on antioxidant system in non-target organisms, as on sensitive plants. Herbicides like fomesafen and sulfentrazone are inhibitors of protoporphyrinogen oxidase (PROTOX) system. Protox inhibition leads to generation of singlet oxygen through the action of protoporphyrinogen oxidase enzyme. This O_2 in the singlet state is responsible for peroxidation of lipids in cell membranes. As a cascade effect (Oliveira et al. 2002), free radicals are formed resulting in the degradation of lipids and proteins, leading to loss of chlorophyll, carotenoids and disruption of cell membranes. Various abiotic stresses like extreme temperatures, high winds, and droughts can lead to the overproduction of Reactive Oxygen Species (ROS) in plants, which are reactive and toxic causing damage to proteins, lipids, carbohydrates and DNA, which ultimately results in oxidative stress (Gill and Tuteja 2010). Among the main enzymatic antioxidant defenses, are superoxide dismutase (SOD), ascorbate peroxidase (APX), guaiacol peroxidase (GPX) and catalases (CAT), which promote the control of ROS levels. Thus, the knowledge of role of SOD, APX, CAT and peroxidases enzymes defines the status of the antioxidant system, which is very important in the reduction of the levels of ROS in the cells (Apel and Hirt 2004), avoiding the oxidative stress promotion. The increase in SOD activity may be one of the possible reasons for an increased lipid peroxidation in plants treated with oxyfluorfen, while, as the activity of SOD increases, hydrogen peroxide levels also increase. SOD, considered the first line of defense against the damage caused by ROS (Wang et al. 2012), catalyzes the conversion of superoxide anion (O_2-*) into H_2O_2 and O_2 in chloroplasts, mitochondria, cytoplasm and peroxisomes.

The herbicides pendimethalin and oxyfluorfen causes lower net photosynthesis, increase substomatic CO_2, a lower water use efficiency and carboxylation. Langaro A.C. et al. 2017 reports that even selective herbicides registered for weed control in rice crops cause phytotoxicity, reduce height and alter the metabolism of plants, generating reactive oxygen species, activating enzymatic and non-enzymatic defense mechanisms and results in the degradation of photosynthetic pigments and in reduced protein content. Table 2 gives a brief overview of changes in antioxidant parameters in various experimental models after exposure to different herbicides. Generally, dysfunction in the antioxidant system results in establishment of oxidative stress, which could progress to lipid peroxidation.

Study by Carla A et al. 2018 found that Fomesafen causes a significant decrease in CAT activity in *V. sativa*. *R. satívus* and *L. albus*, related to the herbicide concentration increase. On other hand, CAT activity increased significantly for *A. sativa*, with the increase of Fomesafen concentration. Herbicide sulfentrazone causes a significant decrease in GPX activity for *A. Sativa* (37%), *R. sativus* (89%), *L. albus* (95%), and *V. Sativa*. This study revealed the effect of herbicide exposure in the promotion of oxidative stress and response of antioxidant defense mechanism in species used as green manure. Decrease in the CAT enzyme activity, is directly related to the increase in the lipid peroxidation. Several studies like (Agostinetto et al. 2016) demonstrated the effects of herbicides bentazon, clodinafop, iodosulfuron, metribuzin, metsulfuron and 2,4-D under *Rhapanus sativus which* shows an increase in CAT activity. MDA accumulation in absolute values was observed in the treatments with metsulfuron and 2,4-D. Increasing fomesafen and sulfentrazone concentration (≥ 0.25 kg ha-1 and 0.6 kg ha-1) induced increase in reactive oxygen species levels in the plant which could weaken the antioxidant defense system.

Atrazine, a widely use herbicide, has been classified as a potential endocrine disruptor (Graymore M et al. 2001), especially for freshwater species. This report says that in waters adjacent to treated fields, as well as in groundwater, atrazine concentrations were as high as 1 mg/L. Although this herbicide is not commonly absorbed in sediments (Jablonowski ND et al. 2011), the fraction associated to this substrate can be very significant. It is seen that mixture of atrazine with other pesticides such as glyphosate caused both lipid peroxidation and DNA damage (Santos and Martinez 2014) in several tissues of clams. According to silverya GR et al. 2018 a metabolic effort (evidenced by the augmented lactate production), together with the increase of glutathione levels were observed, evidencing a clearly stressful effect of the herbicide. Thus, the role of antioxidant enzymes in stress situations is to control the accumulation of ROS (Sharma et al. 2012), limiting oxidative damage. Lipid peroxidation is one of the most investigated consequences of the actions of ROS on membrane structures (Amri and Shahsavar 2010), being one of the first responses to damage induced by stress in plant tissues. As for atrazine effects on antioxidant enzyme activities, sub-chronic exposure to an environmentally relevant concentration of atrazine (0.3 μg L-1) (Chromcova L et al. 2013), caused an increase in the activity of CAT, GPx, GST, and SOD in common carp embryos and larvae, whereas sub-chronic exposure to environmentally relevant concentration of atrazine-2-hydroxy (0.66 μg L-1) did not affect their activities. In adult carp, Xing H et al. 2012 reported that a 40-day exposure to atrazine in concentrations above 42.8 μg L-1 resulted in a decrease in CAT, GPx, and SOD activities. In adult zebrafish (*Danio rerio*), a 28-day exposure to low atrazine concentrations, including the environmentally relevant 0.3 μg L-1 caused a decrease in CAT (Blahova J et al. 2013), but acc to Zhu LS et al. 2011 exposure to higher concentrations of atrazine (>100 μg L-1) for 14 or 21 days resulted in an increase in CAT and SOD activities in the liver homogenate. Two studies in drosophilids (Torres C et al.1992; Marcus SR et al. 2016) observed developmental and genotoxic effects, which prompted Figuera et al. 2017 to expose the embryos (newly fertilised eggs) of the fruit fly *Drosophila melanogaster* to atrazine concentrations ranging between 10 and 100 μmol L-1 through diet until they developed into adult flies. Larvae showed no changes in ROS levels, the adult flies did, so they concluded that redox imbalance must have been related to changes in metabolism after metamorphosis. In another study (Williams JR 2016), honeybees in a laboratory were exposed to atrazine concentrations ranging from 0.1 to 10 μg L-1 for 24 hours, whereas hives in the field were treated with 10 μg L-1 of atrazine a day for 28 days. GPx and GST activities dropped, whereas MDA levels increased in both the laboratory and hive honeybees. In a number of studies (Singh M et al. 2010, 2011; Shirisha K and Mastan M 2013) sub-chronic exposure to 300 mg kg-1 of atrazine increased the activities of CAT, SOD, GPX, and GST and decreased GSH levels in blood and liver. At doses from 25-200mg/kg (Abarikwu SO et al. 2010) exposure to atrazine lowered CAT activity in rat testis.

According to study done by Langaro A.C.et al. 2017 on rice plants they found that exposure of pre-emergent herbicides oxyfluorfen and oxadiazon resulted in increased activity of superoxide dismutase & catalase enzymes compared to control. When evaluated ascorbate peroxidase activity, there was a higher enzyme activity in plants treated with oxadiazon and pendimethalin. In order to keep ROS under control plants balance ROS & their antioxidant system. Thus, an efficient combination of SOD, CAT and APX would minimize the effects of oxidative stress, (Damanik et al. 2012) playing an important role in the regulation of ROS.

Terbuthylazine (N2-tert-butyl-6-chloro-N4-ethyl-1,3,5- triazine-2,4-diamine) has become the key triazine in Europe (Sass JB. and Colangelo A. 2006) in the last two decades. It is also used as an aquatic herbicide (WHO 2018) to control submerged and free floating weeds and algae in water courses, reservoirs, and fish ponds. According to the European Food Safety Agency (EFSA), it poses a high risk to non-target plants in the off field areas. EFSA has also warned about high toxicity of both terbuthylazine and its metabolite desethylterbuthylazine to aquatic organisms. This herbicide persists in the environment and has a tendency to easily move from treated soils to water compartments (Calderon MJ et al. 2016; Stipicevic S et al. 2017) through runoffs and leaching. Very little is known about effects of terbuthylazine on oxidative stress parameters and antioxidant defence in mammals. Furthermore, Acc to EEA 2011, s-triazines have been identified as substances hazardous to the aquatic environment and have been included in the EU Priority Pollutants List. It is evident that environmentally relevant concentrations of terbuthylazine do not generally affect the oxidant/ antioxidant balance, but its metabolites do turned. In other environmentally relevant organisms such as drosophila and honeybees (Tanja Z S et al. 2018), atrazine turned out to be more of a concern because of evident lipid peroxidation and antioxidant depletion.

The mechanism of the toxic action of phenoxy herbicides, including 2,4-D and its metabolites (Bukowska B et al. 2008; Busi R et al. 2018), toward weeds is associated with the generation of ROS and lipid peroxidation. 2,4-D presence led to a decrease in fungal catalase activity, (given in Table 2) associated with a higher amount of thiobarbituric acid-reactive substances (TBARS). The higher TBARS level found in the *U. isabellina* biomass from 2,4-D cultures confirmed the induction of oxidative stress. This phenomenon results from a disturbance between the generation of ROS and their removal by the antioxidant defense system. According to Busi R et al. 2018 susceptible plants treated with 2,4-D, production of H_2O_2 and reactive oxygen species leads to plant death. High levels of MDA were also observed in Escherichia coli strains exposed to the herbicide 2,4-dichlorophenoxyacetic acid. According to Balague et al. 2001 bacterial cells modify their membrane lipid molecules to avoid the toxic effects of the herbicide. This study demonstrated that bacteria exposed to 2,4-D may reduce membrane fluidity to withstand chemical injury; because of lipid–protein interactions, the transport processes of molecules may be diminished. Study (Duchnowicz P and koter M 2003) has shown that 2,4-D caused lipid peroxidation as well as the increase in membrane fluidity at the 16 carbon atom of fatty acids and also hemolysis in human erythrocytes. Suwalsky M et al. 1996 has also shown that 2,4-D disturbs phospholipid bilayer integrity which is essential for the proper condition of cell membrane. The authors postulated that morphological transformation of erythrocytes might be the result of specific oxidative transformation of membrane skeleton. 2,4-D leads to the formation of methemoglobin (Bukowska B et al. 1998) which is unable to transport oxygen. This conversion is associated with superoxide anion production (Mishra HP and Fridovich K 1972) and thereby with the formation of products such as hydrogen peroxide or hydroxyl radicals that may be derived from superoxide anion itself.

IV. CONCLUSION

Different herbicides react differently on various non target species. These are very effective in managing the growth of weeds, known to cause lower growth and productivity in plants, but on the other hand these herbicides are known to cause ill effects and severe perturbations in non-target organisms. One mechanism which leads to environmental, ecological and human health risks is ROS imbalance. Antioxidant alterations generated in response to herbicide mode of action is responsible for an important part of cellular and tissue damage. In this review, I have tried to summarise the oxidative levels or antioxidant alterations caused by different herbicides in several non target species. In most of the studies it is noted that overdose or erratic application of herbicides leads to oxidative damage and alterations in antioxidant parameters.

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Table 1: Herbicide chemical family which directly produce ROS upon action and which produce ROS as a secondary effect. (Herbicide Resistance Action Committee, Jan 2019)

Direct ROS production	ROS- secondary effect
Triazines, Triazinones Uracils, Ureas Nitriles Benzothiadiazoles Phenyl- pyridazines Diphenyl ethers Phenylpyrazoles N-phenyl-phthalimides Oxadiazoles Thiadiazoles Triazolinones Pyrimidinediones Bipyridylium Isoxazolidinones Pyridazinones Pyridinecarboxamides Isoxazoles Triketones Pyrazoles Phosphinic acid	Imidazolinone Sulfonylurea Sulfonamides Sulfonylaminocarbonyl- triazolinones Glycines Phenoxy Benzoic acid Carboxylic acid Phthalamates Semicarbazones

Table 2: Effect of different herbicides on Antioxidant parameters in various experimental models.

Herbicide	Experimental model	Exposure time & dose	Antioxidant levels	Reference
Terbuthylazine	Zebra fish	28days, >400µg/L	↓TBARS (1000µg/L) ↓GR (700,1000 µg/L) ↑GST (400,700 & 1000 µg/L)	Plhalova et al. 2012
Terbuthylazine -2- hydroxy	Marbeled cray fish eggs	62 days, (0.75-750µg/L)	↓SOD (375,750 µg/L) ↓TBARS (375,750 µg/L) ·CAT ·GR	Koutnik et al. 2017
Terbuthylazine-desethyl	Fish-common carp	36 days, (1.80µg/L)	·CAT ·GSH ↓GR ↓SOD ·TBARS	Velisek et al. 2016
Terbuthylazine	Rat	28 days, (0.004,0.4 &2.9mg/kg)	↓Plasma SOD (0.004 &0.4 mg/kg) ↓Plasma CAT(2.9mg/kg) ↑Erythrocyte SOD (2.9mg/kg) ↑GPx(0.4 mg/kg)	Kisby GE et al. 2009
Paraquat	Drosophilla melanogaster	12h, (0.25µM-25mM)	↑SOD ↑CAT	Krucek T et al. 2015
Atrazine	Honey bees & hives	24h,(0.1-10µg/L) 28days (10 µg/L)	↓GPx ↓GST ↑MDA	Willims JR 2016

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Atrazine	Rat Blood &liver	300mg/kg	↑CAT ↑SOD ↑GPx ↑GST ↓GSH	Singh et al. 2010 & Shrisha K and Mastan M. 2013
Atrazine	Rat testis	25-200mg/kg	↓CAT	Abarikwu SO et al. 2010
Acetachlor/ Metachlor	Soil Bacterial isolates	62 & 620mM/ 34 & 340mM (24h)	↑CAT ↑MDA	P.F. Martins et al. 2011
2,4-D	Mouse testis	14 days, (100,200mg/kg)	↑MDA ↓SOD ↓CAT	Zhang D et al. 2017
2,4-D	Umbelopsis isabelina (fungus)	24h,120h (100mg/L)	↓CAT 24h (34.43%), 120h (21.8%) ↑TBARS(38%)	Bernat p et al. 2018
2,4-D	Gold fish liver	40 days	↑GSSG ↓GSH	Zhang et al. 2004
2,4-D	Gold Fish gills	96h, (1,10,100mg/L)	↑MDA ↑SOD (29 & 35% at 10& 100mg/L) ↑CAT (41% at 100mg/L) ↑GPx (19-33%) ↑GSSG (49% at 100mg/L) ↓GSH (20% at 100mg/L)	T. M. Atamaniuk et al. 2013

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Consumer behavior and consumption practices towards less documented wild leafy vegetables among rural households in Dodoma Region, Tanzania

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Abstract— *Inadequate dietary diversity is a key challenge in many countries in sub-Saharan Africa. Diversifying diets with African indigenous vegetables is a sustainable way to supply a variety of nutrients to household members due to their richness in vitamins and minerals. Understanding the preferences and consumption practices of different varieties of wild vegetables is important information for agricultural promoters and is scarcely explored in Tanzania. This study aimed to gain an understanding of consumer behavior and consumption practices of wild vegetables in semi-arid areas in Tanzania in order to inform food policy and agricultural promoters. The study was conducted in two villages; Ilolo and Idifu from the semi-arid Dodoma region in Tanzania. Focus group discussions were conducted with forty women from both villages because women are more involved in cultivation, gathering and preparation of vegetables. Information collected in the focus group discussions included; perceptions, preferences, beliefs and taboos associated with consumption of wild vegetables. Participants reported that wild vegetables are seasonally available with most time of the year being scarce. The majority of the women reported consuming the wild vegetables due to good taste, abundance of nutrients, availability/affordability (they are mostly free), and because the other sources of relish are usually scarce. The most common wild vegetables that were consumed in the past 24 hours preceding the focus group discussions in the two villages included Ipomoea pandurate which is locally known as chiwandagulu and Corchorus trilocularis commonly known as ilende. For most vegetables, leaves and stems were common parts consumed. The women in both villages ranked Corchorus trilocularisas the most preferred wild vegetable. Women also reported some medicinal values attached to some of the wild vegetables such as Bidens Pilosa leaves which are claimed to increase blood. Generally, wild vegetables have the capability to escalate their significance to household income generation if farmers are given the chance to market them. Also domestication and promotion of these vegetables may help to enhance food and nutrition security.*
Keywords— ***Wild, vegetables, rural, women, consumption.***

I. INTRODUCTION

Inadequate dietary diversity is a key challenge in many countries in sub-Saharan Africa, Tanzania inclusive and is one of the causes of malnutrition in rural farming communities (TDHS, 2016; Thompson and Meerman, 2013). This situation perseveres because most households depend on carbohydrate-rich staples while merely small amounts of animal products, fruit, and vegetables are consumed, and therefore diets lack a variety of nutrients needed for good nutrition and health. Diversifying diets with African indigenous vegetables is a sustainable way to supply a variety of nutrients to the household members while battling micronutrient deficiencies and related health problems, mainly for the poor rural households (Keding, 2007). African wild vegetables are wild vegetables which are not cultivated and whose leaves and/or young shoots and flowers are consumed (Abukutsa-Onyango, 2007). African wild vegetables are important due to their influence to food security, nutritional status and household income in many areas in developing countries. They are a source of minerals, fibre and vitamins which are crucial components of a balanced diet (Ojiewo et al., 2013). Wild vegetables may not inevitably be native to an area, but due to their long time use and preference by societies, they have been integrated into wild customs and culture (Keding, 2007). At present, the demand for wild vegetables is very squat and this may be contributed by lack of awareness of consumers regarding the importance of these vegetables to health. Their production and consumption is also very low due factors such as cultural aspects, perceptions and lack of awareness (Afari-Sefa et al., 2016). Studies on wild vegetables in Tanzania and other sub-Saharan countries mainly focused on the production, availability and marketing of traditional (common) vegetables without examining consumer behavior and consumption practices. African wild leafy vegetables which have not been domesticated, but rather gathered from the fields where they naturally occur are almost not explored. Also, it is challenging that information about Sub-Saharan Africa's yearly consumption or production of indigenous vegetables remains mysterious while statistics for cash crops is widely known (Smith & Eyzaguirre, 2007). Understanding of the preferences and consumption practices of different varieties of wild vegetables is important information for agricultural promoters and is scarcely explored in Tanzania. Promoting the inclusion of African wild vegetables in food policy is important first for their richness in nutrition and their probable influences to the household incomes to improve rural livelihoods.

This paper therefore aims to gain an understanding of consumer behavior and consumption practices of wild vegetables in semi-arid areas in Tanzania. While not the best region for vegetable cultivation, Mvumi ward in Dodoma region delivers an opportunity to learn how communities in semi-arid areas have been able to meet their dietary needs during the different seasons of the year. The results of this study will add to the existing knowledge of wild vegetables in the less studied semi-arid areas and thus aid in their promotion.

II. MATERIALS AND METHODS

Study area

The study was conducted in two villages from the semi-arid Dodoma region in Tanzania. Chamwino district was selected and Ilolo and Mzula villages represented the semi-arid climate. Food production in Chamwino is predominantly rain fed. Dodoma region receives one rainfall season per year with an average of 350-500mm per annum and is characterized by a prevalence of high food insecure areas. The food system in Dodoma is mainly cereal based with pearl millet as the preferred staple. Groundnuts are normally mixed in most of the relishes used together with the main dish. Edible wild products particularly vegetables and fruits are important in the local food menus (Mutabazi, 2013). The Chamwino district imports food crops from other regions during the deficit months. Foods imported include maize, beans and pigeon peas. During the deficit months imported food is sold at a price more than three times its price during the months of plenty. This is because there are no structured local markets in the case study villages but small grain and pulses traders.

Study design and sampling procedure

This study was a sub-study in a larger study of the Trans-SEC project. The main aim of the Trans-SEC study was to improve the food security for the most vulnerable rural populations in Tanzania by applying food securing up-grading strategies along local and regional food value chains. The focus of this sub-study was to explore ways of promoting the utilization of wild vegetables to rural communities that could possibly lead to increased wild knowledge and dietary diversity. Initial meetings were held with the village executive officers and ward representatives for their assistance to obtain representative sample of participants from all sub-villages with a mix of wealth levels. The study population comprised women or caregivers in the sampled households. This study chose to include only women from the selected areas because there has been a comprehensive agreement that women are the knowledge-holders of vegetable cultivation and gathering (Nekesa & Meso, 1997). It was also reported that although agricultural activities are performed mutually among the family members, there is a convincing insight that women usually hold the responsibility for vegetable cultivation. The principal perception is that men are mostly responsible for livestock, main staples and cash crops, whereas women are in charge of the vegetables and other household chores (Obuobie et al., 2006).

The respondent was the mother/ woman or any other person responsible for food preparation and serving in the household. Purposive sampling was used for this study following a pre-defined set of criteria. The participating women were required to sign the form or apply a thumb print (in ink), marking their consent to participating in the study. Permission to conduct the study was granted by the District Commissioners' Offices and Ethical clearance was obtained from the Tanzania National Institute for Medical Research

(NIMR/HQ/R.8a/Vol.IX/2226).The study used a qualitative interpretive description approach (Thorne, 2008) to explore and describe women's knowledge and perceptions and their use of wild green leafy vegetables.

Study instruments

To gain a better understanding of consumption behavior and practices of rural farming communities, focus group discussion was selected as a probable method which allows access and understanding of activities and knowledge of the community that cannot be easily gained from direct observation or individual interviews. A semi structured focus group guide was developed and contained four parts including; variety of wild vegetables in the areas and their preference to farmers, availability and consumption of the wild vegetables and how important they are in the local diets. A structured questionnaire was used for socio-demographic characteristics.

Data collection

A total of four focus group discussions (two in each village) were conducted and each comprised 10 women from the study sample and lasted for about 60 minutes. The focus group discussions were held at the village offices on weekend days. The village office location was selected in order to make participants feel that they were in a location to which they were already used; as villagers usually hold village meetings in the village offices. Household socio-demographic characteristics data for the 40 women who participated in this study was collected by using a structured questionnaire before the focus group discussions.

All participating women were provided with some refreshments before and after the focus group discussions. Participants were seated in a circle in order to enable them to see each other during the discussions thus a sense of togetherness. All focus group discussions were conducted in the local language (Swahili), audio-recorded and transcribed verbatim. Each focus group was done by an interviewer and a moderator who was in charge of operating the recorder, making observations and taking notes. The focus group discussions were conducted in semi-structured layout to make sure that the topics covered were accurate through the different groups and they also assured a certain degree of flexibility within the groups as described by Neumark-Sztainer et al., (1999).

For the purpose of this study, African wild leafy vegetables are any vegetables which have not been domesticated, but are gathered from the fields where they naturally occur. Other vegetables that are either native to the region, or were introduced to it a long time ago to evolve through natural processes or farmer selection, including both wild vegetables and ones traditionally cultivated by the inhabitants of a region (Van der Hoeven et al., 2013) are not included. Information collected in the focus group discussions included; perceptions, preferences, beliefs and taboos associated with consumption of wild vegetables. Here, women were asked to mention common wild vegetables consumed and their sources (the interest was in those gathered in the fields). They were asked to mention eight to ten most important wild vegetables and these were categorized based on factors such as their availability, frequency of consumption and preference. In all these aspects, participants were asked to give very detailed information. Regarding consumption, participants were asked to state vegetable parts they consumed for example leaves, flowers and tubers and the frequency of consumption of such vegetables for instance twice per week depending on its availability. Participants were also asked to mention what types of vegetables were consumed in their households in the past 24 hours preceding the focus group discussion. On another level they were asked about preparation and processing methods and if there were any medicinal aspects attached to the vegetables together with cultural taboos on specific vegetables. Questions on best time of the year in which vegetables were readily available were also discussed.

Data analysis

Participant's socio-demographic characteristics data were analysed by descriptive statistics using SPSS (IBM SPSS 21 for Windows). Qualitative data from the focus group discussions were analysed by considering the themes, contents and concepts acquired from the topics and questions discussed as supporting information about the study. A quality check was carried out on the transcribed data of the focus groups by a research assistant who was fluent in both English and Swahili, to make sure that the information was translated in a correct way without losing the intended meaning. The hand written notes taken during the focus group discussions were used to complement the transcribed information.

III. RESULTS AND DISCUSSION

A total of forty (40) women (median age 42.4 years, range 19.2 - 68.0 years) took part in four focus group discussions. Table 1 indicates the characteristics of these women. About 75% of the households were male headed whereas 22% were

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female headed. As indicated in Table1, most participants had low education level and from a lower socio-economic status.

Table 1: Characteristics of focus groups participants (n=40)

Characteristics	n	%
Marital status		
Married-monogamous	24	60
Married-polygamous	6	15
Widowed	2	5
Divorced	2	5
Single	5	12.5
Cohabitation	1	2.5
Level of literacy of caregiver/mother		
Not able to read or write	11	27.5
Can read and write to some extent	6	15
Can read and write	23	57.5
Occupation of respondent		
Farmer	37	92.5
Self employed	1	2.5
Other	2	5
Total number of people living in the household		
3 to 5	22	55
6 to 8	13	32.5
9 to 12	5	12.5
Education level of respondent		
No education	11	27.5
Primary education	25	62.5
Secondary education	4	10
Total monthly household income		
Less than 100,000 TZS	20	50
100,000-300,000 TZS	17	42.5
More than 300,000 TZS	3	7.5

Due to the fact that the names of all wild vegetables were given by their local names, the wild vegetables were identified with the help from the Department of Crop Science and Horticulture of the Sokoine University of Agriculture. In this study, the majority of wild vegetables were acquired from collecting in the field. However, there were also marked differences among different focus group members across different households regarding the role of wild vegetables in food consumption patterns.

Participants reported that wild vegetables are seasonally available with most time of the year being scarce. The wild vegetables are usually not domesticated but rather gathered from the fields during rainy seasons when they are plenty. Most participants reported that local preservation of wild vegetables is done by open sun drying and it is usually the responsibility of the women/ caregivers of the household. They expressed the desire to preserve more vegetables during the season of plenty to be consumed during dry seasons. The

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majority of the women reported consuming the wild vegetables due to good taste, abundance of nutrients, availability/affordability (they are mostly free), and because the other sources of relish are usually scarce. These reasons for the preference of wild vegetables were also mentioned in other studies (CRS, 2017; Van der Hoeven et al., 2013)

Reasons mentioned in this study to affect wild vegetable consumption were cost of the vegetable if it were to be bought and seasonal availability of the vegetables. Other studies also reported cost and seasonality as major factors impending consumption of nutritious foods (Ruel et al., 2004). On the other hand, another study indicated that regardless of seasonal availability, and other foods being cheaper and readily available, still many households do not consume recommended amounts of these vegetables (Hart, 2005). This could be due to limited knowledge on the importance of such vegetables. Together with factors such as price and seasonality, women reported that consumption of wild vegetables has reduced as people in their communities have other alternatives to meet their needs for vegetables and nutrition. Items such as exotic vegetables, anchovies and dried fish from external markets give variety to daily diets and are regarded as superior food items. Participants added that consumption of wild vegetables is perceived by some of the younger generation as being backward and of less value.

Table 2.Common wild vegetables consumed in the past 24 hours

Local name	Scientific name
Ilende	*Corchorustrilocularis*
Mbwembwe/ Kishonanguo	*BidensPilosa*
Bwete	*Urerahypselodendron*
Chiwandagulu	*Ipomoea pandurata*
Mchunga	*SonchusLuxurians*
Fwene/mchichapori	*Amaranthusgraecizans*
Mlendaufuta	*Sesamumangustifolium*
Matanga	*Cucumisanguria*
Chipali	*Ipomoea obscura*
Mhilile	*Cleome hirta*

Table 2 indicates the most common wild vegetables that were consumed in the past 24 hours preceding the focus group discussions in the two villages. These included *Ipomoea pandurate* which is commonly known as *chiwandagulu* and *Corchorus trilocularis* commonly known as *ilende*. For most vegetables, leaves and stems were common parts consumed (Table 3). Regarding the preparation of vegetables, for almost all the vegetable types mentioned leaves are utilized for consumption, some few such as *Corchorus trilocularis* and *Sesamum angustifolium* utilize the stems and for *Cucumis anguria*, even the flower is utilized. Despite from these vegetables being used for human consumption, some of them are also used as animal feeds; for example the leaves and stems of African night shade. In the majority of households, wild vegetable leaves and stems are being prepared to supplement the main meal, but the quantity of vegetables consumed is rather very small and does not matter to them, only what is available is to be consumed and it is used only to add flavor and make the main meal appetizing.

The women in both Ilolo and Idifu villages ranked *Corchorus trilocularis*as the most preferred wild vegetable and *Ipomoea pandurate* was rated next most popular vegetable in both villages (Table 4). Participants of the focus group discussions also reported some of the vegetables such as *Sonchus luxurians* to be more resistant compared to other vegetables during drought.

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Table 3: Plant parts of wild vegetables used for consumption

Wild vegetable	Plant part		
	Leaves	**Stem**	**Flower**
Corchorustrilocularis	x	x	
BidensPilosa	x		
Urerahypselodendron	x	x	
Ipomoea pandurata	x	x	
SonchusLuxurians	x		
Amaranthusgraecizans	x	x	
Sesamumangustifolium	x	x	
Cucumisanguria	x		x
Ipomoea obscura	x	x	
Cleome hirta	x	x	

Table 4: Ranking of the most important wild vegetables in the two villages

Wild vegetable		Ilolo	Idifu
Local name	**Scientific name**		
Mlendamwage	*Corchorustrilocularis*	1	1
Kishonanguo	*BidensPilosa*	6	10
Bwete	*Urerahypselodendron*	7	6
Chiwandagulu	*Ipomoea pandurata*	2	2
Mchunga	*Sonchusluxurians*	3	3
Fwene	*Amaranthusgraecizans*	8	9
Mlendaufuta	*Sesamumangustifolium*	4	5
Matanga	*Cucumisanguria*	9	7
Chipali	*Ipomoea obscura*	10	4
Mhilile	*Cleome hirta*	5	8

The common methods of preparation of the wild vegetables reported are boiling, steaming and frying in oil, even though most participants reported not to use oil on a regular basis due to its un-availability. Ingredients reported to be used by women are mostly locally available. Most women reported to use groundnuts due to their abundance in the area. Exotic ingredients such as onions were also reported to be added occasionally. A number of vegetable recipes were minimal in the two villages, only limited to three or four. Sun drying of vegetables was practiced in both villages due to their scarcity during the dry season. The common method used for drying is by using direct sun light for two to three days. The prolonged dry season constrains the growth of wild vegetables in the two villages and sufficient water sources for irrigation are too scarce. Therefore rural farmers in the study areas practice direct sun and shaded drying of wild vegetables during months of plenty and store them to use during times of scarcity. Women reported that dried vegetables can be stored up to six months as for most households it is the only dependable source of relish to accompany staple foods during the dry months. Sun drying of vegetables is reported to be a normal exercise; nevertheless, it has some glitches. Open drying methods are, however, prone to dust and dirt contamination, attacks by birds, rodents and insects, and re-wetting of the drying material by rain. At the same time nutrient loss especially of vitamins is high through sun-drying probably if vegetables are not exposed to pre-processing such as blanching (FAO, 2001; Mulokozi & Svanberg, 2003; Keding, 2007).

Women also reported some medicinal values attached to some of the wild vegetables that they consume. They said that some vegetables are consumed also due to their preventive and curative properties. For example the women explained that African night shade is eaten due to its capability to improve eye sight, but also raw leaves of this vegetable can prevent bleeding and easy healing of raw

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wounds. Women also reported that *Bidens Pilosa* leaves help to increase blood. Regarding taboos surrounding wild vegetable consumption, women mentioned that there are some types of vegetables that are usually not allowed to be eaten by specific groups of people in the community especially pregnant and lactating women.

IV. CONCLUSION

The respondents in the focus groups described their consumption practices and preferences of wild vegetables and showed their concerns and need for improvement. Wild vegetables are considered to be versatile, steadfast and robust to the dry climate. Taking these reasons into consideration and the fact that even if rural farming households start to consume more of exotic vegetables, the wild vegetables will continue to be part and parcel of the consumption practices of the people in Idifu and Ilolo villages. From the discussions in focus groups it was indicated that most households in the rural areas collect wild vegetables for household consumption and that wild vegetables are an important source of household nutrition in Mvumi diets. Wild vegetables have the capability to escalate their significance to household income generation if farmers are given the chance to market them. Also domestication and promotion of these vegetables may help to enhance food and nutrition security. Issues of adequate quantities to be consumed in order to meet recommended daily requirements need to be addressed.

Conflict of interest: The author declares no conflict of interest.

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The Analysis of Coral Reef Fishes Abundance Based on Coral Reef Condition in Marine Tourism Park of the Kapoposang Islands, South Sulawesi, Indonesia

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Abstract— *The objective of the study was to analyze the relationship between coral reef cover and abundance of reef fish in Marine Tourism Park of the Kapoposang Islands, South Sulawesi. This research was conducted on April 2019. Collecting coral cover data using the Underwater Photo Transect (UPT) method and coral fish data collection using Underwater Visual Census (UVC) with belt transects. The research results of coral fish found in the study site were 15 families and 54 species. The highest abundance of reef fish was found at site I, which was 6280 ind/ha with a percentage of live coral cover of 34% (Moderate), while the lowest abundance was found at site III of 2100 ind/ha with a percentage of live coral cover of 5% (Poor). The relationship between the abundance of reef fish and the percentage of live coral cover can be seen in the results of the regression analysis of the value of* r^2 *= 0.942, this value indicates that there is a close relationship between abundance of reef fish with the percentage of live coral cover, that is if the coral cover percentage is getting better then the number of fish more abundant coral.*
Keywords— ***Coral reef, Kapoposang Islands, Abundance of coral fishes, Marine Tourism Park.***

I. INTRODUCTION

Coral fish is a group of fish taxa whose lives are associated with the environment of coral reef ecosystems. Allen and Adrim (2003) suggest that as many as 113 families of fish are coral inhabitants and most of them are Order of Perciformes. The top ten major families of reef fish are *Gobiidae, Labridae, Pomacentridae, Apogonidae, Bleniidae, Serranidae, Murraenidae, Syngnathidae, Chaetodontidae,* and *Lutjanidae*. According to English et al. (1994), These reef fish are grouped according to their status on the three groups: target fish, major fish and indicator fish.

In general, reef fish will adjust to their environment. Each species shows the right habitat preference/suitability which is governed by a combination of food availability, shelter and variations in physical parameters. A large number of species found on coral reefs is a direct reflection of the magnitude of the opportunity provided by habitat (Allen and Steene, 1996).

Oman and Rajasurya (1998) who examined this matter stated that the complexity of the structure, composition and proportion of live coral cover gave a positive correlation to reef fish communities (Nontji, A. 1993). Coral fish is one group of animals associated with coral reefs, its presence is striking and is found in various micro-habitats on coral reefs. Reef fish live permanently and forage in sedentary areas so that if coral reefs are damaged or destroyed, reef fish will also lose their habitat (Rani et al., 2010).

Marine Tourism Park of the Kapoposang Islands is located in Pangkajene Regency, South Sulawesi Province and one of the islands in the Kapoposang and Sea Surrounding Marine Tourism Park or abbreviated as Kapoposang Islands TWP, which is one of 8 national marine conservation areas under the management of the Kupang National Aquatic Area and 50000 hectares. Allen *et al*, (2003) stated that the presence of fish in the coral reef area was strongly influenced by physical variables (conditions of coral reefs and the environment). Based on this background it is necessary to research the relationship of coral reef cover with an abundance of reef fish. So the purpose of this study is to analyze the relationship between coral reef cover and abundance of reef fish on Kapoposang Island, Pangkajene Islands Regency.

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II. METHOD

2.1 Time and Research Location

This research was conducted on April 2019 in the Marine Tourism Park of the Kapoposang Islands, Mattiro Ujung Village, Liukang Tupabbiring Sub-District, Pangkajene and Kepulauan Regency, South Sulawesi Province. The research station was determined as many as 4 observation points which were considered to represent the condition of coral reefs and reef fish on Marine Tourism Park of the Kapoposang Islands. The selection of observation stations is determined based on information from the management of Marine Tourism Park of the Kapoposang Islands and information from the local community overlaid on a map. Look at Figure 1.

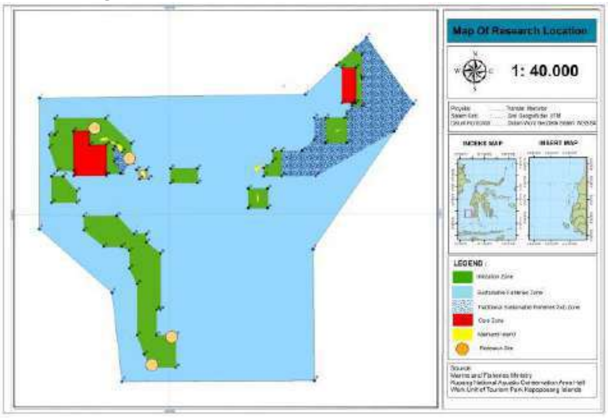

Fig.1: Map of the research location

2.2 Research Tools and Materials

The tools and materials used in the research can be seen in Table I below:

Table 1:

Tools and materials	Fungsi
Global Positioning System (GPS)	To take a research location point
Scuba	Diving equipment for observing and retrieving coral cover data and abundance of reef fish.
Roller meter (50 m)	To measure transects.
Iron Frame (Size 58x44 cm)	As a coral cover transect to make it easier to see photo boundaries .
Underwater camera	For underwater documentation
Stationery	To record observations in the field.
1 ship	For transportation to the research location.
CPCe software	To analyze coral cover data.

2.3 Data Methods and Analysis

2.3.1. Data Collection Method

This study uses two methods, namely the Underwater Photo Transect (UPT) method for coral cover data collection and the Underwater Visual Census (UVC) Method for retrieving coral fish abundance data.

Underwater Photo Transect method (UPT) is performed by shooting underwater using an underwater digital camera At a distance of about 60 cm from the bottom of the substrate, shooting is carried out in each spacing of 1 m along the transect line 50 m previously determined. To maintain the regularity of the shooting distance which is as far as 60 cm from the substrate, a stick made of pipes measuring 60 cm is used as a tool. The shooting start from the 1st meter on the left side of the transect line (the part closer to the mainland), followed by taking a photo on the 2nd meter on the right side of the transect line (further part by land), and so on so that for long 50 m transect obtained 50 frames ("Frame 1" to "Frame 50"). So for frames with odd numbers (1, 3, 5, ..., 49) taken on the left side of the transect line, while for frames with even numbers (2, 4, 6, ..., 50) taken on the side right of the transect line. Illustrations can be seen in Figure 2 below:

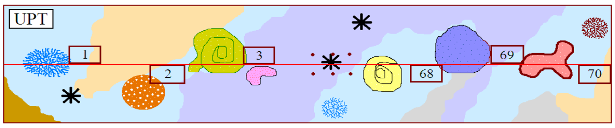

Fig. 2: Illustration in sampling with the UPT method

The underwater visual census method developed by Dartnall and Jones (1986) and English et al. (1994) with modifications. The equipment used is diving equipment (SCUBA), underwater stationery, and rope meter (roll meter). The 50-meter long transect is made parallel to the coastline which is a fast, accurate, effective and environmentally friendly method. The resulting data is relevant to the objectives of reef fisheries management. Do dives to spread the roller meter tape on the coral reef area with a stretch pattern that is parallel to the coastline, where the position of the island is to the left of the meter tape counted from the zero meter point. Meter roll tape stretched for 50 m. The depth of the meter tape placement is between 7 to 10 m or adjusts to the design of the transect location specified in the research objectives and must be at a constant depth.

Record each type and abundance of reef fish (indicator fish, major fish and target fish) found along the 50 m transect line with the right and left borders each 5 m apart so that the observation area covers an area of 250 m 2. Take photos and videos of underwater fish for fish that are difficult to identify directly. Re-identify certain types of fish through photos/videos using a literature book.

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2.3.2. Data analysis

2.3.2.1. Percentage of Coral Reef Closure

Analysis of the percentage of coral reef cover and assessment criteria used to see live coral cover conditions refers to Gomez and Yap, 1988 (Table 2):

Table 2: Standard criteria for coral reef damage

Condition	**Percentage (%)**
Bad	0 - 24.9
Is being	25 - 49.9
Well	50 - 74.9
Very well	75 - 100

2.3.2.2. Abundance of Coral Fish

The formula used to calculate the abundance of reef fish is (Odum, 1971):

$$Xi = \frac{ni}{A} x\ 100$$

Information: Xi = Abundance of type I fish (ind/m ^{2})

ni = number of individuals of type to - i

A = area of sampling area.

The observed reef fish communities were grouped into three main groups (English et al . 1994), namely: Target fish, namely economically important fish and commonly caught consumption. Usually, groups of target fish make coral reefs a place for spawning and nesting / nurturing areas. The target fishes are represented by the family *Serranidae* (grouper), *Lutjanidae* (snapper), *Lethrinidae* (Emperor fish), *Nemipteridae* (Surgeon fish), *Caesionidae* (Fusilier fish), *Siganidae* (Rabit fish), *Haemulidae* (Sweetlips fish), *Scaridae* (parrotfish), and *Acanthuridae* (Surgeon fish). Indicator fish, which are typical types of reef fish that inhabit coral reef areas and are indicators of the ecosystem of the area. Indicator fish is represented by the Family *Chaetodontidae* (Buterfly fish). Major fish groups are small fish species, generally, 5-25 cm long, with diverse colouring characteristics so that they are known as ornamental fish. Major fish groups are generally found to be abundant, both in the number of individuals and species. Criteria for assessing the condition of reef fish based on fish abundance categories are presented in Table 3.

Table 3: Categories of assessment of coral reef conditions based on the percentage of fish abundance

Abundance (ind / ha)	**Criteria**
200-1000	Very rarely
1000 - 2000	Rarely
2000 - 4000	Less abundant
4000 - 10000	Overflow
> 10000	Very abundant

Source: Djamali and Darsono, 2005.

2.3.2.3. Regression Analysis

To find out the relationship between percentage of coral cover and abundance of reef fish, a simple linear regression equation model is used, namely the equation as follows:

$$Y = a + bX$$

Where:

Y = Response variable or dependent variable

X = predictor variable or causal factor variable (independent)

a = constant

b = regression coefficient

III. RESULT AND DISCUSSION

3.1. Condition of the Coral Reef

Based on the results of research conducted on 4 observation sites, the percentage of the condition of benthic coral cover at a depth of 7 m is presented in Figure 3.

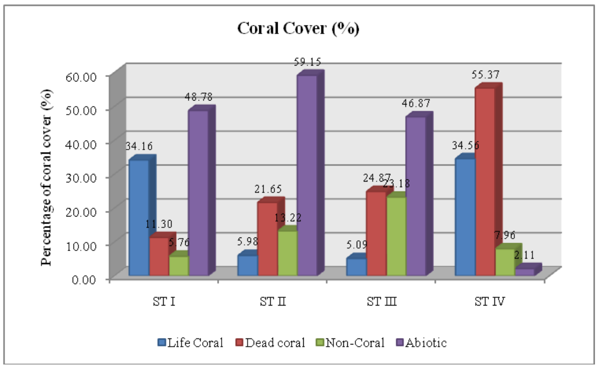

Fig. 3: Percentage of live coral cover

The percentage of live coral cover at each site generally varies. The lowest percentage of live coral cover at 7 m depth is at site III which is equal to 5.09%, while the highest percentage of live coral cover is at the site IV with a value of 34.5 6%.

The results of the coral analysis as shown in Figure 3 show varied values. At a depth of 7 m, the substrate cover is dominated by abiotic, with the highest percentage of 59.15% in Site II located on the southeastern part of Marine Tourism Park of the Kapoposang Islands. The condition of living coral cover on Marine Tourism Park of the Kapoposang Islands consists of a type of Acropora coral and non-Acropora. In general, coral cover more types of Acropora are compared non- Acropora type coral. The dominance of large abiotic substrates this indicates pressure on corals like the use of bombs or poisons, which cover the substrate that used to be is a living coral, then dies to cover the abiotic type substrate.

In general, the percentage of coral cover life is small compared to dominance by abiotic and dead corals with sand type and rubble indicating human activity damaging, whether it's due to fishing not environmentally friendly by using bombs and poisons by the community and the effects of tourism activities. Besides that, natural factors that last long like global warming and climate change and erratic weather conditions can kill the reef is runny, so that is left over only fragments of the reef.

3.2. Abundance of Coral Fish

Hallacher (2003) suggested that fish coral is a group of fish taxa whose lives associated with the environment of the reef ecosystem coral. Based on its role in the coral reef ecosystem, reef fish are divided into three groups, namely the target fish is economically important and commonly caught for consumption. Indicator fish is a type of reef fish that is typical of inhabiting coral reefs and is an indicator of the fertility of the ecosystem of the area. Indicator fish is represented by the family Chaetodontidae (kepe-kepe fish). Major fish are small species of fish, generally 5 to 25 cm, with various colouring characteristics that are known as ornamental fish (English et al, 1997).

Observations abundance of reef fish do in TWP Islands Kapoposang using Underwater Visual Census (UVC) on a 4 point site observation found 15 families of reef fish that is *Chaetodontida* (Angelfish), *Apogonidae* (Cardinalfish), *Balistidae* (Triggerfish), *Labrida*e (Wrasse) , *Mullidae* (Goatfish) , *Pomacanthidae* (angle fish), *Pomacentridae* (damselfish), *Zanclidae* (Moorish idols) , *Acanthuridae* (Surgeon fish) , *Caesionidae* (Fusilier fish) , *Haemulidae* (Sweetlips fish), *Lutjanidae* (Snapper), *Scaridae* (Parrotfish), *Serranidae* (Grouper), *Siganidae* (Rabit fish).

The abundance and composition of reef fish at a depth of 7 m is presented in Figure 4.

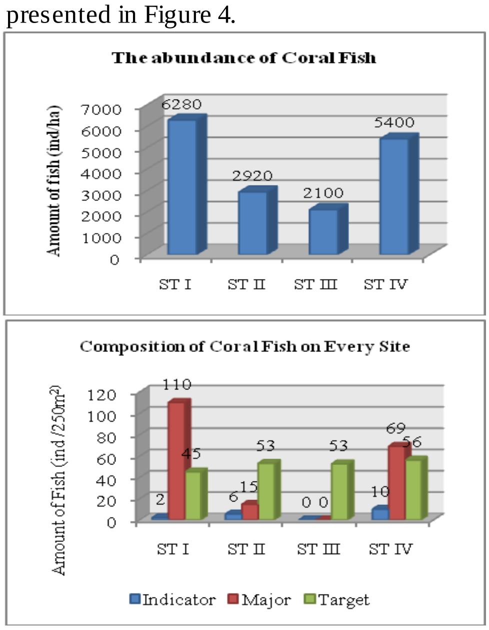

Fig.4: The abundance of reef fish

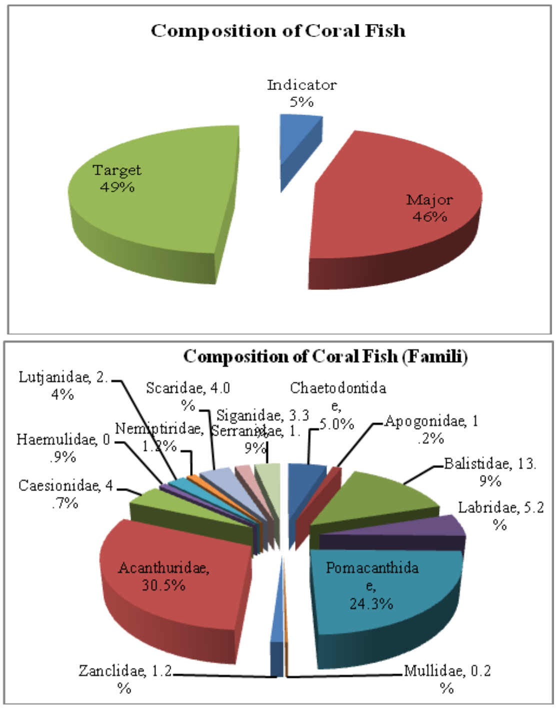

Fig. 5: Composition and abundance of reef fish

Based on Figure 4, the highest number of fish abundance is in Site I with 6280 individuals/hectare and abundance of reef fish which is at least at Site III, which is 2100 individuals/hectare. Of all the sites on Kapoposang Island, the dominant fish group is the target fish, which is 49% of the total number of reef fish dominated by the Acanthuridae and Scaridae families found in all sites. According to Adrim (2012), the type of Scaridae (parrotfish) is not commonly consumed, but because the body is relatively large in size the group of fish can be turned into targets and hunted by fishermen for consumption.

Indicator fish were found only 5% of the 4 sites on Marine Tourism Park of the Kapoposang Islands which were dominated by the Chaetodontidae family. Reese (1981) and Hourigan et al. (1988) suggested that fish belonging to the Chaetodontidae family group had strong associations with corals and could be used as indicators of coral health. During the study, indicator fish from the Chaetodontidae family were found in 5 species and were dominated by the *Chaetodon Kleiini* species. This type of fish is spread in all sites in Marine Tourism Park of the Kapoposang Islands. The same thing was stated by Adrim (2011) who conducted research on Bawean Island and found that there were several relatively prominent types of reef fish on the island, namely *Chaetodon octofasciatus, Chaetodon kleinii, Chaetodon trifasciatus, Heniochus chrysostomus* and *Chelmon rostratus*.

Major fish species were found as much as 46% and were dominated by the type Pomacanthidae (angelfish). Most of the fish are from fish species that have a relatively small body size, and in nature play an important role in the food chain, especially as a food supply for carnivorous fish. Also found are several types of fish that are beautiful body colours that have the potential to be used for diving tours.

Different fish abundance at each station is thought to be caused by differences in the percentage of live coral cover which has an effect on the survival of reef fish. The results of the study of Roberts and Ormond (1987) in the Red Sea coral reef area of Saudi Arabia, suggest that the abundance of reef fish is directly proportional to the value of habitat complexity on coral reefs. The more space, gaps and wrinkles of coral reefs, the more reef fish will inhabit the area in search of protected areas, shelter and upbringing.

3.3. Relation of Percentage of Coral Cover with Abundance of Coral Fish

The relationship of living coral conditions with an abundance of reef fish was calculated using simple correlation analysis. From the calculation results, it can be seen that there is a positive relationship between live coral cover and abundance of reef fish. The correlation coefficient produced is $R^2 = 0.942$ and can be said to have a fairly strong and positive relationship. Graph the relationship between live coral cover and abundance of reef fish can be seen in Figure 6.

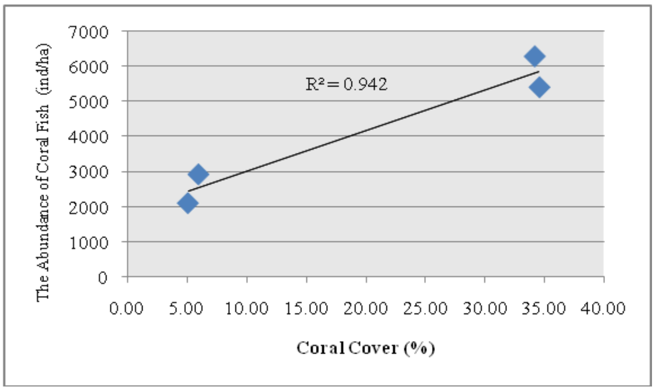

Fig. 6: Relationship between coral cover conditions and the abundance of reef fish

The results of the regression analysis showed that the percentage of live coral cover and associated significantly with the abundance of reef fish. Coral reefs and fish have very strong interactions. The interaction of reef fish with coral reefs can be divided into three forms (Choat et al., 1991), namely direct interaction, as a shelter from predators or predators, especially for young fish. Then the interaction in foraging includes the relationship between reef fish and biota that live on corals including algae. And the last is indirect interaction as a result of the coral structure and hydrological and sedimentary conditions.

This is also in accordance with the research conducted by Muniaha (2016) in Villages in the Village Tanjung Tiram, Konawe Selatan Regency, which shows that the abundance shows links to coral reef conditions, relationships abundance of reef fish, rugosity and conditions coral reefs have a close relationship with a value of $r^2 = 0.997$, if the percentage of coral cover is getting better then the density will be high and cause reef fish to become more abundant in a waters.

IV. CONCLUSION

The percentage of coral cover at 4 sites in Marine Tourism Park of the Kapoposang Islands is in the poor to the moderate category with the percentage of live coral cover ranging between 5.09% - 34.56%. The abundance of reef fish is in the category of less abundant to abundant which is around 2100 ind/ha - 6280 ind/ha. The relationship between the condition of coral reefs and the abundance of reef fish is to have a close relationship with a value of $r^2 = 0.942$ so that if the percentage of coral cover gets better, the number of reef fish will be more abundant.

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Arthropod pests of Coconut, *Cocos nucifera* L. and their management

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Abstract**—***Coconut, Cocus nucifera L. (Palmaceae) is an important crop and widely cultivated in the tropical and subtropical regions of the world. Millions of people depend on this crop by employed in various coconut-based industries like coconut oil, dry coconut powder, tender coconut, coir, coconut cake, etc.But its production has been greatly affected by the infestation of several arthropod pests. Among them; Rhynchophorus ferrugineus Olivier, Oryctes rhinoceros L, Opisina arenosella Walker, Aceria guerreronis Keifer,Latoia lepida (Cramer) and Aspidiotus destructor Signoret are causing maximum damage in coconut which ultimately affect the true potential of the crop. Here, the present article provides recent information regarding different arthropod pests of coconut, their identification, life-history, nature of damage and their management in an effective way.*
Keywords**— *Arthropod pests, Coconut, life-history, damage, management.***

I. INTRODUCTION

Coconut, *Cocos nucifera* L., commonly known as “Kalpa Vriksha” and it provides livelihood to billions of people across the world. It is one of the most useful trees in the world because from top to root, every part of the plant is useful in households. It is grown in almost 93 countries mainly in India, Indonesia, Philippines and Sri Lanka together accounting for 78% of the total world production[9]. Fresh kernel is consumed all over the India and it forms an ingredient of many Indian food preparations [12]. But its production has been greatly affected by the infestation of several arthropod pests. Among them;*Rhynchophorus ferrugineus* Olivier, *Oryctes rhinoceros* L, *Opisina arenosella* Walker, *Aceria guerreronis* Keifer, *Latoia (Parasa) lepida* (Cramer) and*Aspidiotus destructor* Signoret are causing maximum damage in coconut. The tall height of coconut plant creates difficulties in the detection of the pest in correct time to manage the pest, hidden nature of the most coconut pests, and the availability of suitable foods throughout the year create serious pest threats to the coconut plant worldwide [9]. The infestation and intensity of damage caused by the pests varies from different crop growth stages, regions and seasons. So, it is very important to know the different arthropod pests of coconut, their identification, life-history, nature of damage and their management in an effective way for their sustainable productivity.

II. MAJOR ARTHROPOD PESTS ATTACKING COCONUT

1. Coconut black headed caterpillar

Opisina arenosella(Oecophoridae: Lepidoptera)

This insect pest is considered a serious defoliating pest of coconut.

Distribution: It is present in India, Sri Lanka, Bangladesh, Myanmar, Thailand and Indonesia. In India, it occurs more commonly along the west and east coast regions.

Host range: It infests on coconut, Palmyra (*Borassus*), *Corypha, Hyphaene, Phoenix, Roystonia* and banana [9].

Identification and life cycle: Adult is a greyish white moth measuring 10-15 mm long and 20-25 mm in wing span across outstretched wings. The female moth lays about 130 creamy white scale like eggs in batches along the underside of the leaflet generally near the old larval galleries. Eggs hatch in about 4-5 days. Caterpillar is light green with red brown stripes and black head, feed gregariously on the surface tissues of the leaflets scraped out from their lower surface. The leaflets are reduced to papery tissues. The larva constructs a gallery of silk and frass and lives and feeds under it. The attacked leaflets turn brown in colour and dry up. Larval period lasts for about 40 days. The larva pupates inside the gallery. Adult emerges after 12-14 days. Total life history occupies about 45-60 days.Some early larval and egg mortality has been observed in *O. arenosella* as a result

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of cannibalism on the eggs and younger larvae by older larvae.The production of nuts gets adversely affected as photosynthetic activity of the palm is much reduced. The fronds become unsuitable for thatching and other purposes. The damage is more during summer months (March-May) and less during rainy season and the species has 4-5 generations annually.

Damage Symptoms: When the caterpillar lives on the lower surface of leaflets it produces galleries made of excreta and silken web and feeds on the chlorophyll containing parenchymatous tissues. Later, dried up patches appeared on the upper epidermis of the leaves. In severe infestation, the whole plantation presents a burnt like appearance due to the drying of leaves/leaflets or in cases of old infestation leaves remain with midrib of the leaflet only. When palms are severely damaged, the attacked leaves droop, bunches buckle and the immature nuts shed heavily [4, 12].

Management:

- Clipping and destroying the infested portions.
- Bacteria like *Serratia marcescens* and *Bacillus thuringiensis* cause disease in larvae.
- Encourage the population of Predatory carabid beetle,*Parena laticincta*
- Root feeding of bio pesticide Azadiractin F5% @ 10 ml + 10 ml water and inundative release of larval parasitoids *Bracon brevicornis* @ 30 no./ tree and *Goniozus nephantidis* @ 20 no./ tree at 21 days interval for each treatment in two phases significantly reduced Cocont Blackheaded caterpillar.
- Root feeding with Monocrotophos 36 SL 10 ml mixed with 10 ml water.

Root feeding technique: A dark brown coloured root is selected for root administration of pesticide to the trees. The root is given a slant cut. The cut end of the root is kept in polythene bag containing pesticide mixed in water for plants having 15 feet height. Allow the root to absorb the chemical for 24-48 hours. If the root does not absorb the chemical then, change the root.

Note: Before administering the chemical the mature nuts should be harvested. Afterroot administration there should be a gap of at least 45 days for harvest of nuts.

2. Rhinoceros beetle

Oryctes rhinoceros(Dynastidae: Coleoptera)

It is one of the most damaging insects to coconut palm and African oil palm in South and Southeast Asia and the western Pacific Islands. In India, the infestation in oil palm was more prevalent in mature plantations (10-15 year old) compared to immature or younger plantings.

Distribution: It has a wide distribution in Asia, Australia and Pacific Islands and is reportedfrom all regions where coconut is grown.

Host range: It attacks coconut, oil palm, date palm,sugarcane, banana, sisal, pineapple, papaya *etc.*

Identification and life Cycle: Adult is a stout beetle measuring 35-50 mm in length, shiny and black above and reddish brown and hairy ventrally. On the face, beetle has a pointed horn and hence the name, rhinoceros beetle. The cephalic horn is longer in males than in females. Full grown grub is 9-10 cm long, stout, fleshy, dirty white, curved (C-shaped) with brownish head. Tail end dark, body segments wrinkled. Female lays 50- 140 oval creamy white eggs in manure pits or decaying logs or stumps or decaying vegetable matter at a depth of 5 to 15 cm. Egg period 8-18 days, Stout, sluggish, white grub present at a depth of 5 to 30 cm. Grubs feed on the decaying matter and grub stage lasts for 99 to 182 days. Grub pupates in earthern cells at a depth of 0.3 to 1 m and emerges as adults in 10-25 days. The beetles are active at night and hide in feeding or breeding sites during the day. Most mating takes place at the breeding sites. Egg laying starts 10-60 days after emergence. Total life cycle takes about 6-12 months. Adult lives for more than 200 days under favourable conditions.

Damage Symptoms: Coconut rhinoceros beetle adults damage the palms by boring into the center of the crown, where they injure the young, growing tissues and feed on the exuded sap. As they bore into the crown, they cut through the developing leaves. When the leaves grow out and unfold, the damage appears as V-shaped cuts in the fronds or holes through the midrib. In severe infestation, death of the central growing primordium occurred in both young and old plants. Damaged palms become susceptible and often infected by fungal rots [4,12].

Management:

- Periodical examination of the breeding places and destruction of eggs, grubs andpupae by raking and turning up of the manure pits.
- Treating breeding places with carbaryl 50 WP 3g/l atleast once inthree months *i.e.* January, April, July, August.

- Crownless trees and dead trees should be cut and dried to avoid breeding of thepest.
- Extraction of the beetle with a barbed iron hook or wire and filling up the holes withfilling the hole with neem cake 100 g + 150 g sand to prevent further attack.
- Place 3 Naphthalene balls /palm weighing 3.5g each at the base of the inter space and cover it with fine sand.
- Castor cake at 1 kg is soaked in water in small mud pots and when kept in coconut gardens attract the beetle. The slurry should be changed once a month [4].
- Keeping the pheromone [male-produced aggregation pheromone, ethyl 4-methyloctanoate (E4-MO)] in a small, heat-sealed, polymer membrane bag and placed between interlocking metal vanes mounted on a plastic bucket attracted the beetles and trapped inside the bucket. It is very useful as a monitoring tool, and as an economical control method particularly in young oil palm replant areas when placed at one trap per 2 ha [2].
- The histerid beetle, *Santalus parallelus* is predaceous on the eggs and first instar grub.
- The green muscardine fungus *Metarrhizium anisopliae* infects all stages excepteggs.
- Nematode, DD 136 or *Neoaplectana carpocapsae* and the associated bacterium*Achromobacter nematophilus* parasitize the g rub.
- Release of Baculovirus infected adults@ 15/ha.

3. Red palm weevil

Rhynchophorus ferrugineus(Curculionidae: Coleoptera)

The weevil multiplies enormously in young coconut plantations, especially in those close to the forest areas and the damage is to the extent of 5-10 % in young plantations of 5-20 years age.

Distribution: It is distributed in Pakistan, India, Sri Lanka, South East Asia to China, Taiwan and theSolomon islands. In India it occurs in all coconut growing tracts.

Host range: It also infests oil palm,date, sago and other species of Palmae

Identification and life Cycle: Adult is a brown weevil about 35 mm long. It has six dark spots on thorax and inthe males the long snout has a tuft of hairs. The full grown grub is stout, fleshy and apodous. The female weevil commences oviposition1-7 days after pairing and continues it for 25-63 days. Fecundity is 276 eggs. Eggs arelaid in small holes scooped out by the weevil on the soft regions of young palms of up to7 years age, in the grown up trees the eggs are laid only in the cuts or wounds whichmay be present on the stem or leaf stalk. The plant sap oozing out of the wounds andcuts attract the weevil for oviposition. It prefers to oviposit in the exposed plant tissues.The infestation by rhinoceros beetle or crown rot or leaf rot diseases also attracts theweevil for egg laying and for crown infestation. The creamy white egg hatches in 2-5days.Grub tunnels inside and lives in any part of young palms but prefers to concentrate at or near the growing points in trees older than 5 years. A trunk mayharbour 40-45 grubs.Larval period ranges from 36-78 days. Larva constructs an oval cocoon with the fibres of the internal tissues and pupates within it for a period of 12-33 days. The adult female lives for 76 days and the male for 133 days.

Damage Symptoms: The grubs hatched from the eggs laid in crown enter in to the growing point of the crown and causes yellowing and wilting leaves of inner and middle whorls. The grub also causes damage by producing the tunnels when feeding large numbers within the stem tissues. In advance stages, circular holes on the stem are observed and brownish black viscous fluid oozing out from there. Their presence also identified by the occurrence of longitudinal splitting of leaf bases and presence of cocoons or chewed up fibres in leaf axis or at the base of the palm. The sound of feeding by the grub can be heard by keeping the ear on the trunk of the tree [4, 12].

Management:

- Disposal of felled trunks, tree stumps, dying and dead palms, dead plants due to lightening or bud rot
- Avoiding wounds, mechanical injuries and stripping of leaves
- Avoid damage to roots and stem during cultural operation.
- Removal of rhinoceros beetle from the hole using an arrow headed rod and filling thehole with neem cake 100 g + 150 g sand to prevent weevil attack on young plants.
- Set up attractant traps using mud pots with molasses / toddy 2.5 lit + acetic acid 5 ml + yeast 5 g + split tender coconut stems / petioles @ 65/ha.
- Placement of aggregation synthetic pheromone traps viz., Rhino lure (without feeding stimulant)

@ one / ha; Ferro lure @ one / ha with feeding attractant (Sugarcane molasses 2.5kg + 5 ml acetic acid +5gm yeast) at 1-1.5 m height on tree trunk to attract and capture more numbers of beetles and red weevils of both sexes.

- The affected plant puts scraped off and swabbed with coal tar or Japan black.
- Release of sterile males to compete with the normal males to reduce the progeny.
- Conserve the population of earwig, *Cheliosoches moris* which feeds on eggs and grubs
- Insert 1-2 aluminium phosphide tablets inside the tunnel and plug all the holes with clay + copper oxychloride.
- Root feeding with monocrotophos 10 ml mixed with 10 ml of water. (Do not harvest thenuts for the next 45 days).

4. Coconut eriophyid mite

Aceria guerreronis (Eriophyidae: Acarina)

It is one of the most serious arthropod pests of coconut. It was first described in 1965 from specimens from Guerrero State, Mexico [8]. In India it was first reported in Ernakulam district of Kerala in 1998 at Ambalour panchayat [14]. Presently it is present all the coastal states of India mainly Kerala, Tamilnadu, Andhra pradesh, Odisha, West Bengal and Maharastra. It may reduce 7.5-60% yield losses of coconut [7].

Distribution: It is present in the Americas, Africa and in South-East Asia.

Host range: Although coconut palm appears to be the only host of coconut mite, but it also attacks *Lytocaryum weddellianmum, Borassus flabellifer* and *Syagrus romanzoffiana*.

Identification and life Cycle: The adult female miteis vermiform, white and translucent, 36-52 µm wide and 205-255 µm long with two pairs of legs and a finely ringed body with several long setae. A female laid 18-20 ovoid, glossy, translucent white eggs singly on the meristematic tissue of young buttons and on the inner surface of the perianth. The mean incubation period is 2.8 days. The duration of egg, protonymph, deutonymph and adult are 2-3, 3-4, 3-4 and 3-5 days respectively [13]. A coconut mite develops from egg to adult in 10 days, so populations can build up rapidly, often producing thousands of mites in several aggregations on the same fruit. They probably disperse from one plant to another on air currents or by phoresy (e.g., carried on insects or birds that visit palm flowers). Where coconut palms are dense, they can crawl from plant to plant.

Damage Symptoms: The mites infest the abaxial (lower) surfaces of the perianth and the part of the fruit surface covered by the perianth. They penetrate between the tepals of the perianth and fruit surface a month after the fruit begins development. The mites feed by piercing the superficial plant tissue and sucking the juices. Early infested fruits when expands from beneath the perianth and becomes exposed to air, it develops a triangular pale or yellow patch close to perianth and later turn into brown patches with longitudinal deep fissures. If mite feeding is concentrated on one side of the fruit meristem, growth of the fruit may be uneven. Severe damage results in Shedding of butons, oozing of the gummy exudation from the affected surface and stunting of fruits [11].

Management:

- Application of urea 1.3 kg., super phosphate 2.0 kg and murate of potash 3.5 kg./palm / year.
- Application of neem cake 5 kg and organic manure 50 kg / palm / year.
- Grow intercrops, banana, cacao, turmeric, vegetables in rich soils and shelter belt with causuarina all around the coconut garden to minimize the pest.
- Application of Borax 50 g + gypsum 1.0kg + Manganese sulphate 0.5 kg/palm/ year
- Root feeding of Azadirachtin 10,000 ppm @ 10 ml + 10 ml water/ tree (3 times in a year April-May, September –October and February -March) is helpful.
- Root feeding with Fenpyroximate 5 EC 10 ml + 10 ml water/tree is effective against mite infestation.
- Spraying twice at weekly interval on buttons and developing nuts on bunches with wettable sulphur 6g/l or Fenpyroximate 5 EC @ 1ml/lit of water.

5. Coconut scale

Aspidiotus destructor (Diaspididae: Hemiptera)

Coconut scale is considered as one of the major threats to coconut palms throughout the world. It infests at high densities on the undersurface of coconut leaves, as well as on the frond stalks, flower clusters and young fruit. As the coconut scale is classified as an armored scale, unlike other scales, it does not produce honeydew [1].

Distribution: It has been recorded worldwide in tropical and subtropical areas, including China, Southeast Asia,

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India, Pakistan, Russia, Brazil, Central America and Caribbean, the Pacific Islands, Africa and North America.

Host range: It is a polyphagous species and recorded from hosts belonging to more than 60 plant families. Common hosts are banana, coconut, guava, mango, palm, papaya, breadfruit, ginger, bird of paradise, sugarcane, ficus, apple, plumeria, avocado, citrus and grape.

Identification and life Cycle: Adult female have a circular or broadly oval cover that is 1.5-2.0 mm in diameter. The cover is flat and translucent with a subcentral pale exuviae. Adult male are small, two-winged, reddish, gnat-like insects with eyes, antennae, three pairs of legs and long appendages. Adult males do not feed and are short lived. Adult females lay 28-65 smooth, elongate and whitish eggs in concentric circles under the scale cover over a period of 11-13 days, and may produce 3 or 4 consecutive batches in their lifetime. Newly hatched nymphs (also called crawlers) move over the leaf surface for 2-48 hours to find a feeding site. Females have two nymphal stages, while males have two feeding nymphal stages, followed by non-feeding pre-pupal and pupal stages (four immature stages altogether) [15]. After settling, females remain sessile throughout their development; adult males undergo a pseudo-pupation, develop a pair of wings and can disperse by flying to find mates [5]. They reproduce sexually. Males locate unmated females by following pheromones released by them [10]. The life cycle of *A. destructor* typically lasts for 32-34 days for females and 27 days for males. Crawlers are the primary dispersal stage of coconut scale within and between host trees.

Damage Symptoms: On leaves, it causes yellow spots to develop beneath the insects, due to the toxicity of saliva injected in to plant tissues while feeding. Later, entire leaves may turn yellow to brown, wither and dry up, and fruits may be discoloured, stunted or fall prematurely. In severe cases, entire fronds drop off, the crown dies and the entire crop lost.Neglected coconut plantations are particularly susceptible to damage by this insect.

Management:

- Pruning of trees and proper disposal of infested leaves, branches and twigs will help control scale insects on nursery plants and trees.
- Do not use excessive dose of plant fertilizers which may responsible for pest outbreaks.
- Encourage and conserve the population of *Aphytis melinus* and *Aphytis lingnanensis* (Hymenoptera: Aphelinidae) parasitoid species and black coccinellid beetle, Chilocorus nigrius (predator) for controlling the coconut scale populations [4, 16].
- Spraying of Carbaryl 50 WP @ 3g/l or Dimethoate 30 EC @ 2ml/litr of water is effective.

6. Slug caterpillars

Contheyla rotunda
Macroplectra nararia
Latoia (Parasa) lepida
(Limacodidae: Lepidoptera)

Distribution: It is a sporadic pest. *C. rotunda* is common in west coast, while *M. nararia* iscommon in Godavari district in India. *Latoia lepida* mainlyfound in South East Asian region including India, Sri Lanka, Vietnam, Malaysia, Indonesia and Japan. Although slug caterpillars are minor pest but sometimes, in congenial weather they become major pest.

Host range: Beside coconut, these infest mango, castor, cashew and pomegranate.

Identification and life Cycle: In the male insects (*Latoia lepida*)head is greenish, with red brown at the sides and the thorax is green with a brown stripe on the vertex.Hindwing is yellowish at base and reddish brown towards margin.In the female, the reddish-brown stripe on the thorax is much wider and nearly the whole of the hindwing is reddish brown. Larva has greenish body with white lines and four rows of spiny scoli tipped red or black, which cause irritation and pain and slug like, hence also called "nettle grub". Adult female lays flat shiny eggs on the under surface of leaves in batches of 20-30, egg period is 6-7 days. Larval period is about 42 days. It pupates in a compact elliptical chocolate brown shell like cocoon, which is convex above and flat below. Cocoons are covered with irritating spines and hairs; pupal period is 21 days. *C. rotunda*larva is dorsally and dorso-laterally black or grey in colour. Adult is a small greyish brown moth. Forewings are slight dark in colour with series of black points; hind wings slightly darker.

Damage Symptoms: Initially,caterpillar feeds the undersurface of coconut leaflets by scrapping the surface tissues which gives a glistening appearance on the feeding area. Leaf spot-like black halo marking develops on the feeding areas which later coalesce and form bigger lesions. During severe infestation caterpillars feed on the entire leaflet sparing only the midrib. They also feed on buds, flower shoots and developing fruits [6].

Management:

- Clipping the affected leaves along with the larvae.
- Installation of 200 W light traps installed at 1 ½ feet above ground with water pan@ 3 light traps /ha.
- Encourage the population of braconid parasitoid *Apanteles parasae* and the tachinid parasitoid *Chaetexorista javana*, both of which attacked the older larvae[3].
- Spray application of Carbaryl 50 WP@ 3 g/l or Deltamethrin 2.8 EC @ 1ml/l or Fenvalerate 20 EC @ 0.5 ml/l or root feeding with Monocrotophos 36SL is effective[3].

7. Termite

Odontotermes obesus(Termitidae: Isoptera)

It is a widespread termite species in South Asia causing significant losses to major agricultural crops and forest plantation trees.Theygenerally damage the coconut seedlings in the nursery and transplanted seedlings preferring the husk of seed nuts. Invasion is either through the base of the seednut or at the collar region. Later, wilting of central shoot is a common symptom of the attack. Up to 20% of the seedlings are destroyed by the termites in the laterite soils. Base of the plant trunk, is seen plastered with runways made of soil and fibre.

River sand is taken as rooting media, locating termite mounds in or near the coconut nursery or garden, the digging out the termitarium and destroying the queen, drenching the soil with Chlorpyriphos 20 EC @ 10 ml/l of water are effective measures.

However, another coleopteran insect, coconut beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae) is a serious pest of coconut in Southeast Asia. But, it does not occur in India and Sri Lanka. This is probably due to the trade of coconut and planting materials takes in a sea route connecting the Maldives, Malaysia, Indonesia, Vietnam, and other East Asian countries [9].

Beside the above mentioned major insect pests there are many minor insect pests causing damage to coconut palm at different region and growth stages of the crop.

White grub: *Leucopholis coneophora*Burmeister (Melolonthidae: Coleoptera) grub causes leaves to turn yellow, immature nuts shed, flowering delay. They are predominantly noticed in sandy as well as sandy clay soils in coastal districts, feeding on the roots of coconut seedlings. Female lays eggs in the soil at a depth of 7 to 15 cm. Egg period 20 days, grub period 10-11 months, prepupal period 9-12 days. pupal period 25 days. Pupation occurs in soil. Adult beetle emerges after monsoon showers. For management point of view, summer ploughing is helpful which exposes the immature stages; treat the seeds with chlorpyriphos 20 EC @ 12 ml/kg of kernel; Application of Phorate 10G 10 kg or Carbofuran 3G 30 kg per ha in the soil at or before sowing is helpful.

Mealy bug: *Pseudococcus longispinus*(Targioni Tozzetti) (Pseudococcidae: Hemiptera) causes damage by sucking sap from the spindle leaves, spathes and bunches; root mealybug, *Nipaecoccus nipae* (Maskell) feeds on the roots of coconut seedlings. Lacewing bug: *Stephanitis typicus* Distant (Tingidae: Hemiptera) sucking the sap from the under surface of leaflets causing white spots on the upper surface; it is reported as one of the vectors of coconut root (wilt) disease [6]. Coconut skippers, *Gangara thyrsis*Fab. and *Saustus gremius*Fab. (Hesperidae: Lepidoptera) causes damage by cutting the one half of the leaflets and rolled into a case and later the rolled leaflets are dried. Coconut skippers occur throughout the year but maximum population found in June to September months. Spiralling whitefly, *Aleurodicus dispersus* Russel causes damage coconut palm by sucking sap from the foliage. Conservation and release of parasitoid;*Encarsia guadeloupae*can suppress the whitefly population[6].

III. CONCLUSION

Due to the tall height of coconut palm, it is difficult to detect as well as manage the pests during early infestation. So,importance should be given to conserve and release of indigenous bio control agents and other easily available management practices mainly cultural, mechanical and physical means for suppressing the major arthropods pests in coconut.

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Effect of Application Rhizobakter and Fungi Arbuscular Mycorhiza (Fma) on Growth and Results of Potato (*Solanum tuberosum* L.)

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***Abstract*— *Indonesia national potato production is still relatively low compared with other countries. National potato production in 2017 range from 1,164,738 tonnes with an average per hectare production of western Sumatra 15.4 and 40 398 tonnes with an average of 19.37 tonnes per hectare (CBS, 2018). While the production of other countries such as: Australia 39.69 tonnes / ha, with 47.15 tonnes / ha, Japan 30.65 tonnes / ha and Laos 30.04 tonnes / ha. The low productivity of potato in Indonesia can be caused by several factors, such as the limited avaiNARility of nutrients, poor quality seeds, post-harvest handling of seed and farming systems that are less good. One important factor that greatly affects the growth and yield of potato crop is limited nutrients provided one of them is' phosphate.Phosphate is an essential nutrient that is needed for the plants in regulating physiological processes of plants. So to improve the growth and yield of potatoes should be given rhizobakteri and arbuscular mycorrhizal fungi (AMF). Rhizobakter type used in this research iswithout rhizobakteri, RZ1.L2.4, RZ1.L2.1, RZ2.L2.1 while the FMA dose is 5 g, 10 g and 15 g. The best treatment for the growth and yield of potato crop is rhizobakteri RZ2.L2.1 with a dose of 5 g FMA because it can increase net assimilation rate and leaf area index*

***Keywords*— potatoes, rhizobakteri, arbuscular mycorrhizal fungi**

I. INTRODUCTION

Potatoes along with corn, sorghum and rice are included in the five major world commodities as a staple food. Potatoes are horticultural commodities which have multifunctional, both as a source of carbohydrates and raw materials from a variety of other foods, including vegetables and snacks that can improve the nutritional status of the community. Potatoes discount high carbohydrate content which causes potato tuber known as a food ingredient that may replace other carbohydrate-producing foodstuffs such as rice, wheat and corn. This plant is a source of income and employment are high enough to contribute to the economic development of an area because it has been intensively cultivated by farmers (1).

So to improve the growth and yield of potatoes need to look for microorganisms that could help the release of P so that it becomes avaiNARle to plants. One of them using rhizobakteri. Rhizobakteri role as Plant Gowth Promoting Rhizobacteria (PGPR). The use of naturally Rhizobakteri associated with plant roots and have the ability to improve plant growth, as biological agents that stimulate plant growth and increase crop yields. Rhizobakteri utilization is predicted to be an interesting study that continues to grow in the field of agriculture in the future (2). In addition to providing rizobakteri, to stimulate growth can also be used mycorrhizae. Mycorrhizal root system is a structure formed as a manifestation of their symbiotic mutualism between fungi (myces) and roots (rhiza) higher plants.

II. MATERIALS AND METHODS

This research has been conducted in experimental Land BPTP West Sumatra in Sukarami and preparation of isolates Rizobakteri conducted at the NARoratory of Microbiology, Faculty of Agriculture, University of Andalas Padang. Materials used are seed potatoes, isolates Rhizobakteri, FMA Multispora, water, paper NARels, plastic samples, envelopes, manure, lime, fertilizers NPK,

The experiment was arranged according to the design of 4 x 3 with two factors in a randomized block design (RBD) with three replications. The treatments were kind Rizobakteri (R) and the concentration of Mycorrhizal Fungi Fungi (M). Type Rizobakteri (R) provided consisted of four types:

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(R0) without Rhizobakteri
(R1) RZ1.L2.4
(R2) RZ1.L2.1
(R3) RZ2.L2.1
Dose Mycorrhiza Fungi Fungi (M) Multispora namely:
(M1) FMA dose of 5 g / plant
(M2) FMA dose of 10 g / plant
(M3) FMA dose of 15 g / plant

The data were analyzed by analysis of variance by F test, if the F-treatment count is greater than F-table then conducted a further test analyzes Duncan Multiple Range Test at 5.

III. RESULTS AND DISCUSSION

1. Net Assimilation Rate (NAR)

Table 1 shows that treatment without rhizobakteri and rhizobakteri RZ2.L2.1 with a dose of 5 g FMA have significantly different NAR with FMA dose of 10 g and 15 g and 10 g no significant with 15 g. Rhizobakteri RZ1.L2.4 with a dose of 15 g FMA have significantly different NAR with 5 g and 10 g, whereas no significant both. While rhizobakteri RZ1.L2.1 with a dose of 10 g FMA have significantly different NAR with a dose of 5 g and 15 g. The best treatment on without rhizobakteri obtained with a dose of 5 g FMA, FMA rhizobakteri RZ1.L2.4 with a dose of 15 g and rhizobakteri RZ2.L2.1 with FMA dose of 5 g.

Table 1. Effect Rhizobakteri and Mycorrhizal Fungi Fungi against assimilation rate Net average Chips at Age 9 MST

Isolates type Rhizobakteri	dose FMA		
	5 g	10 g	15 g
	.... mg / cm2 / week		
without Rhizobakteri	0.00115 a A	0.00018 b BC	0.00017 b AB
RZ1.L2.4	0.00015 b C	0.00014 b C	0.00016 a AB
RZ1.L2.1	0.0002 b C	0.0003 a A	0.0001 b B
RZ2.L2.1	0.0009 a B	0.0004 b A	0.0003 b A
KK = 5:01%			

The figures followed the same small letters on the same line and the same big letters in the same column according DNMRT no significant level of 5%.

FMA dose of 5 g with no NAR rhizobakteri have significantly different to other treatments, a dose of 5 g with rhizobakteri FMA RZ2.L2.1 also significantly different with rhizobakteri RZ1.L2.4 and rhizobakteri RZ1.L2.1. NAR at FMA dose of 10 g with no significant RZ2.L2.1 rhizobakteri with rhizobakteri RZ1.L2.1 but significantly different from other treatments. FMA dose of 15 g with rhizobakteri RZ2.L2.1 have different NAR unreal with rhizobakteri RZ1.L2.4 and without rhizobakteri but significantly different with rhizobakteri RZ1.L2.1. The best treatment at a dose of 5 g obtained without rhizobakteri, FMA dose of 10 g with rhizobakteri RZ2.L2.1 and RZ1.L2.1.

NAR is basically an average size of leaf photosynthesis efficiency in a community of cultivated plants. Highest NAR obtained when the plants are still small and most of the leaves are still exposed to direct sunlight. Increasing age of the plant the NAR values will also increase and the leaves are protected more cause impairment NAR. Plants that have a high LAI highest young leaves have a chance to absorb the most sunlight, have the highest CO2 assimilation rate and mentranslokasikan largely the result of assimilation into other parts of the plants (3).

The statement shows that the older the plant, the lower the value of NAR. Besides plants having LAI values that are too high will reduce niali NAR plant. NAR will also affect the translocation of food reserves originating from metabolic processes.

2. Leaf Area Index (LAI)

Based on Table 2 treatment without Rhizobakteri at a dose of 5 g FMA significantly different at 10 and 10 g 15 g but not significant at a dose of 15 g on average LAI potato plants. Giving Rhizobakteri RZ1.L2.4 with a dose of 10 g FMA significantly different from the dose of 5 g and 15 g. Giving Rhizobakteri RZ1.L2.1 with FMA dose of 10 g and 15 g doses significantly different with 5 g. While the provision of Rhizobakteri RZ2.L2.1 with a dose of 5 g FMA significantly different from the dose of 10 g and 15 g.

Table 2. Effect Rhizobakteri and fungi Mycorrhizal Fungi on Leaf Area Index Average Average Chips At Age 9 MST

Isolates type Rhizobakteri	dose FMA		
	5 g	10 g	15 g
without Rhizobakteri	0.03093 a B	0.00808 b D	0.01061 b C
RZ1.L2.4	0.01060 b C	0.01637 a C	0.00523 c D
RZ1.L2.1	0.0128 b C	0.0315 a A	0.0360 a A
RZ2.L2.1	0.0465 a A	0.0272 b B	0.0200 c B
KK = 5. 29%			

The figures followed the same small letters on the same line and the same big letters in the same column according DNMRT no significant level of 5%.

Based on these explanations can be concluded that a dose FMA without rhizobakteri best in treatment is a dose of 5 g, rhizobakteri RZ1.L2.4 is a dose of 10 g, rhizobakteri RZ1.L2.1 is a dose of 10 g and 15 g, while rhizobakteri RZ2.L2 .1 is a dose of 5 g. FMA dose of 5 g with rhizobakteri RZ2.L2.1 significantly different with other treatments, without rhizobakteri also significantly different but the provision rhizobakteri RZ1.L2.4 and RZ1.L2.1 but giving no significant RZ1.L2.4 rhizobakteri with RZ1.L2.1. FMA dose of 10 g and 15 g with rhizobakteri RZ1.L2.1 significantly different with all treatments. FMA dose of 10 g and 15 g with rhizobakteri RZ2.L2.1 significantly different from the administration and without rhizobakteri RZ1.L2.1 rhizobakteri. The best treatment at a dose of 5 g FMA is to rhizobakteri RZ2.L2.1, FMA dose of 10 g and 15 g are with rhizobakteri RZ1.L2.1.

It shows every rhizobakteri have different responses to the FMA doses are given in influencing the value of LAI. Rhizobakteri Each type has its own characteristics, it may be rhizobakteri RZ2.L2.1dengan FMA dose of 5 g has a higher ability to support the growth of plant leaves. Based on Table 6 it can be seen that the most number of leaves on RZ2.L2 rhizobakteri treatment is with a dose of 5 g FMA as well as with rhizobakter RZ1.L2.1 a dose of 10 g and 15 g. If korelassi between factors associated with it can be seen that the number of leaves with LAI have a strong positive correlation, where the addition value of the number of leaves a little to be significantly mmeningkatkan LAI value.

These results are consistent with the statement which LAI is the ratio between leaf area and an area of land that is overgrown potato plants at any time. Sne of the factors that influence the value of LAI is the number of leaves of the plant. Leaves that have higher numbers with a size larger then the plant has a higher LAI value (3).

Increased LAI make a positive contribution to the growth of the plant, because the leaf is the main organ where photosynthesis. Therefore, the optimum number of leaves that allow the distribution of the light between the leaves evenly. Light distribution evenly between the leaves reduces the incidence of each shade between the leaf so that each leaf can work as it should LAI on most plants in the field is zero and for a few weeks and then can be below 1.0 further increase in LAI rapidly until it reaches the maximum can vary between species and the environment (4). Large leaf area is usually maintained until the close before maturity, unless the leaves are affected by plant pests and the environment (5).

IV. CONCLUSION

The best treatment of this research is rhizobakteri RZ2.L2.1 with a dose of 5 g FMA because it can increase the value llaju net assimilation and leaf area index.

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Studies on Microplastics Morphology Characteristics in the Coastal Water of Makassar City, South Sulawesi, Indonesia

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***Abstract*— *Pollution of plastic waste is the biggest problem in the environment faced by every country, both developing and developed countries. The Continuous entry of plastics into the sea is accompanied by low degradation capabilities that reach tens to hundreds of years and inadequate management of waste making plastic accumulate in the marine environment. Makassar City as one of the big cities in Indonesia, almost 60% of the population spread in the coastal area has the potential to cause pollution of plastic waste distributed through two large rivers, namely the Jeneberang River and Tallo River and city canals and drainage which empties into Makassar City waters. This study aims to identify and quantify microplastic properties on the surface of the water-based on the characteristics of microplastic in Makassar City waters. The method of this research is the survey method using a purposive sampling technique by microscopically analyzing the possibility of microplastic content in seawater samples. Data analysis uses descriptive analysis. The results of the microplastic characteristics found included size and color. Microplastic size classes are grouped into 4 sizes namely: <0.5 mm, 0.5–1 mm, 1.1-2.5 mm and 2.5-5 mm and are dominated by sizes 1.1-2.5 mm (31- 40%), while the microplastic color variations found were 12 colors.*

***Keywords*— Microplastic: Characteristic; Makassar City: Coastal Waters;**

I. INTRODUCTION

Pollution of plastic waste is the biggest problem in the environment faced by every country, both developing and developed countries.

World plastic production has increased throughout the year and reached 348 million tons in 2017 (Plastics Europe, 2018). Jambeck et al. (2015) research suggests that plastic waste produced by Indonesia as much as 0.48-1.29 million tons/year is spread in the sea, thus placing Indonesia as the second country that contributes plastic waste in the world. Then, the Ministry of Industry (2019) mentions 2018 the demand for plastic in Indonesia is 7.7 million tons supplied from the National production of 6.74 million tons. The growth of plastic waste in Indonesia is very rapid in the last two decades, this is due to the increasing population and human activities that have penetrated almost all types of human needs using plastic packaging.

Population growth and changes in community consumption patterns lead to increasing volume, species, and characteristics of increasingly diverse waste and waste management so far has not been by the methods and techniques of environment-based waste management. As a result, plastic waste enters continuously into the sea accompanied by low degradation capabilities that reach tens to hundreds of years, making plastic accumulate in the marine environment. Plastics as synthetic polymers undergo degradation caused by Ultraviolet-B (UV-B) and waves (Andrady, 2011; Cooper & Corcoran, 2010). Large plastic fragments that are degraded become micro-size (1 <5 mm) commonly referred to as microplastic (GESAMP, 2015). Then, the transfer of plastic throughout the ocean is strongly influenced by wind and currents (Law, et al., 2010).

Based on the source of microplastic is divided into two namely; primary and secondary sources. Primary sources are mostly found in domestic products and cleaning products containing polyethylene, polypropylene, and polystyrene such as scrubs. Also, pellets are used as raw material for making plastic (Cole et al., 2011). Secondary sources are degraded plastic and fragmented into micro-sized particles (<5 mm). According to Hildago-Ruz et al., (2012) the main source of microplastic presence in waters comes from secondary sources.

The presence of microplastic has been proven by several studies that have been carried out in recent years, showing

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microplastic has spread widely in the marine environment. The global distribution of plastics shows the total plastic floating at sea level ranges from 7,000 and 35,000 metric tons (Eriksen et al., 2014; Cozar et al., 2014). In the sub-surface waters in the Pacific Ocean, microplastic concentrations of 8 to 9,200 particles/m^3 were found (Desforges et al., 2014). Fossi et al., (2012) found microplastic concentrations in the Mediterranean Sea protection area of 0.94 particles/m^3 (Ligurian Sea) and 0.13 particles/m^3 (Sardinia Sea). Reisser et al. (2013) research conducted in the Great Barrier Reef Marine Park Authority (Australia) region found 839 marine plastics that were recorded were small ("microplastic" fragments, median length = 2.8 mm, mean length = 4.9 mm). The widespread distribution of microplastic with high density in the waters causes some marine organisms to swallow microplastic, either directly or indirectly such as; fish, shellfish, and marine mammals (Thompson et al., 2004; Lusher et al., 2013).

Makassar City as one of the big cities in Indonesia, almost 60% of the population is spread in the coastal area (Dahuri et al., 2001). In 2017 the population of the city of Makassar reaches 8,741 people/km^2 (BPS, 2018). Production of waste per day produced by 6,485.65 m^3 (BPS, 2018). Likewise with the findings of Rochman et al. (2015) that fish traded in Makassar Poetere Port contain microplastic forms of fragments, films, styrofoam and monofilament, further clarifying the existence of plastic pollution.

Utilization of areas in Makassar City waters such as; industrial activities, coastal tourism activities, reclamation activities, sea transportation activities, and activities of port (Soekarno Hatta Port) have the potential to cause pollution of plastic waste through human activities. Community activities on the Makassar mainland which dispose of littering will also contribute to the pollution of plastic waste distributed through two large rivers, namely the Jeneberang River and Tallo River and city canals and drainage which empties into Makassar City waters (Hamzah, 2007). World Bank (2018) mentions Makassar City as one of the highest plastic waste hotspots in Indonesia from 15 hotspots. According to Stolte et al., (2015), rivers are one of the pathways for microplastic entry into the marine environment. Therefore, Lack of information about the existence of microplastic on the surface of Makassar Coastal Water makes this research very important to do.

II. METHOD

2.1 Study AREA

Lack of information about the existence of microplastic on the surface of Makassar Coastal Water makes this research very important to do.

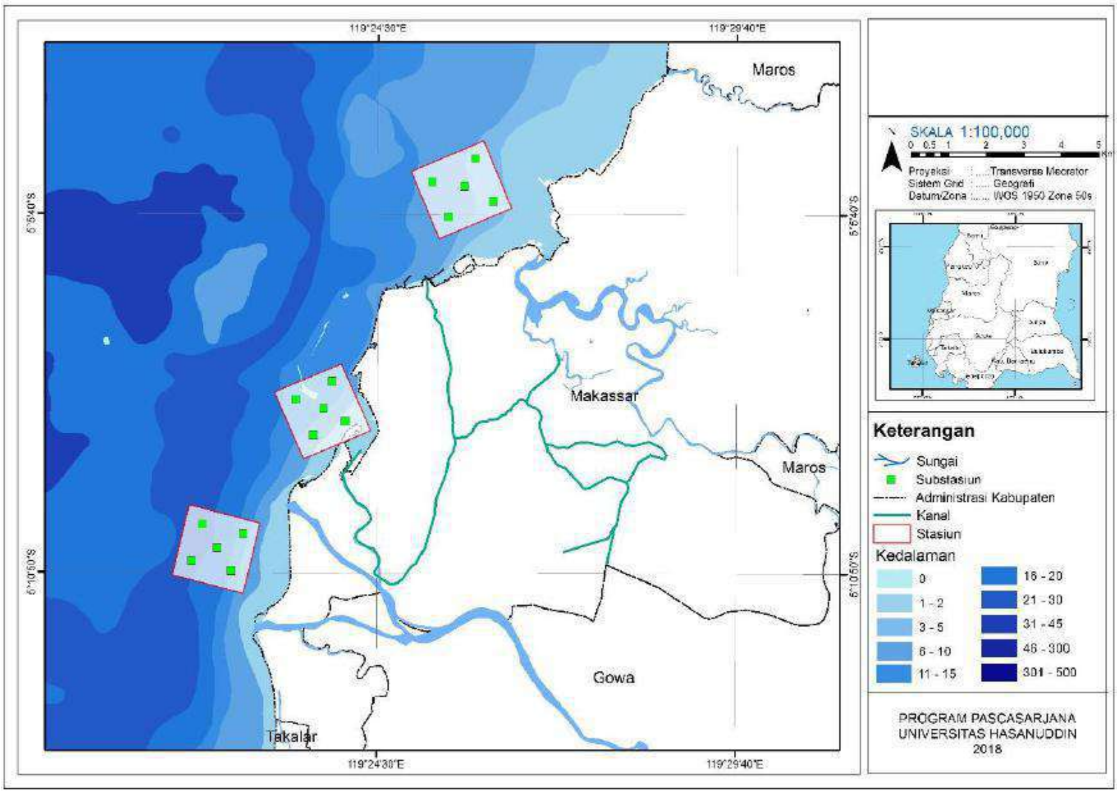

Fig.1: Map of the research location

2.1 Sample Collection

The method of collecting data is a systematic sampling survey method. This method is done by paying attention to the location of the waste discharge from rivers and canals in the city of Makassar. Station one which is in the determination of location sampling point uses a purposive sampling technique. The sampling location consisted of 3 stations with each station consisting of 5 plots. The area of the station is 2 km x 2 km and the plot is 400 m x 400 m. Each sub-station was sampled with a trajectory length of 300 m 4 times (Chesire et al., 2009).

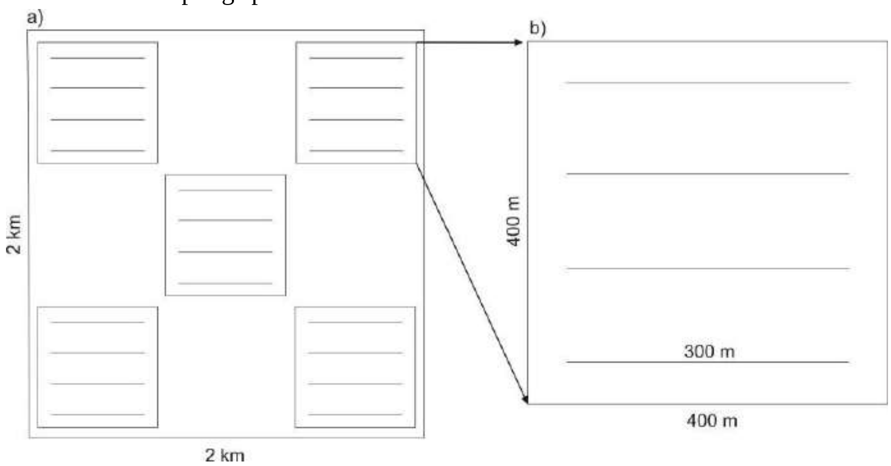

Fig. 2: Illustration in sampling

Water samples were taken using nesuton net from the boat, where the method used refers to the previous method (Syakti et al., 2017). Seawater sampling consists of 3 stations, where the area of the station used is 2 x 2 km. Each station consists of 5 plots with a plot area of 400 x 400 m. The neuston net has a rectangular openings (width 76 cm; height 15 cm), mess size 300 µm, and length from the net opening to the end of the net (Bottle cod end) which is 1.13 meters (figure 3). Neuston net is installed on the side of the boat using a rope with a stretch of 2-3 meters and pulled at a speed of 2-4 knots in the direction of the coastline as far as 300 m x 4 trajectories, with a total track length of 1,200 m in each plot. After that, the coordinates were recorded using GPS (Global Position System). Then, neuston net was rinsed with seawater, so that all existing microplastic particles were netted into the cod end bottle with a volume of 300 ml. Water samples that have entered the cod end were transferred to the sample bottle and put into the cool box, then taken to the laboratory for further analysis (Xiong, et al., 2018).

2.2 Laboratory Analysis

Water samples were filtered using filter paper (Whatman 0.45 µm 47 mm diameter) using Medi Pump brand vacuum equipment. After filtration, the filter results (filter paper) were inserted into the petri dish for furtherobservations of the characteristics (shape, size, and color) of microplastic visually using a Stereo Microscope (Euromex Stereo Blue 1902) with a magnification of 4.5 x 10. Microplastic that has been found placed on glass preparations and closed using a glass cover. Furthermore, it is stored in a room with a maintained temperature to avoid degradation. Microplastic measurement using ImageJ software.

2.3 Data Analysis

This study analyzed the size and color of microplastic, us descriptive analysis.

III. RESULT AND DISCUSSION

1.2. Characteristics of Microplastic

1.3. 1. Size of Microplastic

aa The results of microplastic measurements are grouped into 4 sizes: <0.5 mm, 0.5–1 mm, 1.1–2.5 mm and 2.5–5 mm. The percentage of microplastic size <0.5 mm is 13-25%; size 0.5-1 mm (28-40%); size 1.1-2.5 mm (31-40%); and size 2.6-5 mm (12-19%) (figure 3). The highest microplastic size is at station 3 which is 0.5-1 mm, while the lowest size is at stations 1 and 3 which is <0.5 mm. Then, at stations 1 and 2 the class size is 1.1-2.55 mm.

Based on this study, the highest percentage of microplastic abundance was found in the class size 1.2-2.5 mm (31-40%), while the lowest abundance was in the 2.6-5 mm class (12-19%). Syakti et al., (2017) also found microplastic abundance in Cilacap Beach waters to be in the size of <2.5 mm (20-46%). The Baini et al., (2018) study of microplastic abundance in coastal waters of Tuscany (Italy) was found in sizes 1-2.5 mm (60%), which consisted of 4 size classes (<0.5 mm; 0.5-1 mm; 1-2.5 mm; and 2.5-5 mm). Then, Zhao et al. (2014) found

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an abundance microplastic of surface water of the Yangtze Estuary system (China) is <1 mm.

Based on the results of this study with several studies, it shows the highest similarity of microplastic abundance in the class 1.2-2.5 mm, where the percentage value is different. Decreasing particle size will increase microplastic abundance (Barnes et al. 2009; Zhao et al. 2014). Troyer (2015) also found differences in microplastic size distribution, suggesting that large microplastic has not been sufficiently damaged. The difference in microplastic size distribution is due to the influence of hydrodynamic conditions (Troyer, 2015), wind speed (Kukulka et al., 2012), and the presence of bio-fouling (Pedrotti et al., 2016)..

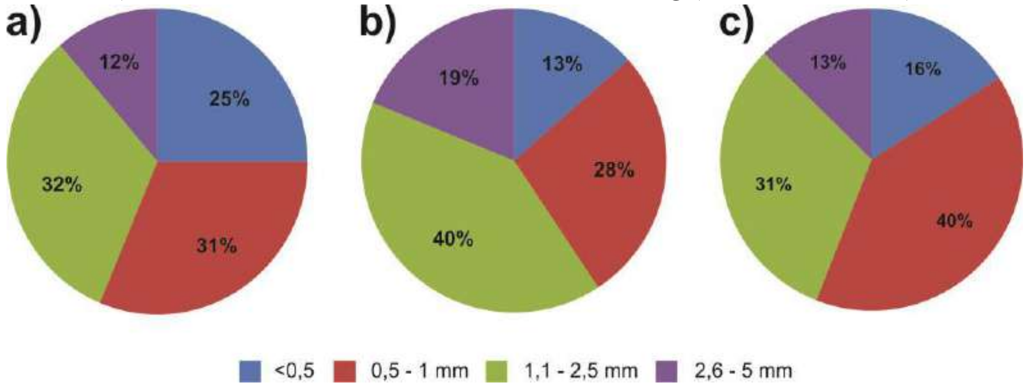

Fig. 3 : Percentage of Form of Microplastic a) Station 1; b) Station 2 and c) Station

Microplastic in size <1 mm has the same size range as marine food so it is likely to be consumed by various marine organisms (Lusher et al., 2013). The main potential hazards associated with microplastic consumption by birds, fish, and invertebrates include reduced ability to eat and stimulate food, loss of nutrients and intestinal blockages, and even death (Ashton et al., 2010; Cole et al., 2013).

Research in fish shows that microplastic and toxins can accumulate and cause problems such as intestinal damage and changes in metabolic profiles (Li et al., 2017). Then, microplastic can carry out the task of carrying organic contaminants including chemical additives, hydrophobic organic compounds and polycyclic aromatic hydrocarbons (Mato et al., 2001; Karapanagioti et al., 2011, Zhang et al., 2018).

3.3.2. Color of Microplastic

Microplastic color observations found around 12 types of colors grouped by the station. At all stations, most commonly found microplastic colors are blue as much as 28-% (594 pieces). Then, at stations 1 and 2 are dominated by blue; while station 3 the highest color is transparent (30%), followed by blue (28%). According to Andrady (2011) and Zhao et al., (2015) light-colored microplastic proportions are more easily consumed by fish and the colors that float almost resemble their natural food. Whereas according to a study conducted by Boerger et al. (2010) in the North Pacific Gyre shows that white, clear, and blue plastic is the color of plastic that is generally digested by fish.

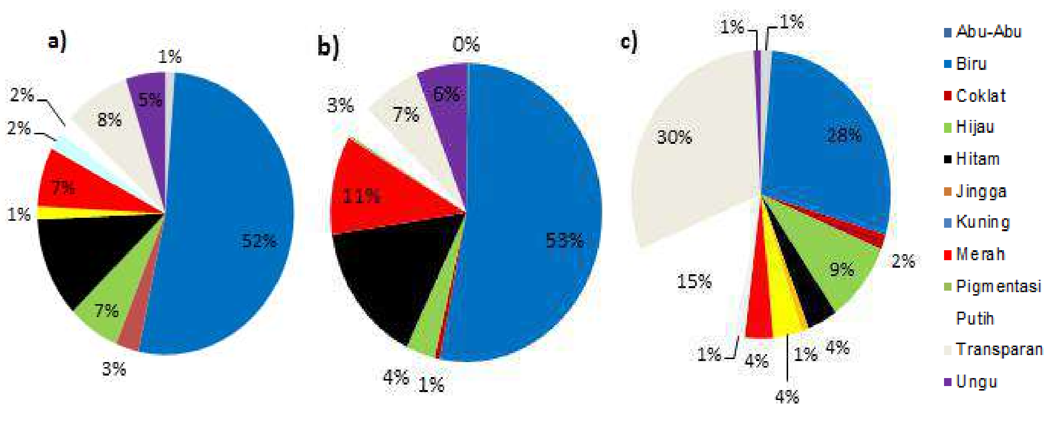

Fig. 4: Percentage color of Microplastic a) Station 1; b) Station 2 and c) Station 3

IV. CONCLUSION

Microplastic morphology characteristics founded were include the size and color. The microplastic size is grouped into 4 classes, namely: <0.5 mm (13-25%); 0.5-1 mm (28-40%); 1.1-2.5 mm (31-40%); and 2.5-5 mm (12-19%), while for the microplastic colors, 14 types of colors were found, dominated by blue and transparent.

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Nitrogen Preference for Growth Rate of *Ulva reticulata* cultivated in Eutrophied Coastal Waters: A Seaweed Laboratorium Testing Experiment

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***Abstract*— *This study aims to evaluate seaweed Ulva reticulata preference for available nitrogen forms of eutrophic coastal waters for its growth rate. Simple experiment was developed for laboratorium testing of U. reticulata preference for NH_3, NO_2, NO_3 for 20 days. Levels of those nitrogen species and their composition were provided naturally from filtered eutrophic coastal waters of western coast of south Sulawesi Indonesia, without any exchange. The composition of NH_3:NO_2:NO_3 in the eutrophic water of the experiment was 1.0 : 2.4 : 3.3. The results showed that the NO_2 was the most preferred form of nitrogen for the growth. The average amount of uptake of NO_2, NH_3, and NO_3 was respectively 4.58 ± 1.71 µg/l/day, 2.70 ± 0.17 µg/l/day, and 1.98 ± 1.19 µg/l/day. The average growth rate of U. reaticulata was 15.40 ± 3.12 % day^{-1}.*

Keywords*— N*itrogen preference, Ulva reticulata, Seaweed, Eutrophic coastal waters.

I. INTRODUCTION

Seawater multicellular macroalga, seaweed aquaculture in Indonesia becomes one of main economic revenues from the coastal and marine sectors, contributing 54.46 % or US$ 129.92 million of Indonesia (Central Bureau of Statistics 2018) Coastal water of south Sulawesi, Indonesia is one of the seaweed aquaculture foci, with production reaches 13 million tones per annum. Instead of providing revenue and livelihood for coastal community, the seaweed aquaculture plays a significant role in abating coastal eutrophication resulting from fish aquaculture, as one of the targets of SDG 14. The use of aquaculture seaweed (or even multitropic model) for coastal eutrophication abatement has increased scientific attention over the last two decades (Troell & Berg, 1997; Bates et al., 2001). It lies on the capacity of seaweed to readily uptake nutrient (Choi et al., 2009; Luo et al., 2012; Martinez and Rico, 2012; Bulboa, 2014; Rabie et al., 2014; Brundu and Chindris, 2018). Seaweed uses nutrients (N and P) as a food source for growth and development. Nitrogen is assimilated into amino acid constituent, while phosphorus is a major source of chemical energy for photosynthesis (Graham & Wilcox, 2000). This capacity to absorb nutrients is then sought to be an alternative mitigation measures of eutrophication in the waters.

The health of ecosystems and their use in coastal areas is an indicator of water quality, especially in the field of marine conservation and various activities in other fisheries sectors. Aquaculture and agricultural effluents are a major challenge in maintaining the quality of waters in coastal areas, where increased concentrations of nutrients i.e. nitrogen, phosphorus and silicon from these activities can cause eutrophication of waters which have a negative impact on organisms. This condition has been found in the waters off the west coast of South Sulawesi where nutrient enrichment is quite large (Lukman et al., 2014; Nasir et al., 2015) and symptoms of eutrophication have been identified (Nurfadillah, 2016).

Waste discharges from aquaculture, especially shrimp and fish ponds, and agriculture have been recognized as are the main sources of nutrient enrichment causing cultural eutrophication and impacting the coastal ecosystems in the western coast of South Sulawesi (Nasir et al., 2016; Hopkins et al., 1995). The availability of excessive nutrients cause changes in the composition of community structures in marine ecosystems such as microorganisms (Kegler et al., 2017), plankton (Nasir et al., 2015) and coral reef ecosystems (Teichberg et al., 2018; Edinger et al., 1998). Therefore efforts to overcome eutrophication or nutrient pollution need to get serious attention. Increased nutrient in coastal waters can be mitigated by increasing nutrient partition coefficient in the aquatic compartments which absorb or consume these nutrients (Carpenter, 2008). Absorption by seaweed can accumulate and store organic materials such as nitrogen in thallus cells (Boyajian & Carriera 1997). Organic waste stored in seaweed thallus cells will be degraded through photosynthetic assimilated sunlight to produce energy used for growth (Boyajian & Carriera 1997

Furthermore, from an economic standpoint, the Indonesian government encourages increased seaweed aquaculture and industrialization as a response to increasing demand for seaweed commodities both on a national and international scale (Radiarta et al., 2016). The potential and quality of Indonesian seaweed attract demands from various countries in the world. There are more than 550 types of seaweed in Indonesia and most of the products from seaweed has been exported as dried seaweed as well as processed forms. These various opportunities owned by one of the biological resources in Indonesia make seaweed can be used as a superior export product (Ditjen PEN, 2013).

However, a comprehensive study of the preference of any particular seaweed, for instance *Ulva raticulata*, to all forms of available nitrogen – ammonia (NH_3), nitrite (NO_2), and nitrate (NO_3) - as nutrients in waters in the context of eutrophication is still relatively lacking and even non-existent, especially in the South Sulawesi region. Therefore, research on the ability to nutrient uptake seaweed is important, to optimize seaweed aquaculture and eutrophication mitigation effort. This is also to developing application of ecosystem-based seaweed farming, a sustainable cultivation system that is a world trend (FAO, 2011).

II. RESEARCH METHOD

This study used *Ulva reticulata* taken from the Lae-lae Island, and cultivated in the laboratory under their natural condition. As much as 72 grams of the The decreasing rate (or equivalent to nutrient uptake) of NO_2, NH_3, and NO_3 was 4.58 ± 1.71 µg/l/day, 2.70 ± 0.17 µg/l/day, and 1.98 ± 1.19 µg/l/day, respectively. It indicated that the NO_2 become *Ulva reticulata* preference nutrient uptake in the eutrophic coastal waters. Compared to other *Ulva reticulata* in this experiment took up nutrient less than other experiments (Table 1). It is most likely due to that there was no nutrient additional inputs into the water systems, so the available nutrient in the experimental aquarium gradually lessen was prepared for each aquarium filled with filtered 42-liter eutropic coastal waters taken from the western coast of south Sulawesi, Indonesia, without any exchange for 20-day period of experiment. Moreover, each of the aquarium was light-enriched with 1,561 lux, and small pump was introduced in the aquarium to obtain slow movement of water. The experiment was undertaken in triplicates, with additional control experiment in also triplicates. Concentration measurements of NH_3, NO_2, and NO_3 were carried out every 10 days, using APHA method (1989) with trichlorometric spectroschopy. Seaweed weights was measured for growth. Seaweed growth was calculated using the method adopted by Balina et al (2017). Water quality was checked in situ for parameters: temperature, pH, salinity and dissolved oxygen. Absorption nutrients by seaweed were calculated from the rate of decrease in nutrients in the water column. With the formula, the rate of decline = (T1-T2) / t. Where t is the monitoring period, T1 is the initial nutrient concentration and T2 is the final nutrient concentration.

III. RESULT AND DISCUSSION

3.1. Decreased nutrient concentration (N)

The initial concentrations of NH_3, NO_2, and NO_3 were respectively 0,05 mg/l, 0,120 mg/l, and 0.163 mg/l. All the nutrient experienced decreasing in concentration during the experimental period (Fig 1). Significant decreased in nitrogen availability compared to the control experiments indicates nutrient uptake by the *Ulva reticulata*. Changes in this composition showed that NO_2 experienced higher decrease in the concentration than the other NH_3 and NO_3 species. NO_2 decreased 1.8% from the initial concentration. While, NO_3 was decreased by around 0.20% and NH_3 around 0.13% during the trial period. The decrease in concentration of the three forms of nitrogen (NO_2, NO_3, and NH_4) shows that seaweed is very requires nitrogen in nutrients the period of its growth (Wahyudi, et. al., 2018).

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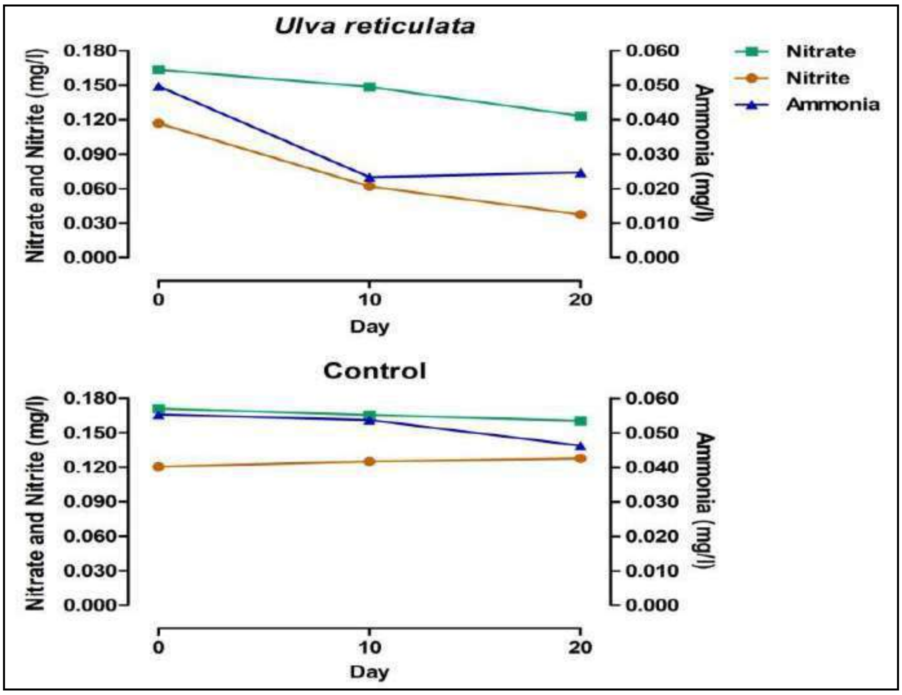

Fig 1. Decreased in NH_3, NO_2, NO_3 in the experiment aquariums relative to the control ones

3.2. Nutrient Uptake

The decreasing rate (or equivalent to nutrient uptake) of NO_2, NH_3, and NO_3 was 4.58 ± .71 µg/l/day, 2.70 ± 0.17 µg/l/day, and 1.98 ± 1.19 µg/l/day, respectively. It indicated that the NO_2 become *Ulva* preference nutrient uptake in the eutrophic coastal waters. Compared to other *Ulva* in this experiment took up nutrient less than other experiments (Table 1). It is most likely due to that there was no nutrient additional inputs into the water systems, so the available nutrient in the experimental aquarium gradually lessen.

Table 1. Comparison of nutrient uptake of various species of ulva seaweed

No.	Seaweed	Nutrient Uptake of Nitrogen Species			References
		NO_3	NO_2	NH_3	
1	*Ulva reticulata*	1.98 ± 1.19 µg/l/day	4.58 ± 1.71 µg/l/day	2.70 ± 0.17 µg/l/day	This study
2	*Ulva lactuca*	1.89 µmol/l/day	-	0.092 µmol/l/day	Bulboa, 2014
3	*Ulva plorifera*	125,24 mol g-1DM h-1	-	284.60 mol g-1DM h^{-1}	Luo et al., 2012
4	*Ulva linza*	109.13 mol g-1DM h^{-1}	-	250.25 mol g-1DM h^{-1}	
5	*Ulva reticulata*	0.33 mg/l/12 day	1 mg/l/day	1 mg/l/day	Rabie et al., 2014
6	*Ulva lactuca*	12.09 mg/l/day	0.68 mg/l/day	0.71 mg/l/day	Brundu & Chindris, 2018
7	*Ulva pertusa*	0.984 µM/g/h	-	-	Choi et al., 2009
8	*Ulva intestinalis*	1.25 µmol/g/h	1.07 µmol/g/h	3.67 µmol/g/h	Martinez & Rico, 2012

Note: h= hour

3.3. Effect of seaweed growth on nutrients (N)

The growth rate of *Ulva reticulata* is linear until the end of the trial (20 days). The average growth rate is 15.40 ± 3.12% day-^{1}.Fig. 1 reflects the effect of each species of nitrogen on the rate of growth. The negative impact on growth is only shown by NH_3 with a slope of -1780 (R^2 = 0.880) . Positive trends in growth are shown by NO_2 and NO_3. with slope of 146.4 (R^2 = 0.718) and 68.66 (R^2 =

0.148). The highest decrease in NO_2 concentration in the absorption process by *Ulva reticulata* was also found in a study conducted by Rabie, 2014. The relationship of NO_2 absorption to *Ulva reticulata* seaweed growth was explained by Marinho-soriano, et al., 2011 that the high ability of *Ulva reticulata* to absorb NO_2 is a strategy to get a large amount nitrogen which is useful for growth.

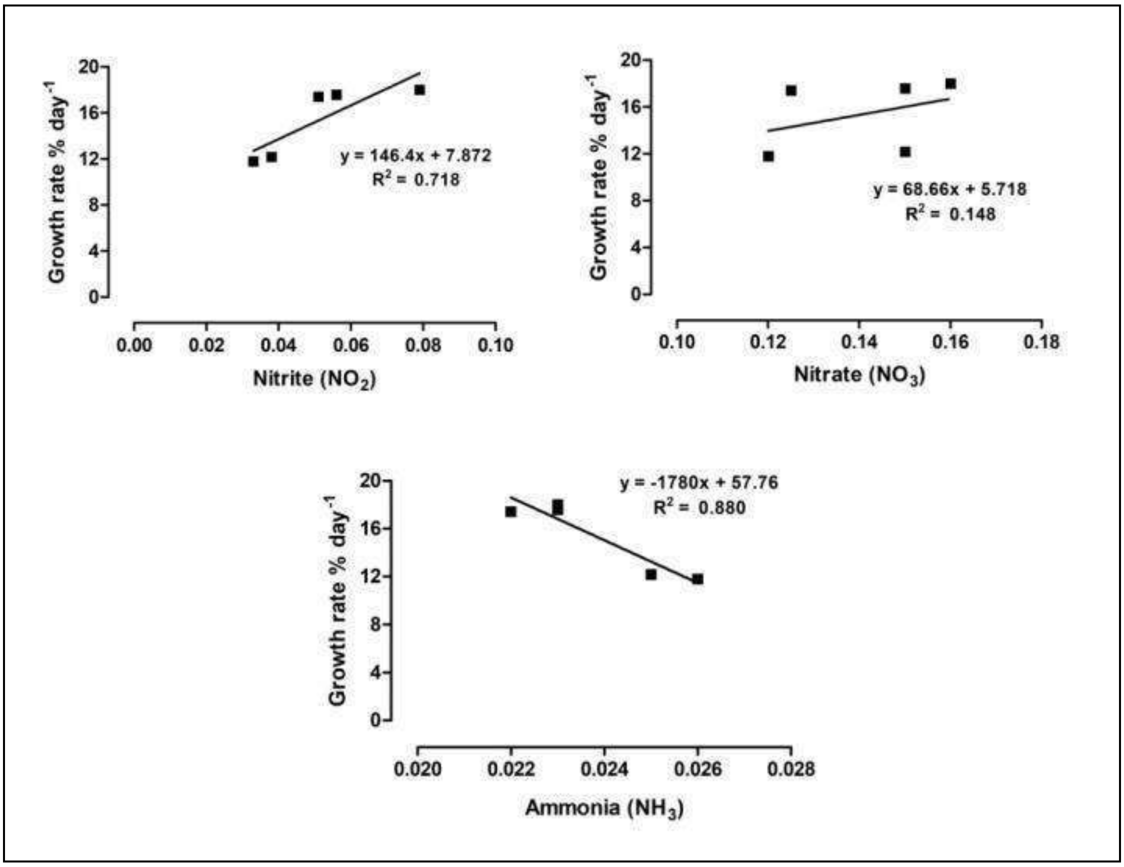

Fig 2. Growth of Ulva reticulata under no water exchange during lab experiment

3.4. Water Quality Condition

Experimental water quality provided sufficient condition for seaweed cultivation and nutrient preference experiments. The water quality was maintained almost stable during the period of experiment. ANOVA test results for water quality parameters ($p > 0.05$; Table 2). The salinity remained in the average of 30 - 31 $^o/_{oo}$. pH varied between 7.8 and 8.10. Water temperature was between 29 – 30 ^oC, and dissolved oxygen (DO) was in the range of 5.63 to 6.38 mg/l.

Table 2. Water quality condition during the period of experiment (mean ± standard deviation)

Parametes	Species	Number of day		
		0	10	20
Salinity ($^o/_{oo}$)	*Ulva reticulata*	31 ± 1.0	30 ± 0.43	30 ± 0.60
	Control	31 ± 0.58	30 ± 0.19	30 ± 0.69
pH	*Ulva reticulata*	7.48 ± 0.07	7.71 ± 0.23	8.10 ± 0.07
	Control	7.48 ± 0.07	7.70 ± 0.26	8.18 ± 0.05
Temp (^oC)	*Ulva reticulata*	29 ± 0.58	30 ± 0.43	30 ± 0.43
	Control	29 ± 1.0	30 ± 0.43	29 ± 0.43
DO (mg/l)	*Ulva reticulata*	5.63 ± 0.32	6.07 ± 0.49	6.38 ± 0.20
	Control	4.83 ± 0.55	6.05 ± 0.60	6.66 ± 0.31

IV. CONCLUSION

Without exchanging of water meaning no additional nutrient in the experiment, the preference of *Ulva reticulata* in eutrophic coastal waters of western coast of south Sulawesi, Indonesia was to NO_2. The uptake of the NO_2 was 4.58 ± 1.71 µg/l/day, and the growth rate of the seaweed was 15.40 ± 3.12 % day^{-1}. The experimental condition was stable indicating water quality had no significant impact to the growth.

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Response and Behavior of Rajungan *Portunus pelagicus* on the Use of Natural Bait and Artificial Bait *PVa Chamois*

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***Abstract*— *Rajungan (Portunus pelagicus) is one of the fisheries resources that has important economic value as an export commodity. The exploitation of rajungan is done by using traps. The success of catching using traps is influenced by several factors such as traps construction, soaking time and bait, the research method uses experimental methods. This study aims to determine the comparison of responses and behavior of rajungan to natural bait and artificial bait. Two types of bait used are sardinella fish meat (sardinella fimbriata) and Pva Chamois. The measured time data was collected by testing the habits and speed of 10 rajungan samples in response to bait and data analysis based on the t-test using the independent t-test at 4 phases of chemical stimulation. Selain carried out a descriptive analysis of the pattern of rajungan movements in response to the bait given, the results of the analysis showed that 3 phases of rajungan behavior, namely detection, orientation, and locomotive, did not have a significant difference, whereas in the feeding initiation phase there were significant differences. Furthermore, the movement pattern shown by the rajungan in response to natural bait is a direct movement pattern while the artificial bait is a non-direct movement pattern.*

***Keywords*—Artificial lure, behavior, motion patterns. natural bait, rajungan**

I. INTRODUCTION

Rajungan (Portunus pelagicus) is one of the fisheries resources that has important economic value as an export commodity. Fresh and processed rajungan exports to various countries, including Singapore, Hong Kong, Japan, Malaysia, Taiwan, and the United States. The high market demand and prices of rajungan can increase the income of fishermen (Adam. 2006). Market demand and high prices cause the capture of natural rajungan to increase or fishermen catch large numbers of rajungan. This is because the rajungan fishery resources are open access (open access), similar to other fishery resources in Indonesia.

In open exploitation, fishermen are competing to increase the effort, even making arrests to the catchment area further from their base (Adam. 2006). In addition, national rajungan products are obtained by cultivation and capture. Catching rajungan directly from nature is done by using various types of traps and one of them is traps (Rakhmadevi, 2004).

The success of catching using traps is influenced by several factors such as bubbling construction, soaking time and bait (Miller, 1990). Bait is one of the important factors in supporting the success of a fishing operation, especially for passive fishing gear such as traps and fishing rods (Subani and Barus 1989).

Traps fishing gear usually uses natural bait in the form of fish, because it is easily obtained and still has good freshness (Ramdani, 2007). There are various types of bait used in fishing activities, including natural and artificial bait. As for the traps fishing gear which is operated to catch the rajungan, it usually uses natural bait in the form of sardinella fish (Sardinella fimbriata) . sardinella fish is widely used because it has good freshness.

The problem that is often faced by passive fishing devices, including Traps, is that the operation of these fishing gear requires bait. The availability of bait sometimes does not always exist so that it affects the intensity of the catch that cannot be done at any time. On the other hand, baitfish have a relatively high price so that it will cause the operational costs of catching fish traps to be higher. Therefore, the need to make artificial bait that is cheap has a specific odor and is always available so that the results are expected to be more effective than the bait that has been used by fishermen so that the productivity of fishing can increase.

II. THE RESEARCH METHOD

Research was conducted in 2 Months (January 2019 - February 2019), in the Bonto Ujung Village, Tarowang Subdistrict, Jeneponto Regency, South Sulawesi The selection of the research location was determined based on the habit of using traps fishing gear by local fishermen and the experimental laboratory was carried out as close as possible to the fishing location to maintain the parameters and suitability of aquarium conditions and fishing .

This research was carried out by following an experimental method, namely an experimental design that was tested to obtain information about the problem being studied. Through this method, information is needed in conducting research about the issues to be discussed so that a conclusion will be produced in accordance with the objectives of the study (Sudjana, 1994).

The research method used is an experimental laboratory method. The sample used as an object is carapace-sized rajungan> 9.5 cm using bait song. The research was carried out based on previous research by Supadminingsih (2015), Fitri (2016), and Asryanto (2016) which had been refined so that the research was carried out as follows:

1. Maintenance phase

The maintenance stage is the stage of adaptation of the rajungan Portunus pelagicus in laboratory conditions for 2 days. Rajungan not given food and left to dwell in a bag net and tied up against seaweed

2. Treatment preparation stages

Data collection by observing. Primary data taken in the form of observing the pattern of rajungan movements done after the rajungan passing through the arousal area until it enters the food area and the crunch response time for the type of food as from the time it is inserted into the treatment aquarium as the barrier is opened to the rajungan enters the catchable area. Observations made in the area of start, searching and finding are in the form of:

a. Detection and Orientation

Is the phase that occurs in the start area , namely the rajungan Portunus pelagicus is said to be aroused when the bulkhead is opened, the measurement of the speed of the rajungan movement use stopwatch done The start area is used as area A with a width of 35 cm considering the size of the rajungan with a carapace of 11 cm has a large and wide size, and this applies to (finding);

b. Locomotion

Rajungan perform a search for signal sources in the searching area and observe the pattern of rajungan movement in looking for food to enter the catchable area and finding the area. The size of this area is 70 cm long considering the ease of unit in speed;

c. Initiation of Feeding (finding food)

It is an area of food if the rajungan has entered the catchable area, it is said to be a rajungan respond to the smell of food. Measuring the speed of the rajungan movement use the stopwatch stops. Then the rajungan response was observed food after the rajungan Portunus pelagicus enters cachable area and found the food (finding). Repetition is calculated for each rajungan group for each food. Next design Aquarium Treatment:.

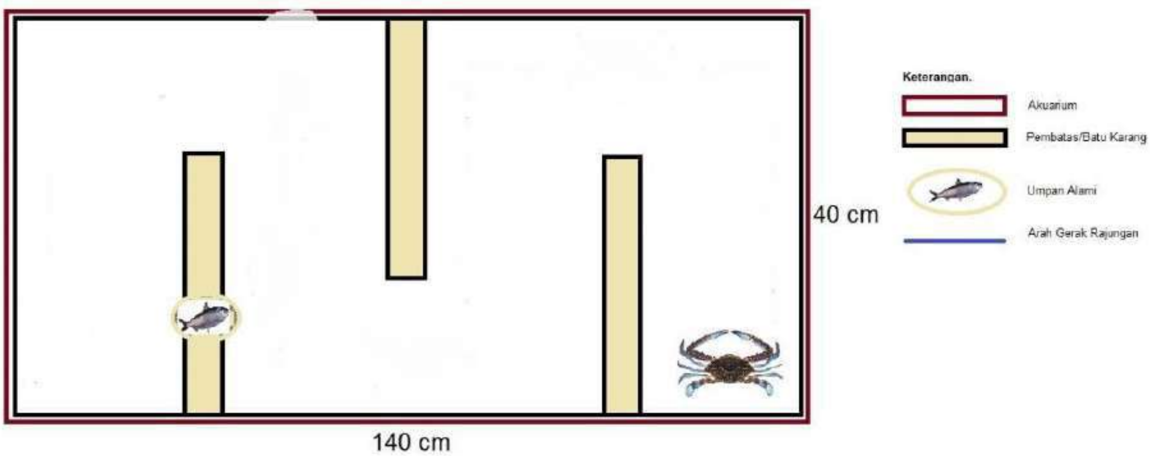

Fig.1: Design of the rajungan response study natural bait

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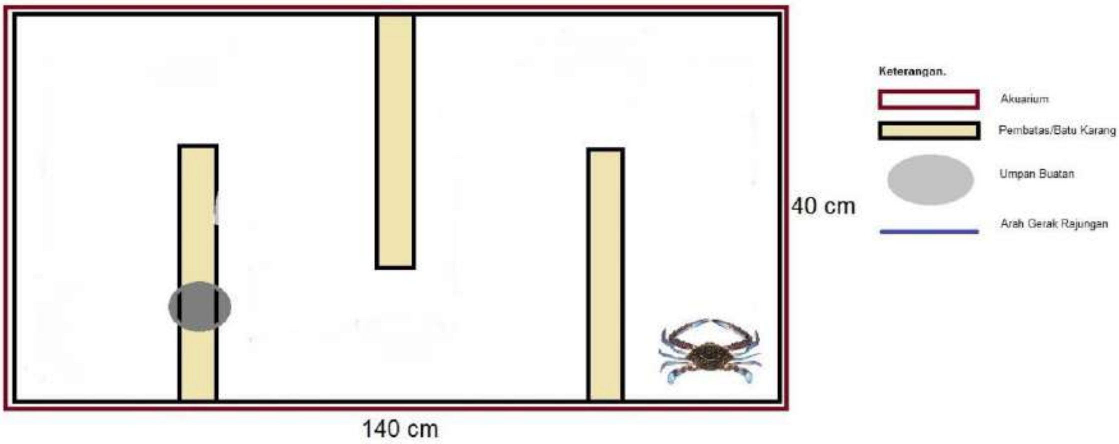

Fig.2: Design of rajungan response research artificial bait

The treatment limit is made one hour, this is related to the rate of release of amino acids in proteins in seawater which will decrease after 1-hour immersion. According to Perdian, (2014), the rate of release of amino acids in tembang fish is high at the time of immersion in the first hour and then decreases with increasing duration of immersion.

Data obtained from the observation processed and compiled in the table, then do data processing in order to be concluded in accordance with the purposes of research. Data analysis will be carried out as follows:

Raw data that has been collected needs to be labeled in groups and categorization is held, so that the data has meaning to answer the problem and is useful in testing hypotheses (Natsir, 2003). Data normality testers aim to find out whether the distribution of this data is normal or not, after which a variance test with a normality test can also be examined by the Kolmogorov-Smirnov test. If the distribution data is normal, then it is analyzed using an independent t-test

III. RESULTS

The Observations were made on 10 rajungan with 2 different feed-giving treatments with adult age stages in accordance with the catch target which was the objectives of this study.

Descriptive data produced showed male rajungan had a larger carapace size and longer claws compared to female rajungan. The carapace color of the male rajungan is bluish with bright white patches, while the female has a greenish carapace color with gloomy white patches. Color differences are seen in individuals who are rather large even though they are not yet mature. The carapace length of this animal can reach 10.8 -13.1 cm.

The average time needed for rajungan to respond to chemical stimuli from natural feed sources can be distinguished based on the stimulation phase and the movements carried out are described as follows:

Table 1. Time and behavior of rajungan responding to natural bait

Portunus pelagicus	*Time (s)*			
	Detection	*Orientation*	*Locomotion*	*Initiation Of Feeding*
I.a	2520	42	148	20
I.b	1260	20	120	10
I.c	2100	45	180	18
I.d	660	30	180	18
I.e	2400	15	122	10

Table 2. Time and behavior of rajungan responding to artificial bait

Portunus pelagicus	*Time (s)*			
	Detection	*Orientation*	*Locomotion*	*Initiation Of Feeding*
II.a	3300	30	162	60
II.b	3150	45	240	90
II.c	1530	20	180	60
II.d	1890	30	180	60
II.e	3600	30	140	90

The use of artificial bait in five rajungan samples shows the response and behavior of rajungan divided into 4 phases based on chemical stimuli by looking at the indicators and movements of sensory organs and the main movements towards food sources

In the four phases of rajungan behavior on natural bait, it can be concluded that the time needed by the rajungan to detect the highest chemical stimuli is in the first phase

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(Detection). This is in accordance with the study (Supadminingsih, 2015) arousal to wait and be careful, in response to food.

In the four phases of rajungan behavior on artificial bait can be concluded that the time needed for rajungan to detect the highest chemical stimuli is in the first phase (Detection) , when compared to using natural bait which tends to be stimulated faster by rajungan organs this is caused by bait naturally fulfilling the requirements to stimulate the sense of smell and taste. The odor dissolved in water using natural bait stimulates receptors on the olfactory organs which are part of the fish's sense of smell and the type of rajungan (Ramdhani, 2007).

1. Detection

In observation of behavior navigating bridge in the early phase of this shows that the rajungan are aware of the presence of odors generated by both natural bait or artificial bait.

Table 3. Detection phase t-test

		F	Sig.	t	df	Sig. (2-tailed)
Waktu	Equal variances assumed	.469	.513	-1.660	8	.135
	Equal variances not assumed			-1.660	7.845	.136

The results of the Normality test for one sample column Smirnov showed that the results of treatment in the form of response time for 5 rajungan samples using 2 different types of bait showed that the Natural Feed P value (0.20> 0.05) and Artificial Bait P value (0.19> 0.05) then Ho was accepted thus it can be stated that the treatment has a normally distributed value.

Independent t-test results with the basic design of RAL (Complete Random Design). Significant value 0.13> 0.05, then Ho is accepted, it can be concluded that there is no significant time difference between rajungan in detecting chemical stimuli of natural bait and artificial bait.

Rajungan time difference in responding or detecting chemical stimulation produced by bait is shown in figure 4, to ten samples, the time needed for natural bait is faster than artificial bait, except in sample 3 so it can be concluded that interest in chemical stimulation of natural bait is faster compared to artificial bait.

Stimulus chemical stimulation of bait makes the rajungan respond with signal perception by chemoreceptors in the antennule, mouth and prepaid will move continuously with increasing intensity

2. Orientation

Based on the results of observations in the feed test aquarium given in the form of natural bait and modification of the bait can cause stimulation in the rajungan, the olfactory organ which first plays a role. These organs are usually used to detect prey/bait that is located far away. These stimuli arise because of the chemical content in the bait.

The second phase is the orientation (orientation), where the animals prepare for the movement of interest or reject. The position of the crustacean changes relative to the position before stimulation, but does not move and continues to respond as in phase 1 the movements shown by the rajungan are likely to remain silent and are in the path of movement towards the bait.

Table 4. Orientation phase t-test

		F	Sig.	t	df	Sig. (2-tailed)
Waktu	Equal variances assumed	1.550	.248	-.084	8	.935
	Equal variances not assumed			-.084	7.044	.935

The results of the Normality test for one sample column Smirnov showed that the treatment results in the form of response time for 5 rajungan samples using 2 different types of bait showed that the Natural P-value of P (0.20> 0.05), and the value of Artificial Bait P (0.053> 0.05) then Ho thus it can be stated that the treatment has a normally distributed value.

Independent t-test results with the basic design of RAL (Complete Random Design). Significant value 0.93> 0.05, then Ho is accepted, it can be concluded that there is no significant time difference in rajungan in detecting chemical stimuli of natural feeds and artificial baits.

These results indicate differences in the time of rajungan in the orientation behavior of the chemical stimuli produced by the bait. As seen in figure 12, there is no significant difference in the time required by the rajungan to orient the bait between 15-45 seconds.

3. Locomotion

Movement (locomotion), the rajungan begins to move slowly because it is attracted or refused. towards or away from sources of chemical signals, and occasionally continue to respond as in phase 1 and phase 2

Table 5. Locomotion phase t-test

		F	Sig.	t	df	Sig. (2-tailed)
Waktu	Equal variances assumed	.000	.990	-1.432	8	.190
	Equal variances not assumed			-1.432	7.612	.192

The results of the Normality test for *one sample column smirnov* showed that the results of treatment in the form of response time for 5 rajungan samples using 2 different

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types of bait showed that the Natural Feed P value (0.14> 0.05), and P Artificial Bait value (0.45> 0.05) then Ho thus it can be stated that the treatment has a normally distributed value.

Independent t test results with the basic design of RAL (Complete Random Design). Significant value 0.19> 0.05, then Ho is accepted, it can be concluded that there is no significant time difference between rajungan in detecting chemical stimuli of natural bait and artificial bait.

This comparison data shows the time it takes for the rajungan to respond and move *(Locomotion)* in finding the bait position with a not too significant time range in the two different types of bait. Chemical stimulation of the rajungan when the rajungan-movement towards the feed *(Locomotion)*, the organ of vision that comes into play, but not apart that the olfactory organs still come to work this thing looks jelaas *antenulla* occasional rajungan rajungan is still moving in a state of moving toward the bait.

4. Initiation of Feeding

Initiation for *feeding* , the rajungan begins to handle and consume food *(incitant* or pressing). And move up to the food source, then handle food with *cheliped* and mouth parts so that the chemoreceptor is exposed to chemical signals.

Table 6. Test t phase initiation of feeding

		F	Sig.	t	df	Sig. (2-tailed)
Waktu	Equal variances assumed	3.051	.119	-7.459	8	.000
	Equal variances not assumed			-7.459	4.172	.001

Results of the normality test for one sample column Smirnov showed that the results of treatment in the form of response time for 5 rajungan samples using 2 different types of bait showed that the natural feed P value (0.71> 0.05), and the value of Artificial Bait P (0.13> 0.05) then Ho thus it can be stated that the treatment has a normally distributed value.

Independent t-test results with the basic design of RAL (Complete Random Design). Significant value 0.001 <0.05, then Ho is rejected so it can be concluded that there are significant differences in rajungan time in initiating feeding on natural bait and artificial bait.

These results indicate differences in patterns of movement and initiation of different types of bait, in this phase the response shown by the rajungan to natural bait is to directly carry out feeding activities on fish feed as bait, while the response shown in bait modification is that the rajungan slowly approaches the bait but it did not directly initiate to eat, the rajungan circled around the bait and moved towards the back of the bait.

The rajungan behavior in responding to food based on its motion patterns is divided into 2 namely direct motion patterns and indirect motion patterns. The pattern of direct motion is the behavior of the rajungan moving towards the food area and grabbing food by following a predetermined direction of movement, while the indirect pattern of the rajungan will find food with longer movements, uneven patterns, and tend to go back and forth to the food source. The rajungan movement pattern is indicated by the direction of the arrow as follows:

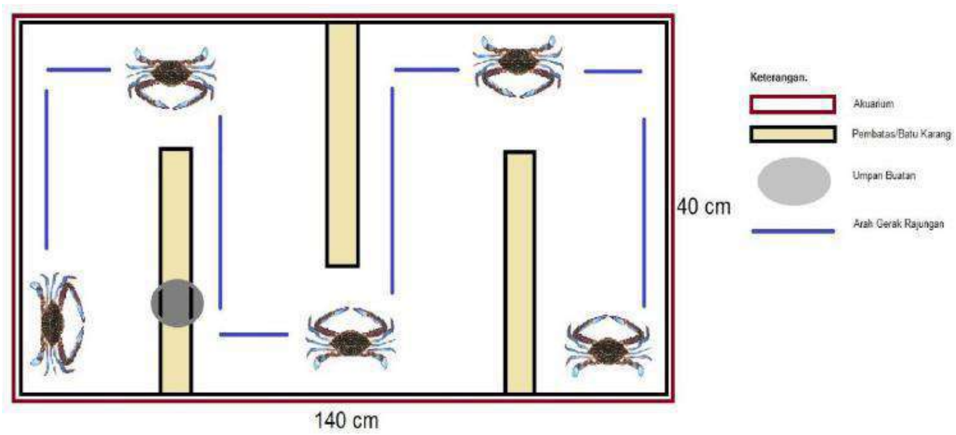

Fig.3: Artificial Bait Pattern

Observation on the use of artificial bait shows the rajungan moves slowly out of the aurosal phase towards the searching area. Then the rajungan will pause and re-enter the aurosal area and stop, then the rajungan continues to search for food until it enters the last area and finds food.

In observing this artificial bait, it shows that the rajungan moves out of the start area and moves backwards to the

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starting area and stops for a moment until it enters the *catchable area* .

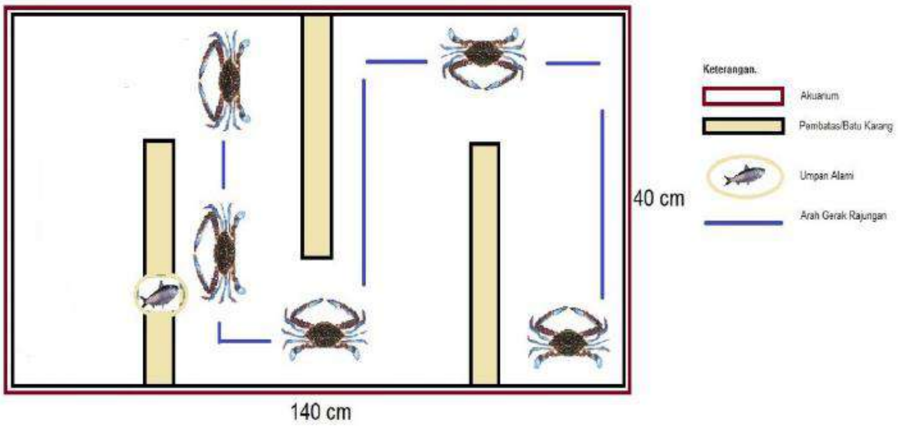

Fig.4: Natural Bait Pattern

Whereas observations using natural bait show the rajungan making a direct movement towards the center of the food source in a straight pattern. The direction of this movement is behavior that tends to be shown by adult rajungan even though initially adult rajungan tend to be more silent than juvenile rajungan which shows an aggressive response to food consumption and has a movement pattern that tends to be fast (Fahresa, 2016).

Other behaviors shown by adult rajungan are also due to the form of awareness of the stimulus, after making sure there is food then the new rajungan will move towards the center of the stimulus, other movement patterns also show the rajungan moving sideways in the start area then exit and stop in the second area, silent first with a faster antennule movement indicating the rajungan is observing and looking at the smell then looking at the location of the food, after confirming the location of the food the rajungan will immediately walk towards the center of food

IV. CONCLUSION

The time ratio of rajungan in response to natural bait and artificial bait to the 4 phases of chemical stimulation shows phase detection. Significant value 0.13> 0.05, indicating no significant time difference, in detecting the chemical stimulation of natural bait and artificial bait. Phase Orientation, Significant value 0.93> 0.05, Indicates that there is no significant time difference in rajungan in response to chemical stimuli of natural bait and artificial bait. Locomotion phase, Significant value 0.19> 0.05, Indicating no significant time difference, Phase Initiation of Feeding, Significant value 0.001 <0.05, Indicating a significant time difference, in initiating feeding on natural bait and artificial bait.

The pattern of movement that shows the rajungan on natural bait is a pattern of direct movement, the rajungan moves towards the food source by following a predetermined pattern, while the pattern of movement that shows the rajungan on artificial bait is an indirect movement pattern, the rajungan moves slowly back and forth and circulates around the food source.

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Bioeconomic Analysis of Resource Utilization of Flying Fish *(Hyrundicthys oxycephalus)* in the Makassar Strait, South Sulawesi, Indonesia

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***Abstract*— *This study aims to analyze the bioeconomic value of the use of flying fish in the Makassar Strait waters. The study was conducted in November 2018-March 2019 which took place in Takalar District. Data collection techniques are conducted by interview, observation, questionnaire and literature study. The research method in this study is the survey method. The sampling technique in this study used a purposive sampling technique by taking a sample of 36 samples of flying fish business. Data analysis using the static and optimal dynamic bioeconomic formula with the help of Microsoft Excel and Maple 18. Software. The results showed that the actual conditions of the use of flying fish in the Strait Waters have experienced overfishing, both biologically and economically with the actual production amount of 1,604 tons, maximum production in the management regime of MSY (Maximum Sustainable Yield) with a total production of 2,545 tons, maximum production in the MEY (Maximum Economic Yield) management regime with a total production of 2,538 tons with an economic rent of 14,687,087,983 IDR.*
Keywords*— *Bioeconomic, Utilization, Flying Fish, Makassar Strait

I. INTRODUCTION

The increasing population increase has led to increased use of funds from time to time. This condition requires an agreement on resource management and exploitation will ultimately resolve the balance of the Environment. Therefore, resources must consider the technology used and the carrying capacity of the environment or preservation. Economic pressure has become very dominant in applying coastal communities. Sustainability of the Fisheries and Marine Fund has not received attention in meeting market demand for fish where demand has increased along with the increasing population of the world.

Even though fishery resources are classified as renewable resources, if they are not managed properly, there is a possibility that there will be a decrease in both the quality and quantity of the stock or even the worst is the occurrence of scarcity or extinction. According to [1] that there has been a significant increase in the exploitation of fish resources from 1995-2004. The exploitation of the resource in question has exceeded sustainable production and in some regions of Indonesia, overfishing has occurred, fishing, at least economic overfishing is characterized by high use of inputs, but not followed by proportional increases in output and returns.

The exploitation of flying fish fisheries, especially their eggs, it is feared that in the future there will be a decline in flying fish stocks. This trend has begun to be identified, namely by decreasing the number of flying fish and flying fish eggs, and decreasing the average length of caught flying fish. [2].

This condition resulted in the condition of flying fish resources began to experience a decline in production from year to year, due to the exploitation of the mother of flying fish and flying fish eggs on a large scale and continuously. The impact of externalities produced not only affects the ecosystem but also affects the socio-economic conditions of fishing communities in the future. Seeing the existence of flying fish resources is pride as an icon of fisheries in the Makassar Strait will disappear as well as the presence of endemic fish in Sumatran waters such as terubuk fish.

The bioeconomic approach is a combination of aspects of biology, technology, and economics [3][4].

Research on bioeconomic is still limited in South Sulawesi, namely Mackerel Indians [5], Scad Indians [6], Flying Fish [7] in the Makassar Strait and Flores sea, (Petersen, et. al, 2011), Bioeconomic of Utilizing Grouper *(Plectropomus leopardus*) in Selayar Islands Regency [9], and Bioeconomic of Coral Grouper in the Spermonde Islands [10]. The bioeconomic model approach to marine fisheries

resources have been recommended by FAO, because of the many uncertainty factors in fisheries management. [11].
This study focuses on cases of catching flying fish economic value and increasing market demand which causes the exploitation of these fish to increase every year. Exploitation on a large scale and continuously will have an impact on stock conditions which will ultimately have an impact on fishermen's income and fishermen's losses. The purpose of this study was to analyze the bioeconomic value and efforts to the actual use of flying fish *(Hyrundicthys oxycephalus)* in the Makassar Strait waters.

II. RESEARCH METHODS

2.1. Time and Place
This research was conducted from November 2018 to April 2019. The place of this research was conducted in Takalar District in South Galesong District. Location determination is done intentionally because there is a flying fishing business unit in this sub-district that specifically catches flying fish.

2.2. Data collection technique
Data collection is done using interviews, observations, questionnaires and literature studies.

2.3. Research Method
The research method is primarily a scientific way to get data with specific purposes and uses. To achieve these objectives, a method that is relevant to the goals to be achieved is needed. The method used in this study is the survey method. According to [12] the survey method is "Research conducted using questionnaires as a research tool carried out in large and small populations, but the data studied is data from samples taken from the population, so that relative events, distribution, and relationships between variables, sociological and psychological ".

2.4. Sampling Technique
Sampling for research according to [13], if the subject is less than 100 people, all should be taken, if the subject is large or more than 100 people can be taken 10-15% or 20-25% or more. Based on data from the Department of Maritime Affairs and Fisheries, the number of flying fish businesses in South Galesong is 104. Whereas in the District of North Galesong and South Galesong there were no fishing businesses that specifically caught flying fish but were more focused on catching flying fish eggs. So from that researcher took a sample of 35% of the population, which is about 36 samples of the fly fishing business.

2.5. Data Analysis

2.5.1. Catch per Unit Effort (CPUE)
After the production data and efforts (input or effort) are arranged in a time series according to the type of fishing gear, the next step is to find the catch per unit effort (CPUE). According to [14], the calculation of CPUE aims to determine the abundance and level of utilization of fisheries resources in a particular water area. The CPUE value can be denoted as follows:

$$\mathbf{CPUE_t} = \frac{Catch_1}{Effort_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where :
$CPUE_t$: catches per fishing effort in year t
$Catch_1$: catch in the t-year

2.5.2. Standardization of Fishing Gear
Standardization of fishing gear aims to homogenize different units of effort, so it can be assumed that the effort to capture a type of fishing gear is the same as standard fishing gear. The standard fishing gear is based on the amount of the catch obtained and the magnitude of the value of the fishing power index (FPI) with the input (effort) of a standardized tool.

$$\mathbf{E_{std} = Y_{tot} / CPUE_{std}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Dimana :
E_{std} : Standardized Fishing Efforts
$CPUE_{std}$: CPUE standard capture tool
Y_{tot} : CPUE is the standard

2.5.3. Estimated Biological Parameters
Biological parameters include the water carrying capacity constants (K), natural growth constants (r), technological parameters (q). While the economic parameters include the cost per fishing effort (c/p), the price of flying fish per unit, the catch (p), and the discount rate. There are several approaches in estimating biological parameters, but in this study the estimation model is CYP (Clark, Yoshimoto and Pooley) with the approach and development of the formula model [15] and [16], systematically the equation is written as follows: [17]

$$\mathbf{Ln}\ (U_{t+1}) = \frac{2r}{(2+r)} Ln(q,K) - \frac{(2-r)}{(2+r)} Ln(U_t) - \frac{q}{(2+r)}(E_t + E_{t+1}) \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where :
U_{t+1} : CPUE at time t + 1
U_t : CPUE at time t
E_t : Effort at time t
E_{t+1} : Effort at time t + 1
β_0 : intercept coefficient regression results

http://dx.doi.org/10.22161/ijeab.4424 ISSN: 2456-1878

β_1 : variable X coefficient 1 regression results
β_2 : variable X coefficient 2 regression results

2.5.4. Estimated Economic Parameters

Economic parameters include estimated input costs, estimated capture output prices and the level of resource cuts. Catching costs or estimation of input costs obtained from primary data which is then made data series of annual capture costs using the formula:

$$c = \sum c_i / n_1 \quad \ldots (4)$$

Where :
c : Average catching costs (IDR) per year
c_i : Cost catch per effort, respondents to-i
n_1 : Number of respondents

Output price estimation is obtained from primary data which is then made the real sales price data series in the year with the formula: [17]

$$p = \sum p_i / n_2 \quad \ldots (5)$$

Where :
p = Average price of catch per kg
p_i = Average price in the season
n_2 = Number of seasons (peak, normal, famine)

Parameter of the level of pieces of flying fish resources (d) using equations [3] :

$$d = \ln(1+i) \quad \ldots (6)$$

Where :
i : investment interest rate - inflation rate
d : discount rate of resources

2.5.5. Bioeconomic Analysis

The output of the bioeconomic model includes optimal stock (X *), optimal catch (Y *) and optimal fishing effort (E *) which is assumed by using the equation:

$$X^* = K/4[c/qpK + 1-\sigma/r)+\{(c/qpK + 1-\sigma/r)2 + 8c\ \sigma/qpKr\}1/2] \quad \ldots (7)$$

$$Y^* = rX^*(1-X^*/K) \quad \ldots (8)$$

$$E^* = Y^*/qX^* \quad \ldots (9)$$

Where :
K : Environmental carrying capacity
c : The cost of catching flying fish
p : The price of flying fish per kilogram
r : Intrinsic growth
q : capture power coefficient and flying fish gear
σ : discount rate of resources

2.5.6. *Maximum Sustainable Yield* (MSY)

As a comparison, MSY, MEY and Open Access potential calculations are carried out. Calculation of the Maximum Sustainable Yield (MSY) model uses the equation:

$$E_{MSY} = \frac{r}{2q} \quad \ldots (10)$$

$$Y_{MSY} = \frac{Kr}{4} \quad \ldots (11)$$

$$X_{MSY} = \frac{K}{2} \quad \ldots (12)$$

Where :
E_{MSY} : Efforts to capture MSY's condition
Y_{MSY} : Catch of MSY condition
X_{MSY} : Optimal stock estimation of MSY conditions

2.5.7. *Maximum Economic Yield* (MEY)

Assuming that the demand curve is perfectly elastic, the rent of fisheries resources based on the Maximum Economic Yield (MEY) value is obtained by using the following equation:

$$E_{MEY} = \frac{r}{2q}\left(1 - \frac{c}{pqK}\right) \quad \ldots (13)$$

$$Y_{MEY} = \frac{rK}{4}\left(1 + \frac{c}{pqK}\right)\left(1 - \frac{c}{pqK}\right) \quad \ldots (14)$$

$$X_{MEY} = \frac{K}{2}\left(1 + \frac{c}{pqK}\right) \quad \ldots (15)$$

Where :
E_{MEY} : Efforts to capture MEY's condition
Y_{MEY} : Catch of MEY condition
X_{MEY} : Optimal stock estimation of MEY conditions

2.5.8. *Open Access* (OA)

The level of effort under open access conditions (open access)

$$E_{OA} = \frac{r}{q}\left(1 - \frac{c}{Kpq}\right) \quad \ldots (16)$$

$$Y_{OA} = \frac{rc}{pq}\left(1 - \frac{c}{Kpq}\right) \quad \ldots (17)$$

$$X_{OA} = \frac{c}{pq} \quad \ldots (18)$$

Where:
E_{OA} : Efforts to capture OA's condition
Y_{OA} : Catch of OA condition
X_{OA} : Optimal stock estimation of OA conditions

III. RESULTS AND DISCUSSION

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3.1. Flying Fish Production

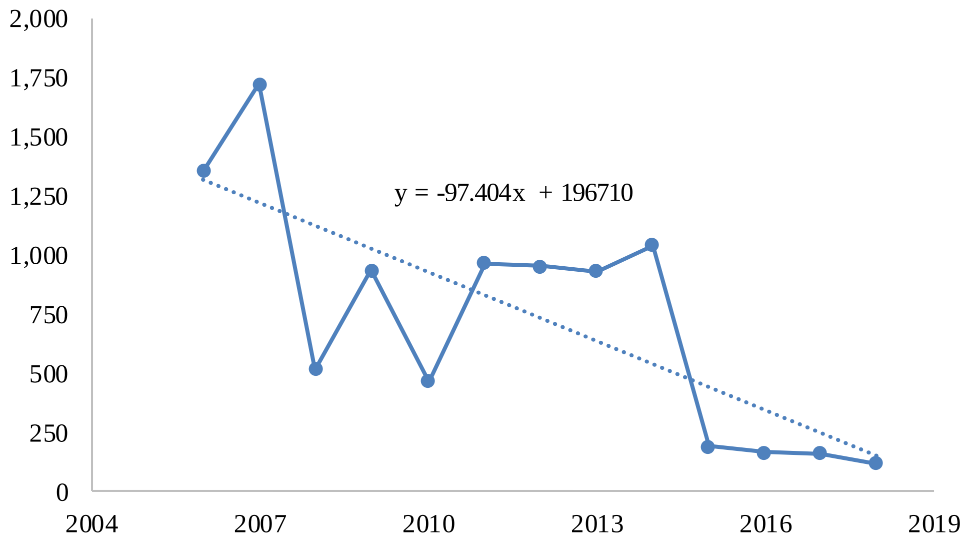

Fig.1: Production of Flying Fish in the Makassar Strait in 2006-2018

The production of flying fish in the Makassar Strait waters is very fluctuating. However, if you look at the data carefully, the number of flying fish production in the Makassar Strait waters tends to decrease from year to year, especially in 2008, starting from 1,722.50 tons, it experienced a very large decline in production to 515.00 tons. The same thing happened from 2015 until 2018, a significant decrease of 73%.

3.2. Flying Fish Catching Efforts

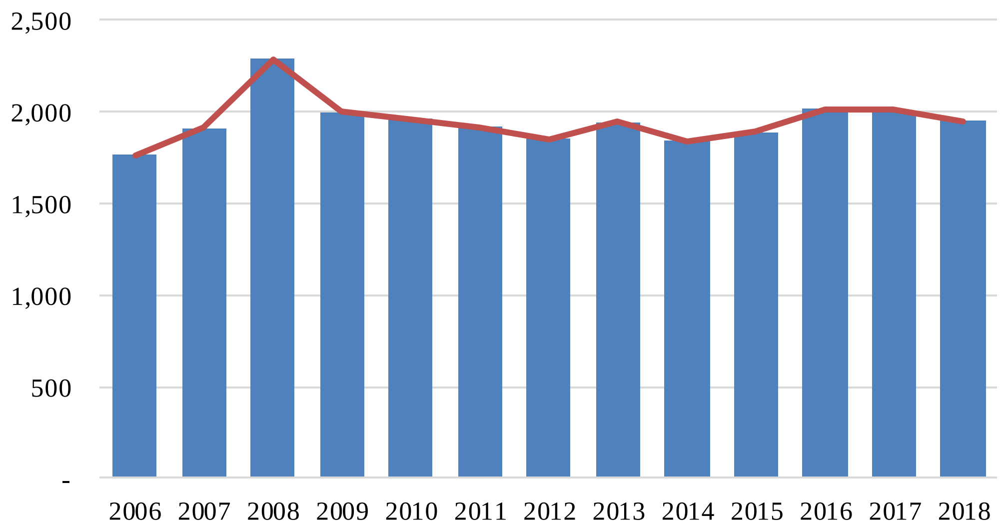

Fig.2: Flying Fish Catching Efforts in Makassar Strait Waters in 2006-2018

Catching efforts on fly fishing in the Makassar Strait waters tend to decline even though in several years there has been an increase. The decrease in fishing efforts occurred in 2008 until 2014, which amounted to 2,287 to 1,841 fishing units.

3.3. Catch Per Unit Effort (CPUE)

CPUE is one indicator of sustainable fisheries management. The general pattern of a fishery that is exploited which experiences overfished indicators is that the increase in total effort is followed by an increase in catches which is then followed by a decrease in catch per unit effort (CPUE). Catch per unit effort or Catch Per Unit Effort (CPUE) is a number that describes the comparison between catches per unit of effort or effort.

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Catch Per Unit Effort (CPUE) for flying fish varies greatly each year. In several years several fishing gears were no longer used. The reason is that productivity has decreased so that it is necessary to use other fishing gear that is more effective and efficient for catching flying fish, especially in the Makassar Strait.

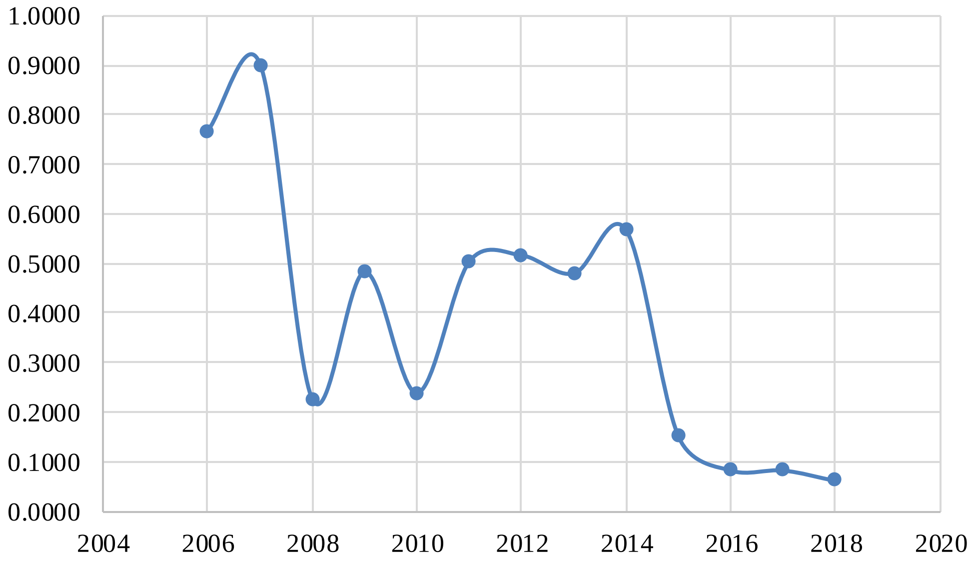

Fig.3: CPUE Resources for Flying Fish in the Makassar Strait in 2006-2018

See the CPUE value above, which number starts to decrease every year. If seen the above phenomenon is very worrying by the opinion of [18] that the CPUE value can be used to see the ability of the resource if it is continuously exploited. A declining CPUE value can indicate that the resource potential is unable to produce more even though the effort is increased.

3.4. Relations CPUE and Effort

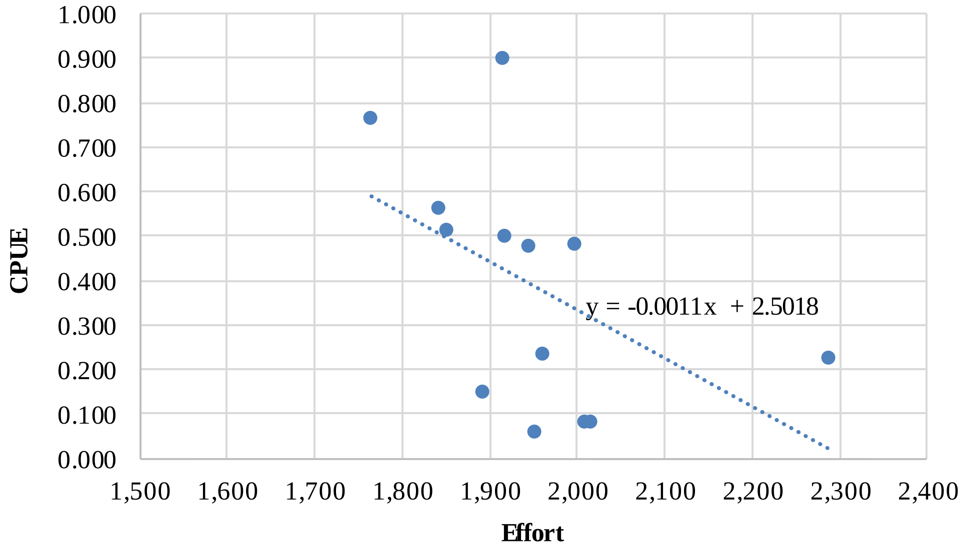

Fig.4: Relationship between CPUE and Fish Flying Efforts in the Makassar Strait

The relationship between CPUE and Effort on efforts to fly fishing in the Makassar Strait in the graph above shows a reciprocal relationship. This means that the increase in flying fishing efforts has caused CPUE to decline. From this equation it can be seen that the value of the slope that is negative indicates the CPUE and Effort relationship shows a negative relationship, the negative relationship is the relationship when the increase in a variable will cause a decrease in other variables and conversely the increase in a variable will cause a decrease in other variables [19]. This can be interpreted that an increase in effort will reduce the productivity of the catch (CPUE).

3.5. Estimated Biological Parameters

Biological parameters are one of the factors that greatly affect the survival of a marine organism, especially flying fish, because if one variable from biological parameters such as the carrying capacity of the environment does not match the needs, this will have an impact on the growth rate of flying fish.

Biological parameters that will be estimated include environmental carrying capacity (K), capture power coefficient (q), and fish growth rate (r). The estimation model used to estimate biological parameters is an estimation model developed by [17] or better known as the CYP model.

Estimation of biological parameters by the CYP method requires logarithmic input data from CPUE at time t + 1 and logarithm CPUE at time t and input data Effort t at t and t +1. To use OLS or regression, Ln CPUE t + 1 as Y, Ln CPUE t as X1 and Et + Et + 1 as X2 [20]. The estimation results from the three parameters presented in table 11 are useful for determining the level of production of sheets such as maximum sustainable yield (MSY), maximum economic yield (MEY) and open access (OA) conditions. This value can be seen in the following table:

Table 1. Results of Estimating Biological Parameters of Flying Fish

Number.	Biological Parameters	Estimated Results	Unit
1	Fish Natural Growth Rate Constants (r)	0.8651	ton/year
2	Capture Coefficient (q)	0.00036	ton/unit
3	Environmental carrying capacity	11,765	ton

Source: Data Analysis Results processed, 2019.

Based on the data obtained as presented in Table 1. The constant growth rate of flying fish (r) is 0.8651 which means that flying fish can grow naturally without any interference from natural symptoms with a coefficient of 0.8651 tons or 865.1 Kg per year. The capture coefficient (q) is 0.00036, this means that the proportion of flying fish stocks that can be captured by a standard unit of fishing gear is 0,00036 tons. The catch coefficient value is influenced by the number of fishing gear used and the availability of flying fish resources in nature.

The waters carrying capacity constant (K) is 11,765, this indicates that the aquatic environment supports flying fish production of 11,765 tons per year from its biological aspects, including food abundance, population growth, and fish size. The greater the carrying capacity of water allows the increasing the number of flying fish production in the Makassar Strait waters.

3.6. Estimated Economic Parameters

3.6.1. Estimated Input Cost

The cost of using fly fish consists of fixed costs and variable costs. Fixed costs are costs that are not used up in one trip (trip). For fixed costs, the costs of depreciation of fishing equipment include boats, machines and gill net floats. While variable costs are costs that are used up for one trip (trip). Fisheries economic theory states that in open access fisheries where the cost of fishing is assumed to be comparable to business fishing business will continue to increase even though income per business unit decreases and ultimately income will decrease to equal costs incurred.

The overall estimation results of the cost of input flying fish in fly fishing business per trip are 1,318,861 or 137,985,212 IDR per year. This input cost is dominated by oil fuel (diesel) which requires at least 90-150 liters of diesel per trip.

3.6.2. Estimated Output Price

In addition to the components of the capture costs required in this analysis also required price component data. The price component to be used in the analysis is the average price obtained from primary data or through direct interviews with fishermen and also secondary data from the Takalar District and Department of Maritime Affairs and Fishery of South Sulawesi Province with the 2006 time series up to 2018.

One problem in determining prices is the existence of abnormal price movements due to inflation. To overcome the abnormalities of the movement, adjustments were made by converting the nominal prices obtained to real prices. To convert nominal prices into real prices, the consumer price index (CPI) is used.

The estimated output price is obtained from the analysis of the nominal price which is then multiplied by the consumer price index. Then from that, the average real price is 6,200 per kilogram of flying fish.

3.6.3. Estimated Discount Rate Level

The parameter of the discount rate level refers to the investment interest rate and an inflation rate that applies in 2019. Based on data from Bank Indonesia for the value of the prevailing interest rate of 17.50 and the inflation rate of

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3.32%. To get the value of the piece of resource level estimated by the equation d = ln (1 + i) where i = the investment interest rate minus the inflation rate, so that the value of the piece of resource is obtained as d = ln (1+ (17.50% - 3.32%) = = 2.72.

3.7. Bioeconomic of Fish Resources Utilization in the Makassar Strait

Bioeconomic analysis of the use of flying fish in this study is estimated in 3 (three) management regime models, namely the Maximum Sustainable Yield (MSY) management regime, the Maximum Economic Yield (MEY) management regime and the Open Access (OA) management regime. The three management regime models are determined using analytical solving tools through the Microsoft Excel 2019 and Maple 18 program. The results of the bioeconomic optimization analysis of each flying fish management regime in this study are briefly presented in the following table.

Table 2. Results of Bioeconomic Optimization Analysis

Number	Management Model	Effort (E) (Unit)	Yield (Y) (Ton)	Biomass (X) (Ton)
1	Maximum Sustainable Yield (MSY)	1,215	2,545	5,882
2	Maximum Economic Yield (MEY)	1,210	2,536	6,232
3	Open Access (OA)	2,285	568	698
4	Actual	1,944	1,604	

Source: Data from the analysis, processed 2019

Based on the above table, the balance of MSY (Maximum Sustainable Yield) in the production conditions is 2,545 tons per year, in the MEY (Maximum Economic Yield) balance it is 2,536 tons per year and when the Open Access condition is obtained the production is 568 tons per year. Of the three regimes above, it shows that in the Maximum Economic Yield condition it is advantageous when viewed from biological parameters and economic parameters when compared to the other two management regimes. To see more details, the picture follows.

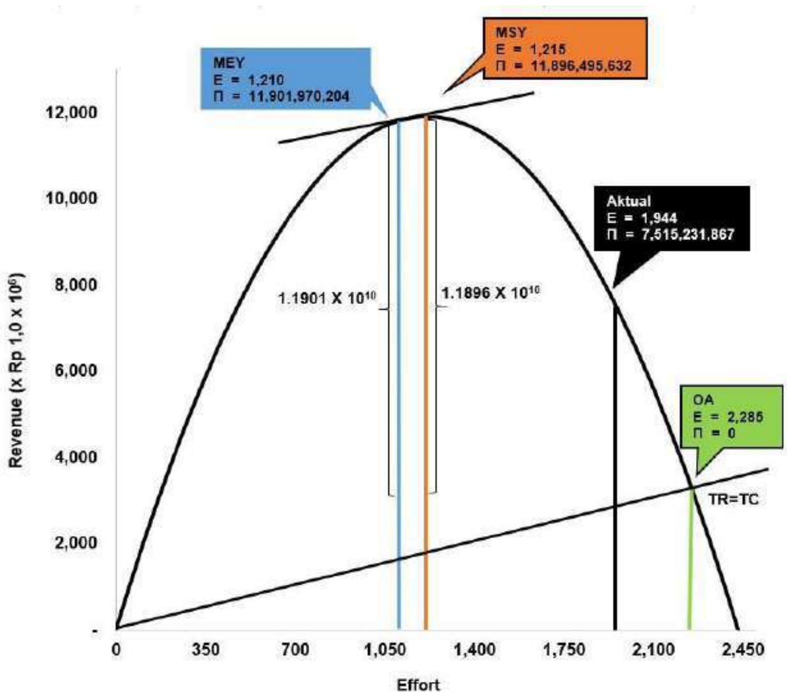

Fig.5: Bioeconomic Equilibrium of flying fish in the Makassar Strait

The maximum profit occurred during the MEY condition with an effort of 1,210 with an economic rent of 11,901,970,204 IDR. When compared with the value of MSY with a smaller economic rent of 11,896,495,632 IDR. The difference in economic rent between MEY and MSY is around 5,474,572 IDR. While the Open Access (OA) condition does not have a rent value, in other words, the value of TR = TC so that no profit is obtained at all.

IV. CONCLUSION

The bioeconomic model consists of a management regime for Maximum Sustainable Yield (MSY), Maximum Economic Yield (MEY) and Open Access (OA). In the Maximum Sustainable Yield (MSY) regime the economic rent value of 11,896,495,281 IDR and the effort of 1,215, the Maximum Economic Yield (MEY) regime obtained the economic rent value of 11,901,970,205 IDR and an effort of 1,210, while the open-access management regime obtained an effort of 2,285 and not economic rent, is obtained because the value of costs and revenues obtained are of equal magnitude.

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Relational Effects of Land Resource Degradation and Rural Poverty Levels in Busoga Region, Eastern Uganda

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Abstract— *Land degradation in southeastern Uganda is a recent phenomenon driven by population pressure and scarcity of extra fertile land. This paper explores the economic relations of soil conservation practices to rural poverty levels among the farming communities in southeastern Uganda. Using random sampling methods, 120 respondents from the districts of Kamuli, Iganga and Jinja were selected and interviewed. The results showed that about 42% of the farmers were poor. The Logistic regression reveals that farmers geographical location and being educated significantly reduced poverty, while household size increased it ($p<0.05$). Increasing the number of fertile land areas under fallow significantly reduces probability of being poor ($p<0.01$). Farmers that use crop rotation, vegetative cover crops and organic manure have significantly lower probability of being poor compared to those using zero tillage ($p<0.05$). Adoption of improved soil conservation practices will assist farmers to increase agricultural outputs and reduce their poverty levels, while fertilizers should be made available at affordable prices. Site-specific research, to address soil-related constraints and socio-economic and political issues, is needed to enhance and sustain production.*

***Keywords*—Agriculture, environmental degradation, poverty, Busoga region.**

I. INTRODUCTION

Agriculture is the largest sector of the Ugandan economy. About 80 percent of the population depends on it as the main source of income and livelihood. The agriculture resource base has been both shrinking and degrading with the increasing population pressure and marginal land with steep and very steep slopes increasingly being brought under cultivation. This has led to intense land degradation due to soil erosion in the hills and mountains (Bagoora, 1988).

The problems of poverty and environmental degradation in many developing countries are closely related (WCED, 1987). Because of increased population pressure, the long time needed for regenerating natural resources once degraded and persistent economic hardship in many African nations, natural resource degradation is a common phenomenon among the poor, as they try to escape the scourge of poverty (Maxwell, 1995). No doubt, poor farmers face the consequences of land degradation and are implicated in some of its processes. Specifically, rich farmers own more land than the poor arid are able to clear large expanse of forests, use large quantities of agrochemicals and open up/expose soils to erosion through agricultural mechanization. In like manner, poor farmers play some important role in unsustainable agricultural intensification, expansion of farming into marginal lands and overexploitation of forest resources. However, because they lack sufficient asset base to buffer its effects, the poor are more seriously affected by the consequences of environmental degradation (Wortmann and Kaizzi, 1989).

In Uganda, increasing poverty level despite several past policy interventions, is a matter of serious concern. For instance, analysis of 2003/2004 data revealed that national poverty incidence is 58%, with rural area having 64%, while urban has 35% (UBOS, 2005). This situation poses a daunting challenge to the achievement of the Millennium Development Goals (MDGs) Therefore, given the several forms of environmental degradation, the general consensus is that for any meaningful economic growth and development to be experienced, Uganda needs to first and foremost address widespread poverty, especially among its rural populace .

Moreover, Ugandan small-scale farmers largely depend on traditional methods of farming. These farmers are facing various land use constraints, which is one of the major sources of decline in agricultural productivity. Suppose rural households choose to stay on degraded land, without appropriate soil conservation practices, its declining productivity will not be able to support growing rural populations, not to consider the nation as a whole. Therefore, shortage of good quality agricultural land for smallholders is a major problem (UNDP, 2005). Consequently, some households are forced to abandon existing agricultural areas in search of new forest land. Where land is scarce, land fragmentation and continuous cropping persist with little or no soil conservation investments (Nabalegwa *et al*., 2007).

It should be stressed that poverty influences households' decisions for any investment in soil conservation practices (Barbier, 2001). Therefore, decline in the welfare of people could degenerate into serious ecological crises, with serious implications on the environment (WCED, 1987). An attempt was made in this study, to determine the effect of land degradation and use of soil conservation approaches on the poverty level of rural households in southeastern Uganda. The key study questions included: How does ownership of land affect the poverty level of the farmers?. What influence does use of soil conservation have on poverty level across the different socio – economic groups?

II. MATERIALS AND METHODS

Study area and sampling procedures: The study was carried out in southeastern part of Uganda. The study districts were Jinja, Kamuli and Iganga. Climatically, these districts enjoy tropical climate with two distinct seasons; rainy season from April to October and dry season from November to March. The traditional practice of slash and burn agriculture predominates and this is expected to be followed by a period of fallow for the soil to regain the lost fertility However, with growing population and scarcity of land, the practice of fallowing is gradually being phased out and this aggravates land degradation.

Multi-stage sampling method was used to select the households for the survey. At the 1st stage, 3 districts were randomly selected from the seven districts that form eastern Uganda region. The 2nd stage involved selection of 2 sub-counties from each district and from these sub-counties we selected 2 villages from each. In Jinja district, data were collected from 4 villages of Buwenge sub-county. A total of 100 households were sampled from the 4 villages of Jinja. In Iganga district, a total 100 farming households were sampled from 4 villages of Nakalama sub-county. Finally, in Kamuli district, a total of 103 farming households were sampled from 4 villages of Bugulumbya sub-county. Agricultural data were obtained for the 2005 cropping season.

Econometric analysis and model description

Effect of land on income inequality: The study used descriptive analytical methods like percentage, mean and frequency. The Gini-coefficient was used to analyze the distribution of the different categories of land owned by farmers. To calculate Gini-coefficient, Buyinza and Lusiba (2008) noted that where items are ordered so that $Y_1 \leq; Y_2 \leq; Y_3 \leq \ldots . \leq Y_n$ the Gini-coefficient can be computed as:

$$I_{Gini}(Y) = \sum_{i=1}^{n} a_i(Y) Y_i \; and \; a_i(Y) \frac{2}{n^2 u}\left(i - \frac{n+1}{2}\right) \quad \ldots\ldots\ldots\ldots\ldots 1$$

where,

n = the number of items

I = the rank (1...n).

μ = the mean of the items. The closer this value is to 1, the higher the inequality.

Description of econometric analysis: In order to analyze the land ownership/use, socio-economic and soil conservation factors that explain poverty among the farmers, Descriptive statistics were run to describe the farmers' socio-economic characteristics, while logistic models were used to estimate the intensity of effect between size of landholding, application of land management practices and poverty levels. Following Foster *et al*. (1984), poverty line was computed as the 2/3rd of the mean per capita monthly expenditure of all the members of the sampled households. The FGT index allows for the quantitative measurement of poverty status among sub-groups of population (i.e., incorporating any degree of concern about poverty) and has been widely used (Kakwani, 1977). Preferring higher status, humans dislike inequality and household intolerance to inequality increases with inequality (Bolton and Ockenfels, 2000). The Atkinson inequality aversion parameter (Atkinson, 1970) is

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incorporated in the estimation of income inequality to measure this intolerance. The measure takes values ranging from zero to infinity. Increases in the parameter signal increased household intolerance to inequality and that the households attach more weight to income transfers at the lower end of the distribution and less weight to transfers at the top.

The headcount ratio measures the ratio of the number of poor individuals or simply measures the poverty incidence (i.e., the percent of the poor in the total sample). The analysis of poverty incidence using FGT measure usually starts with ranking of expenditures in ascending order $Y_1 \leq Y_2 \leq \ldots \leq Y_n$:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z-y_i}{z}\right]^\alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where,

P_α = Non negative poverty a version parameter, which can be zero for poverty incidence, one for poverty gap or two for poverty severity.

y_i = The per-capital expenditure of *i*th poor household and *i=1, 2,…q*

n_i = Total number of individuals in the population.

q = Total number of poor individuals / households below the poverty line.

z = Poverty line.

The FGT is made up of three basic measures; when α = 0, 1, and 2 and these are the head count poverty measure, poverty gap index, and the measure of poverty severity, respectively.

The Probit model was applied using the Maximum-Likelihood function (Heckman, 1979) and was estimated using the LIMDEP 7.0 statistical package can be stated as:

$$\begin{aligned} p_i = {} & \beta_i + \beta_2 DST_i + \beta_3 GND_i + \beta_4 MRG_i + \beta_5 HHS_i + \beta_6 EDU_i \\ & + \beta_7 ANM_i + \beta_8 VEG_i + \beta_9 PCL_i + \beta_{10} PFL_i + \beta_{11} EDC_i + \beta_{12} EDF_i \\ & + \beta_{13} TRC_i + \beta_{14} MLC_i + \beta_{15} CLA_i + \beta_{16} CRT_i + \beta_{17} ORG_i \\ & + \beta_{18} ZRO_i + \beta_{19} FRT_i + \beta_{20} CVC_i + \beta_{21} SPD_i + \ell_i \end{aligned}$$

P_1 = Poverty status dummy (poor = 1, 0 otherwise)

DST_1 = district dummy variable (Jinja =1, 0 otherwise)

GND_1 = Sex (Male = 1, 0 otherwise)

MRG_1 = Marital status dummy (married = 1, 0 otherwise)

HHS = Size of the household

EDU_1 = Education dummy (formal education n = 1, 0 otherwise)

ANM_1 = Land area under livestock farming (ha)

VEG_1 = Land area under vegetable production (ha)

PFC_1 = Productive food cropland area (ha)

PFL_1 = Productive fallow cropland area (ha)

EDC_1 =Eroded coffee cropland area (ha)

EDF_1 =Eroded food crop land area (ha)

TRC_1 = Tractor / Harrowing (yes = 1, 0 otherwise)

MLC_1 = Mulching (yes = 1, otherwise = 0)

CLA_1 = Cleaning clearing (yes = 1, 0 otherwise)

CRT_1 = Crop rotation (yes = 1, 0 otherwise)

ORG_1 = Organic manure (yes = 1, 0 otherwise)

ZRO_1 = Zero tillage (yes = 1, 0 otherwise)

FRT_1 = Fertilizer application (yes = 1, 0 otherwise)

CVC_1 = Cover crop (yes = 1, 0 otherwise)

SPD_1 = Frequency of social-psychological dis-order during cropping season

e_1 = Error term

We tested the hypothesis that "*number of fertile land under fallow does not significantly reduce poverty*".

It should be noted that also, many independent variables were initially proposed, but some collinear' ones were later removed. We determined the level of variable collinearity using the SPSS 100 statistical package. With these, the tolerance levels of the variables were determined using the variance inflating factors (Kakwani, 1990). Variables with low tolerance were therefore removed.

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III. RESULTS AND DISCUSSION

Demographic and household socio-economic characteristics. Descriptive analysis of the household demographic attributes shows the following: 84% are males, 38% are married, 52% acquired formal education, 38% are engaged in agroforestry farming. The average age is 56 years and average household size is 7 (Table 1). The farming households reported an average of 24 years of farming experience. As ret1ected by the standard deviation and coefficient of variation, wide variations exist among these data.

Table I. Farmers' household demographic attributes

Socio-economic characteristics	Mean	SD	Coefficient of variation
Age	56	13.1	309.14
Household size	7.04	2.32	301.44
Farming experience	23.58	11.24	189.22
Per capita expenditure	33,235	24,975	1,729
Social- Psychological disorder days	3.42	3.01	89.17
Agroforestry rotation cycles	4.02	1.08	280.42

The farmers' awareness of the agricultural technologies varied. Table 2 shows that the most popular technologies were: improved fallows (92%); hedgerow intercropping (87%), vegetative practices (84%), use of improved simsim varieties (85%), and poultry management technology (80%). The results further show that farmers had little or no information with regard to improved clonal coffee varieties (30%), multi-storey (42%) and fish pond management (45%) technologies.

Table 2. Farmers' awareness of selected agricultural technologies (n = 120)

Technologies	Awareness	Perception	
	Aware (%)	Relevance (%)	Relevance index
Agroforestry technologies (0,82)			
Improved fallow **	92	87	0.95
Hedgerow intercropping*	87	53	0.61
Multistorey	42	25	0.60
Homegarden **	50	60	1.20
Clonal coffee ^{ns}	30	12	0.40
Soil and water conservation (0.44)			
Contour ploughing*	76	12	0.16
Trash lines ^{ns}	66	18	0.27
Terraces*	78	58	0.74
Vegetative practices	84	12	0.14
Compost and green manure ^{ns}	60	53	0.88
Improved crop varieties (0.98)			
Banana**	80	73	0.91
Cassava**	75	82	1.09
Beans**	76	75	0.99
Simsim*	85	70	0.82
Maize**	74	83	1.12

Livestock technologies (0.92)			
Multiplication of goats*	74	58	0.78
Cattle cross-breeding*	68	63	0.93
Fish ponds management ^{ns}	45	42	0.93
Poultry management**	80	87	1.09
Feed grinder (350 kg per hour)	76	67	0.88

** = 0.01 level of significance, * = 0.05 level of significance, ns = not significant

Table 3. Zero-order correlation between farmers' awareness and perception of agricultural technologies

Technologies	Correlation coefficient (r)	P - Value
Agroforestry technologies	0.58	$p < 0.05$
Soil and water conservation technologies	0.02	$p > 0.05$
Improved crop varieties	0.44	$p<0.05$
Livestock technologies	0.42	$p<0.05$

S = Significant at $p<0.05$; NS = Not significant

The farmers were asked about the local community's indicator of soil resource quality. The results presented in Table 2 shows that based on the agroforestry farming component, most of the farmers (57%) judge soil fertility status using the previous agroforestry yields (forestry and agricultural crop yields). However, 42% consider the colour of the soil, while only 12% would judge fertility based on intensity of weed growth. With regard to food crops, 86% of the farmers judge fertility levels with the performance of cassava crop, while 76% used the easiness to tillage. Similarly, 72% considered the number of years the land has been continuously used for crop cultivation without fallowing (Table 4).

Our findings concur with Greenland (1997) and Wild (2003) who identified four systems to enhance productivity of small landholders of the sub-tropics. These include: mixed farming systems that provide animal manure to recycle nutrients and enhance soil fertility through integrated nutrient management, agro-forestry systems that create diverse farming systems, conserve soil and water resources, and recycle nutrients from sub-soil to the surface, water-based systems, mostly for cultivation of rice and associated crops, that renew soil fertility through supply of silt and alluvial material carried in irrigation canal, and water harvesting and recycling in dryland systems, and fertilizer-based systems that enhance soil fertility through judicious use of chemical fertilizers.

Table.4. Farmers indicators for perceiving degraded cash and food crop farms

Characteristics	Agroforestry	Food crop
Porosity and drainage	34.32	50.17
Type of soil	37.29	67.00
Continuous farming (years)	33.33	72.01
Soil color	42.34	48.24
Soil depth	33.99	32.67
Tillage	12.09	76.61
Intensity of weed growth	15.51	29.70
Common weeds	21.45	37.62
Last cereals yields	26.73	81.67
Last cassava yields	30.69	86.22
Last coffee yields	57.02	-
Soil texture	35.97	46.20

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The categories of different uses to which farmers subject their land and their distribution (measured by Gini-coefficient) is presented in Table 5. Average coffee cropland is 125 ha with variability index of 69%. However, because the farmers were mainly pre-occupied with food production, average land areas devoted to food production is 1.8 ha. Other uses of land for vegetable cultivation and livestock husbandry take an average of 0.15 and 0.07 ha, respectively. An average of 1.12 ha of the farmers land is kept under fallowing. Similarly, from farmers' perception of fertility, 72 and 79% of the farmers' coffee cropland and food cropland, respectively, are considered to be fertile. Similarly, 78% of the land under fallow is fertile.

Food cropland has the lowest Gini-coefficient (0.39). This shows that they are more equitably distributed. However, land use categories like fallow land, mined coffee cropland, mined food cropland are distributed more unequally due to the largeness of their Gini-coefficient values.

Table 5: Land areas owned by farmers in Busoga region, eastern Uganda

Land use category (ha)	Mean	S.D.	Coefficient of variation	Gini coefficient
Coffee cropland	1.34	1.82	6883	0.67
Fallowing land	1.12	330	3116	0.85
Food cropland	1.85	1.70	101.19	0.39
Livestock land area	0.05	0.24	2879	0.88
Vegetable land area	0.18	0.34	44.38	0.84
Productive coffee cropland	1.00	1.56	63.93	0.73
Productive food cropland	1.54	1.48	95.71	0.48
Productive fallow land	0.83	3.08	26.81	0.80
Eroded coffee cropland	0.20	0.68	25.32	0.86
Eroded fallow cropland	0.18	1.23	23.01	0.85
Eroded food cropland	0.25	0.73	33.36	0.89

Table 5 presents poverty analysis using the conventional Foster *et al.* (1984) approach. The poverty line based on Mean per Capita Household Expenditure (MPCHE) is UGX 20,234/=. With this, 42% of the farmers were moderately poor (falling below the 2/3rd MPCHE). However, 3% are severely poor (falling below 2/3rd MPCHE). Of the 36 poverty incidence, we proceeded to calculate the contributions of each group of soil conservation users and non-users to this value. It shows 88% used clean clearing, this group contribute 30% to poverty. Clean clearing is a method whereby farmers do not allow crop residues and plants cleared from a farm to decompose on the farm. In this case, these are either gathered at some point outside the farm for decomposition or burning. While, only 12 and 15% of farmers could afford the use of tractor and ploughing, respectively, the group contributed 5 and 2% to poverty, respectively. Soil nutrient enhancing management practices like mulching, crop rotation, use of organic manure, planting of cover crops and application of fertilizers are not so widely used by the farmers. Specifically, the contributions to poverty were 6 and 7% for those using cover crops and organic manure, respectively. However, those using bush burning contributed 28% to poverty (Table 6).

Table 6: Use of traditional soil conservation practices in Busoga region, eastern Uganda

Cultural/ soil conservation practice	Users (%)	Poverty contribution by Non-users	Poverty contribution by Users
Use cow dung	14.52	29.04	06.60
Burning bush	78.85	12.34	28.37
Tractor farming	12.11	33.33	02.31
Use ploughing	15.17	3102	04.62
Use mulching	58.75	17.49	18.15

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Use clean clearing	88.28	04.64	30.02
Use crop rotation	67.09-	15.84	19.80
Use organic manure	24.42	27.06	06.18
Use zero tillage	32.01	20.46	15.18
Apply fertilizer.	66.34	14.85	20.76
Vegetative cover crop	26.07	28.38	07.47

Factors explaining rural poverty: The results of the Probit regression are presented in Table 7. It shows that the data presented a good fit as reflected by the statistical significance ($p<0.01$) of the chi-square (X^2) of the Maximum Likelihood Estimate (MLE). This shows that farmers from Jinja district have lower probability of being poor. Proximity to urban area (Jinja town) may be responsible for this occurrence due to direct market outlets and opportunities for off-farm activities. Similarly, house hold size is statistically significant (p<0.0l). This shows that increasing household size will increase the probability of the households becoming poor. This is expected because desire to have many children lies largely with poor households and it is generally the cause of poverty. Buyinza and Lusiba (2008) noted that in rural parts of Uganda, the net effect of high family size is lower income, little savings and increased poverty. Also, marital status variable is statistically significant ($p<0.01$). This shows that those married farmers have lower probability of being poor.

Table 7: Probit regression of the determinant of poverty in Busoga region, eastern Uganda

Factor	Coefficient	t -statistics
Constant	-1.519	-2.620
District	-0.662	-2.901
Sex	0.466	1090
House size	0.319	7.082
Marital Status	-1.608	-4.378
Formal education	-0.196	-0.843
Livestock land area	1.202	2.128
Vegetable land area	0.019	0.056
Fertile food cropland	-0.089	-1.056
Fertile fallow land	-0.498	-3.503
Degraded coffee cropland	-0.426	-1.240
Degraded food cropland	-0.768	-0.321
Tractor / Ploughing	-0.936	-2.750
Mulching	0.071	0.303
Clean clearing	0.078	0.224
Crop rotation	-0.493	-1.980
Organic manure	-0.542	-2.010
Zero tillage	O.686	2.732
Fertilizer.	-0.168	-0.708
Cover crop	-0.524	-2.124
Time sick	-0.013	-0.893

Increasing land areas devoted to livestock production increases the probability of being poor significantly ($p<0.05$). Similarly, the number of fertile land area under fallow variable is statistically significant ($p<0.01$). This implies that probability of being poor reduces as farmers have enough fertile lands under fallow. The hypothesis that "*the size of fertile land under fallow does not significantly reduce poverty"* is therefore rejected.

Those farmers that were using harrowing for land preparation have lower probability of being poor. This is

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expected because usage of harrowing/tractor for land preparation shows that the farmer has large number of hectares. Cultivation of large number of hectares can lead to higher income if the farms are well managed. The farmers that were using crop rotation have lower probability of being poor and the parameter is statistically significant ($p<0.05$). Theoretically, crop rotation enhances soil nutrients if the pattern of the rotation is well selected. With this, farmers output may increase with consequential reduction in the level of poverty. Also, those using organic manure have lower probability of being poor. In absence of inorganic fertilizers, the only options available to farmers for enhancing the nutrient contents of their farms is to use organic manure. Those farmers were also using zero tillage have significantly higher probability of being poor. This shows that use of zero tillage may lead to higher level of poverty as farm profit decreases. Ideally, in southeastern part of Uganda, use of zero tillage on already degraded land may lead to reduction in farm profit as more labour is being engaged for weed control. Similarly, zero tillage exposes the plot to direct soil erosion. Where ridges are made, it is possible to control erosion by construction of bunds (Maxwell, 1995). However, those farmers that were using planting cover crops have significantly lower probability of being poor ($p<0.05$). Cover crops rejuvenate the soil nutrients and prevent excessive soil erosion. These may result into increased productivity and poverty reduction.

IV. CONCLUSION AND POLICY IMPLICATIONS

The 21st century has brought numerous and varied demands on limited soil resources. The conventional soil functions included: soil as a medium for crop growth. Managing soils for achieving food security, for present and future generations, is the primary function of soils especially of those in densely populated countries of Africa. Applying the knowledge of soil science can improve agronomic production and supply of food to rural and urban poor. There exists a vast potential to increase crop yields per unit area, by vertical expansion of agriculture, through adoption of sustainable soil and water resources management approaches. Site-specific research, to address soil-related constraints and socio-economic and political issues, is needed to enhance and sustain production.

Farmers in the districts of southeastern Uganda are seriously concerned about the dwindling status of their land. Any negligence in land management would make them vulnerable to food security under the situation of shrinking landholding size and undergoing process of land degradation due to interactive natural and cultural factors. Farmers, therefore, have increasingly employed different land conservation strategies to maintain the fertility of their land. Increasingly they have adopted different structural and biological land conservation strategies developed by their forefathers and consolidated by line agencies and NGOs; and used different organic and inorganic fertilizers to maintain soil fertility.

Land degradation in southeastern Uganda is recently phenomenon driven by population pressure and scarcity of extra fertile land. As the ultimate goal of policy makers is to reduce poverty, this study investigates the effect of several land ownership and use patterns on the poverty levels of the farmer. The policies implications are that household size increases poverty, therefore efforts to sensitize rural population on the need and way of population control for poverty reduction will yield positive results. Secondly, use of soil conservation practices like crop rotation, planting of cover crops, addition of organic manure hold great potential for poverty reduction. Natural resource managers and technical service providers therefore, need to liase with research institutes in order to disseminate evidence-based soil management techniques to farmers.

Finally, despite the fact that farm land are degrading, not many farmers applied fertilizers on their farms due to its high prices and scarcity. The onus therefore, rests on the government to implement a workable and efficient plan for fertilizer production and distribution. Also, efforts by researchers should be directed at developing crop hybrids that can withstand environmental stress. The farmers' awareness and perception of the relevance of agricultural technologies has a significant impact on the rate of adoption of technologies promoted under the PMA. According to the survey results, most of the agroforestry technologies were perceived to be relevant by the farmers except the clonal coffee this is because compared to traditional coffee, clonal coffee is a high cost technology, hence unaffordable to most farmers.

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Effect of Seed Treatment on Hydration-Dehydration Respiration Sprouts Sorghum

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***Abstract*— *The limiting factor affecting sorghum production in Indonesia is the rapid decline of sorghum seeds, it is necessary to do invigorate one way to hydration-dehydration. The purpose of this study was to know that invigorates with the hydration-dehydration method can increase the respiration rate of sprouts sorghum. This experiment using a completely randomized design (CRD) with 3 treatments and 4 replicates in order to obtain 12 units of trials conducted at the Laboratory of Seed Science and Technology, the University of Andalas from January to March 2019, The treatment in this trial are: A = low-quality seeds, B = Hydration for 1 hour and dehydration for 6 hours at a temperature of 400C, C = high-quality seeds. The data were analyzed by the F test significance level of 5%. If they are real continued by Honestly Significant Difference (HSD) at 5% level. The results showed that hydration-dehydration can increase the respiration rate of sorghum seedlings which have been in decline, from respiration rate 67,434mgCO_2 be 82,412mgCO_2.*

***Keywords*— hydration-dehydration, seed deterioration, sorghum seeds, viability, respiration sprouts.**

I. INTRODUCTION

Sorghum is a crop that is potentially good for food, feed, and industrial. Research on sorghum has been carried out, both in terms of plant breeding and cultivation. However, research on quality sorghum seed is still very little. According to Fatonah (2015) one of the limiting factors that affect the development and production of sorghum in Indonesia is the rapid decline of sorghum seed (deterioration). While the main requirement is to use the plant to increase the production of quality seeds, including sorghum.

Efforts should be made to overcome the problem of deterioration in sorghum seeds are invigorated. Invigorate seed is the treatment given to the seed before planting to improve germination and seedling growth (Koes and Arief, 2010). Invigorate method that has been was done on sorghum will be: Osmo conditioning, bio-matrix conditioning, and hydration-dehydration (Rini et al., 2005; Sutariati et al., 2011; Mutia, 2018).

One method is hydration-dehydration invigorate. According to Mutia (2018) hydration-dehydration is a moisturizing treatment or soaking the seeds in a given time followed by drying the seeds until it returns to its original weight. Seed by hydration-dehydration treatment proved to have a germination percentage, the maximum growth potential, germination first count, and test emerging land, and the index value higher than the seed without hydration-dehydration. This shows that invigorate with hydration-dehydration means it can optimize seed viability that has been stored for 8 months (Nurmauli and Nurmiaty, 2010). in general, if the germination of seed germination is high then the respiration rate will also be higher.

II. MATERIALS AND METHODS

This experiment was conducted at Seed Technology Laboratory Science starts from January to March 2019. The experiment is using a completely randomized design (CRD) with 3 treatments and 4 replicates to obtain 12 units of trial. The treatment in this trial are: A = low-quality seeds, B = Hydration for 1 hour and dehydration for 6 hours at a temperature of 400C, C = high-quality seeds. Quantitative data were analyzed using the F test significance level of 5% if there is significant then tested further by using test HSD 5%, while the qualitative data were analyzed descriptively.

a. Germination / DB (%)

The purpose of this test is to determine the viability of seeds to see the percentage of seeds that germinated. The percentage of normal germination seeds that can be generated by certain environmental conditions within a predetermined period. Observations were carried out by observing the normal germination, abnormal sprouts, seeds dormant and dead seeds in which the first observations made on the 4th day after the seeds germinate and the last observation on the 10th day.

b. The Maximum Growth Potential (%)

The Maximum Growth Potential is the percentage of germination seeds (normal or abnormal germination). The Maximum Growth Potential is a measure of the total viability that showed the ability to grow.

c. Germination First Count (%)

This test aims to determine the vigor of seeds by the rate of seeds germination on the first day of observation. This observation at the 4th day after germination by counting the number of normal germinated seeds.

d. Respiration rate analysis Sprouts (Yulinda, 2000)

The seeds germinated in an airtight jar. The jar is placed in a container of 0.2 N KOH solution of 20 ml, then the jar was sealed and incubated for 24 hours. After an incubation period of respiration measurement is done by moving the KOH solution into the flask and add 1 drop of phenolphthalein and titrated with 0.4 N HCl until the pink color is gone, then add 1 drop of methyl orange, and titrated again with HCl until the color changed to the orange color pink. CO2 production is calculated based on the volume of HCl used. In determining the endpoint done carefully because the color change is not too obvious. Respiration rate sprouts were observed daily for five days, then summed.

III. RESULT

a. Germination

Results obtained from observations of normal and abnormal germination in seeds of sorghum on the various treatments showed significantly different effect after analyzed using ANOVA. The observed data normal and abnormal germination can be seen in Table 1.

Based on Table 1 it can be seen that the percentage of normal germination on low-quality seed treatment (55%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (75%) and high-quality seed treatment (97.5%). This means that hydration-dehydration does germination percentage increased by 20%. It can be concluded that hydration-dehydration treatment can improve the germination of seeds in a seed lot. This is by the opinion of Mutia (2018), hydration-dehydration treatment can improve normal germination of seeds. Judging from normal germination percentage of the seeds, the treatment of 1-hour hydration and treatment of dehydration to 6 hours of high-quality seeds have a difference in the value of 22.5%. It can be said that the hydration-dehydration treatment can increase seed germination percentage,

The seeds were used in this study with the seed germination rate of 55%. After the hydration-dehydration seed germination to 75%. Hydration-dehydration treatment is a treatment to make the germination process occurs early, with a hydration-dehydration treatment imbibition process occurs earlier. As it is known that the germination process begins with a faster imbibition process will result in the next process occurs early, such as the outbreak of the seed coat, the activation of enzymes and hormones, change in food storage, transport of nutrients, assimilation, respiration, and growth. Kamil (1982), stating that the initial process of germination is imbibition, namely the entry of water into the seed so that the water content in the seed reaches a certain amount. Water is needed in the optimal amount so that germination can take place optimally. Water is needed in the process of germination, with the entry of water into the seed with the seed metabolism will soon begin

Based on observations in Table 1 percentage germination abnormal low-quality seed treatment (12%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (4%) and quality seed treatment high (0%). This means hydration-dehydration treatment can decrease the percentage of abnormal germination of seeds of sorghum, but not yet on par with a high-quality seed treatment. In line with the opinions Mutia (2018), hydration-dehydration treatment in one lot of seeds can lower abnormal germination of seeds.

One indicator that states of quality seeds are the number of abnormal sprouts. The low-quality seed is usually characterized by a large number of abnormal sprouts. This is in line with the opinion of Copeland and McDonald (2001) which states that the aging process or pullback vigor physiologically is characterized by a decrease in germination, increase the number of sprouts abnormal, decreased appearance of sprouts in the field (field emergence) inhibition of plant growth and development, increased sensitivity against extreme environments that ultimately can reduce crop production.

b. Dead Seeds and Maximum Growth Potential (%)

The results obtained from observing the percentage of dead seeds and the maximum growth potential in sorghum seeds in different treatments showed significantly different effects after being analyzed using ANOVA. The data were dead seed and seed the maximum growth potential can be seen in Table 2.

Based on Table 2 it can be seen that percentage of dead seed in low-quality seed treatment (33%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (21%) and high-quality seed treatment (2.5%). Therefore it can be said hydration-dehydration treatment in one lot of seeds can decrease the percentage of dead seeds. This is by the opinion of Mutia (2018), hydration-dehydration treatment in one lot of seeds can decrease the percentage of dead seeds, but not yet on par with a high-quality seed treatment.

Dead seeds are seeds that germination until the end of the germination period are not able to germinate and not be in a dormant state. The percentage of dead seeds on sorghum seed that has been treated with hydration-dehydration can be said to be lower than that of the untreated hydration-dehydration. Hydration-dehydration treatment to condition the seed germination of early experience. Seed germination process begins with the imbibition faster will result in the next process to occur earlier. Therefore, these conditions can lower the percentage of dead seeds.

One of which led the seed dies are a pathogenic attack. Pathogens is a living entity that can lead to disease. All classes of pathogens such as fungi, bacteria, viruses, and nematodes can be carried by seed. Fungus usually attacks the seeds on the surface, the bacteria usually attack the seed on space between cells, while the bias virus directly attacks the cell nucleus.

Microorganisms (bacteria and fungi) can grow and develop rapidly in sorghum seeds to become pathogens. This can cause the seeds into nonperishable and grow abnormally. In this study, there are some seeds of sorghum seed fungus causing death as in Figure 1. The high percentage of dead seeds were allegedly caused by the fungus possibility depleted embryo or seed endosperm is absorbed by the fungus so that when the size of the split seed endosperm found very little. This is by the opinion Mardinus (1998), explains that the pathogens attack not only damages the seed endosperm, but also disrupt the growing point of the embryo that sprouts new growth becomes abnormal and unable to penetrate the soil surface.

Based on Table 2 it can be seen that the percentage of maximum growth potential in the treatment of low-quality seed (67%) were significantly different from the treatment of dehydration hydration 1 hour 6 hours (79%) and high-quality seed treatment (97.5%). This means that by doing hydration-dehydration percentage of maximum growth potential increased by 12%. By the opinion of Mutia (2018), hydration-dehydration treatment can increase the percentage of the maximum growth potential. Judging from the percentage of the maximum growth potential, hydration treatments 1 hour 6-hour dehydration and treatment of high-quality seeds have a difference in the value of 18.5%. It can be said that the hydration-dehydration treatment can increase the percentage of the maximum growth potential, but not yet on par with a high-quality seed treatment.

The maximum growth potential is a measure of the total viability of the seeds, the seeds can germinate (life) and the metabolic processes that occur. This is due to the PTM benchmarks only measure the ability of seeds to grow just normal, although not yet germinated, resulting in less showed no significant differences in the evaluation of the test results. The maximum growth potential value of the total viability of a seed, it shows symptoms of a life marked by the appearance of the radicle and hypocotyl elongation. The maximum potential value growth will be greater than with germination.

The viability and vigor is irreversible, it applies to a single individual. Increased viability contemplated in this study is viability in a seed lot where an increase in value by 12% viability. Allegedly 19.33% seed is a seed that is sick and damaged membranes. After being given the care with hydration-dehydration treatment, water entering the hydration-dehydration treatment could organize existing cell membrane, activating enzymes and organelles especially mitochondria. With active mitochondria, the respiratory process is underway and accelerated by enzymes that will remodel the existing food reserves in the seed be simple molecular compounds to be translocated to the embryonic axis so that the seed that was capable of germination pain well. So point average decline in vigor and viability lines can be enhanced so that the line which was originally sharp decline can slowly down. Bustamam (1989) cit. Putih et al., (2009) stated that with the seed metabolism active ingredient food reserves lasted overhaul and produce energy for translocated to the embryonic axis and plumula radicle to the formation and also to support the growth of early germination.

c. Germination First Count (%)

The germination first count is one of indicator in determining seed vigor. The percentage of germination first count would indicate that high seed vigor. The seed that has high vigor will grow normally in the field according to suboptimal field conditions. Results obtained from observations of sorghum seed germination first count on a variety of treatments showed significantly different effect after analyzed using ANOVA. The data were germination first count percentage can be seen in Table 3.

Based on Table 3 it can be seen that percentage germination first count on low-quality seed treatment (55%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (75%) and high-quality seed treatment (97.5%). Hydration-dehydration treatment can improve the germination first count. This is in line with Mutia (2018) seed hydration-dehydration treatment to give effect to an increase in the percentage of the first count. Judging from the first count germination percentage, hydration treatments 1 hour 6-hour dehydration and treatment of high-quality seeds have a difference in the value of 22.5%. It can be said that the hydration-dehydration treatment can increase the percentage of germination first count, but can not be the same as the treatment of high-quality seed.

Hydration-dehydration can cope with variations in the level of initial absorption of water on the seed. All seeds are likely to reach the level where the seeds are ready to germinate in unison when positioned in the optimum condition. Differences germination first count is determined by the seed's ability to absorb water and the level of damage to the membrane, where the availability of water that has been able to increase the optimal seed germination percentages of the first count, in this case, means faster seed germination.

Hydration-dehydration treatment on sorghum seed which has undergone deterioration can improve the vigor. Although fundamentally the line vigor or viability line will never come back, with a hydration-dehydration treatment averaged point increase in height, so that the line which was originally sharp decline will be stripped. Sadjad (1979) states that the periodization viability and vigor, the period to three or critical period marked by a sharp decline in seed vigor and predated the potential viability.

d. Respiration rate of Sprouts

Results obtained from observations of the respiration rate of germination at different levels of quality sorghum seeds showed a significantly different effect after analyzed using ANOVA. The data were the respiration rate of germination can be seen in Table 2.

Based on Table 2 can be seen that respiration rate of germination on low-quality seed treatment (67.434mgCO2) Significantly different from the treatment of dehydration hydration 1 hour 6 hours (82.412mgCO2) And high-quality seed treatment (98.516mgCO2). Judging from the respiration rate of germination, treatment of dehydration hydration 1 hour 6 hours and low-quality seed treatment has a difference of 14.978 values. It can be said that the hydration-dehydration treatment may accelerate the rate of respiration, but not yet on par with a high-quality seed treatment.

Respiration rate lower seed during storage can prevent a decline in seed quality and vigor can be kept high (Tambunsaribu et al., 2017). Low-quality seed respiration slow pace due to the deposit of the seed is experiencing respiratory quickly so that the food reserves in the seed has been reduced. Therefore, the energy used to germinate seeds is low, so that poor seed germination.

This is in accordance with the opinion of Justice and Bass (2002) argued for the seed is stored, a process of respiration in the seed, so the food reserves contained in the endosperm, which is used as an energy reserve in the next seed growth process has been overhauled so that a reduction in food reserves. According to Nurfarida (2011) the relationship between the benchmarks germination to seed respiration rate was positively correlated, meaning that the higher seed germination rate, the higher the respirate. Germination high value indicates that the seeds have high potential viability of being able to utilize normal food reserves for germination optimum conditions.

Respiration is one of the stages of the process of seed germination physiology that occur after water absorption, digestion, food transport, and assimilation. If respiration is limited then germination will be slow. One cause limited respiration Utomo (2006), states that the water is necessary for germination, though soaking for too long can lead to loss of oxygen, thereby limiting the respiration process.

IV. FIGURES AND TABLES

Table 1. Percentage of germination Normal and Abnormal germination at Various Treatment

Treatment	Germination (%)	
	Normal	Abnormal
Low-Quality Seeds	55,000 a	12,000 a
1-hour hydration, dehydration 6 hours	75,000 b	4,000 b
High-Quality Seeds	97.500 c	0,000 c
KK	3.38	15.86

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

Table 2. Percentage of Dead Seeds and Maximum Growth Potential on Various Treatment

Treatment	Dead Seeds (%)	Maximum Growth Potential (%)
Low Quality Seeds	33,000 a	67,000 a
1 hour hydration, dehydration 6 hours	21,000 b	79,000 b
High Quality Seeds	2,500 c	97.500 c
KK	13.59	3.15

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

Table 3. Percentage Germination First Count on Various Treatments

Treatment	Germination First Count (%)
Low Quality Seeds	55,000 a
1 hour hydration, dehydration 6 hours	75,000 b
High Quality Seeds	97.500 c
KK	3.38

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

Table.4: The respiration rate of germination at Various Levels of Quality Seeds of Sorghum

Treatment	Respiration rate of germination (mgCO2)
Low-Quality Seeds	67.434 a
1-hour hydration, dehydration 6 hours	82.412 b
High-Quality Seeds	98.516 c
KK	6.97

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

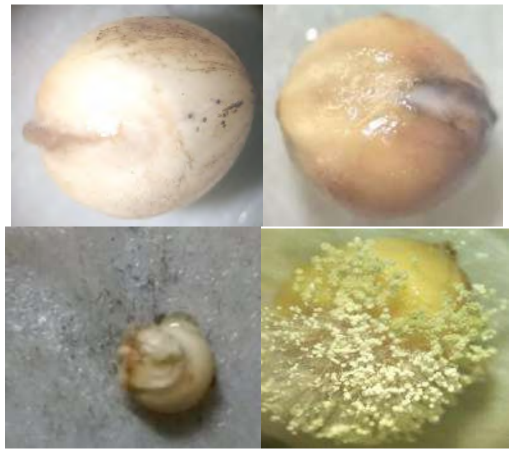

Fig. 1. Dead Plant Seeds Sorghum after 10 HSS

V. CONCLUSION

Hydration-dehydration can increase the respiration rate of sorghum seedlings which have been in decline, from respiration rate 67,434mgCO_2 be 82,412mgCO_2.

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Evaluation of Some Rice Cultivars to Salt Tolerance under Antioxidant Using Physiological Indices

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***Abstract*— *Salinity is considered as one of important physical factors influencing rice production. Soil salinity harmful influenced germination characters of rice cultivars Salinity is the main limiting factor that adversely affecting germination, growth and yield of rice. A laboratory experiment accompanied in the Giza Central Seed Testing Laboratory of Central Administration for Seed Certification (CASC), Ministry of Agriculture Egypt during May and June 2017. In order to investigate the salt tolerance of rice cultivars using some physiological parameters, i.e. germination stress, tolerance index, promptness index, shoot length, stress tolerance index, root length stress and tolerance index. Sakha 106 surpassed other cultivars promptness index, germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, Shoot dry fresh stress index, root dry stress index. Sown Sakha 106 cultivar exceeded Sakha 104 cultivar by 34.64% in germination stress tolerance index and 14.90 % in shoot height stress index and 30.26% in root fresh stress index. Sakha 106 cultivar exceeded Sakha 101 cultivar by 22.15 % in root dry stress index. Sakha 106 cultivar exceeded Giza 178 cultivar by 8.97 % in root height stress index and by 26.58 % shoot fresh stress index and by 20.70 % in shoot dry stress index. Humic acid at 500 ppm surpassed other antioxidants in germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry stress index and root dry stress index. Salinity level of 100 mM exceeded all salinity concentration in germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index, shoot fresh stress index, shoot dry fresh stress index, root fresh stress index. Increasing salinity concentration up to 300 mM decreased germination stress tolerance index, shoot length stress index, root length stress index, root fresh stress index, shoot fresh stress index, shoot dry stress index and root fresh stress index by 52.4, 38.6, 40.4, 39.5, 47.6 and 49.8 %, respectively. In general, in order to maximize physiological indexes parameters by priming seeds of Sakha 106 cultivar in Humic acid at 500 ppm. It can be used in breeding program to boost production in Egyptian territory.*

***Keywords*— Rice cultivars, Antioxidants, Salinity levels, Physiological indices parameters.**

I. INTRODUCTION

Soil salinity is the important abiotic stress problem in Egypt and the World. Rice genotypes differ in their salt tolerance due to their genetic and salts in the soil. Higher salinity level inhabits seed germination and root emergence due to osmotic effect, which is deleterious and prevents the plant in maintaining their proper nutritional requirements necessary for their healthy growth. To increase grain yield production of rice through cultivating modern rice cultivars in new reclaimed soil, which suffers from salinity also, clay soil as old soil gains salinity from irrigation salinity water and with drought.

Genetic variations among genotypes of wheat provide a practical for screening to salt tolerant cultivars for improving breeding program. Salinity mainly causes hyper-osmotic stress and hyper-ionic toxic effects, which leads to germination inhibition and seedling growth[1]. The relative shoot growth and chlorophyll content significantly reduced at 250 mM of NaCl through stomatal and non-stomatal factors[2] .The accessions with high GSTI, cell membrane stability (less % injury), PHSTI, DMSTI and low RSD were more salt tolerant than the others, thus seem promising for getting good productivity in salt-affected areas[3]. The variation among the genotypes for the physiological indices at germination and early seedling has been analyzed in many crop plants[4] . The physiological parameters tried in the present study are useful to screen large quantity of sorghum germplasm for salt tolerance leading to selection of suitable lines that can recommended for different saline areas to improve yields[5] . Osmotic adjustment can be an important component of drought resistance in wheat within a relevant environmental context[6] . Root growth was different among cultivars even when treated with normal water. The cultivar C3 (mix white and red seeds) was observed as more salt tolerant and cultivar C4 was more salt sensitive on the basis of the germination-ability and shoot development. Cultivar C3 observed to produce better seeds compared with the other cultivars[7] . The SARC-I (V5), Sehar-2006 (V8) and Shafaq-2006 (V9) genotypes were found tolerant to salinity because of better growth, lower NaCl relative toxicities, leaf Na^+, higher tolerance indices, photosynthetic rate, total chlorophyll contents, transpiration rate, stomatal conductance and leaf K^+ concentration[8] . Physiological indices can use to screen the wheat germplasm for salt tolerance. Tolerant genotypes can directly recommend for cultivation on salt affected soils or can used to develop high yielding salt tolerant wheat cultivars[9] . Therefore, the goals of this investigate aimed to study the salt tolerance of wheat cultivars using some physiological parameters, *i.e.* germination stress, tolerance index, promptness index, shoot length, stress tolerance index, root length stress and tolerance index. Salt total and salt ranking tolerance indices grouped the wheat entries into tolerant i.e. Bayraktar 2000, Gerek 79, İkizce 96, Gün 91, Demir 2000, and Momtchil and susceptible ones i.e. Population-4, Population-14, Population-15, Population-9, Population-11, and Population-10[10] . Screening at seedling stage along with other morphological, physiological parameters and stress indices do provide useful clues about the salt tolerance potential of rice genotypes[11] . Sown Sids-13 cultivar appeared to the most tolerant cultivar shadowed by Misr-1, Misr-2, Gimmeza-9, Gimmeza-11, Sids-12, Sakha-93, Sakha-94, and Giza-186 cultivars and the last rank was Shadwell-1 cultivar with the maximum sensitivity[12] . Soaking of Gemmiza 12 or Misr 1 cultivars in concentration of 200 ppm of ascorbic acid for 12 h under salinity stress for enhance physiological indices of wheat[13] . The objective of present study was to evaluate rice cultivars under NaCl stress, antioxidants and physiological indices. Our study is an attempt to compare the usefulness of several stress indices for identification of cultivars with better performance at different levels of salt stress.

II. MATERIALS AND METHODS

2.1. Treatments and Experimental Design:

A laboratory experiment conducted in the Giza Central Seed Testing Laboratory of Central Administration for Seed Certification (CASC), Ministry of Agriculture Egypt during May and June 2017, to study the response of antioxidants seed prim of some bread wheat cultivars to germinate under salinity levels. A factorial experiment in Randomized Complete Block Design in four replications used. The five rice cultivars, Giza 178, Egyptian Hybrid 1, Sakha 101, Sakha 104 and Sakha 106 cultivars include the first factor. The second factor includes the four salinity levels 0, 100, 200 and 300 mM. The four types of antioxidants, Salicylic acid 100 ppm, Folic acid 15mM, Ascorbic acid 100 PPM and Humic acid 500 PPM includes the third factor. Selected cultivars obtained from Rice Research Institute at Sakha, ARC, Ministry of Agriculture, Egypt. Rice cultivars stored under normal conditions in paper bags. Each cultivar was prim in the antioxidants at above concentrations of 24 hours. Each cultivar irrigated with sodium chloride solution as above concentrations under the chamber condition at 28±1ºc with darkness. Thereafter, seeds moistened with distilled water under control treatments. The prim seeds in antioxidants and non-primed seed of study cultivars sown in Petri dishes used fifty seeds per each treatment for each cultivar allowed to germinate on Petri dishes moistened with a water solution at three different NaCl concentrations except the control. The experiment consisted of 400 Petri dishes arranged in a factorial experiment in Randomized Complete Block Design (RCBD) at 4 replications placed in a growth chamber for 14 days at 28±1 ºc for germination according to[14].

2.2. Studied Characters:

Physiological indices:

To calculate the germination stress tolerance index (GSI), promptness index (PI) was estimated using following formula[3].

$$\textbf{Promptness index}\ (PI) = nd1\ (1.00) + nd2\ (0.75) + nd3\ (0.50) + nd4\ (0.25)$$

Where nd1, nd2, nd3 and nd4 = Number of seeds germinated on the 1st, 2nd, 3rd and 4th day, respectively.

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The germination stress tolerance index (GSI) calculated in terms of percentage as follows:
1-Ggermination stress tolerance index (GSTI) = It calculated according the following formula:

$$\text{GSTI} = \frac{\text{PI of stress seeds}}{\text{PI of control seeds}} \times 100$$

After 14 days of the experiment, shoot and root lengths and fresh weights were calculated. The plants dried at 70oC for two days and their dry weight recorded. Root and shoot length stress tolerance index (RLSI, SLSI) and fresh and dry matter stress tolerance indices (FMSI, DMSI) calculated according to the following formula:
2- Seedlings height stress index (PHSI): It calculated according the following formula:

$$\text{PHSI} = \frac{\text{Seedlings height of stressed seeds}}{\text{Seedlings height of the control}} \text{X } 100.$$

3- Root length stress index (RLSI) = It calculated according the following formula:

$$\text{RLSI} = \frac{\text{Seedlings length of stressed seeds}}{\text{Seedlings length of the control}} \text{X } 100.$$

4- Shoot fresh stress index (SFSI) = It calculated according the following formula:

$$\text{SFSI} = \frac{\text{Shoot fresh weights of stressed seeds}}{\text{Shoot fresh weights of the control}} \text{X } 100.$$

5- Root fresh stress index (RFSI) = It calculated according the following formula:

$$\text{RFSI} = \frac{\text{Root fresh weights of stressed seeds}}{\text{Root fresh weights of the control}} \text{X } 100.$$

6- Shoot dry stress index (SDSI) = It calculated according the following formula:

$$\text{SDSI} = \frac{\text{Shoot dry weights of stressed seeds}}{\text{Shoot dry weights of the control}} \text{X } 100.$$

7- Root dry stress index (RDSI) = It calculated according the following formula:

$$\text{RDSI} = \frac{\text{Root dry weights of stressed seeds}}{\text{Root dry weights of the control}} \text{X } 100.$$

2.3. Experimental analysis:

The data collected was analysis, statistically by the analysis of variance technique using the MSTAT–C statistical package programmed as described by a procedure of[15]. Lest significant differences test (LSD) for 5 and 1 % level of probability was used for comparing between treatment means, according to[16] MSTAT-C computer based data analysis software[17].

III. RESULTS AND DISCUSSION

3.1. Cultivar Performance:

The results presented in Tables 1 and 2 showed a significant effect by studied rice cultivars in germination stress tolerance index, shoot length stress index, Root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress

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index. Sakha 106 surpassed other cultivars promptness index, germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root dry stress index. Sown Sakha 106 cultivar exceeded Sakha 104 cultivar by 34.64% in germination stress tolerance index and 14.90 % in shoot height stress index and 30.26% in root fresh stress index. Sakha 106 cultivar exceeded Sakha 101 cultivar by 22.15 % in root dry stress index. Sakha 106 cultivar exceeded Giza 178 cultivar by 8.97 % in root height stress index and by 26.58 % shoot fresh stress index and by 20.70 % in shoot dry stress index.

(73.16%), shoot dry fresh stress index (70.68%), root dry stress index (63.98%) compared with the control and other antioxidants.

Table 1: Means of promptness index, germination stress tolerance index, and shoot height stress index as affected by cultivars, antioxidants and salinity levels.

Characters / Treatments	Promptness index (PI)%	Germination stress tolerance index %	Shoot Height stress index %	Root Height stress index (RLSI) %
A- Cultivars:				
Giza 178	3.59	53.40	70.96	68.18
Egyptian Hybrid 1	3.46	60.21	81.92	74.90
Sakha 101	3.13	52.29	76.43	70.31
Sakha 104	3.29	50.62	70.12	74.11
Sakha 106	6.25	77.45	82.40	69.27
LSD at 5%	0.06	0.84	0.72	0.95
B- Antioxidants:				
Control	4.26	63.84	78.08	73.58
Humic acid at 500 ppm.	5.05	76.40	80.92	74.22
Ascorbic acid at 100 ppm	3.35	49.50	76.93	69.61
Folic acid at 15 mM	3.93	58.30	73.10	70.56
Salicylic acid at 100 ppm.	3.13	45.92	72.81	68.80
LSD at 5%	0.06	0.85	0.72	0.95
Interaction effects:				
A * B	*	*	*	*
C: Salinity Stress				
0 mM	5.27	78.89	93.46	91.25
Characters / Treatments	**Promptness index (PI)%**	**Germination stress tolerance index %**	**Shoot Height stress index %**	**Root Height stress index (RLSI) %**
100 mM	4.44	66.44	80.81	74.69
200 mM	3.55	52.30	73.88	65.18
300 mM	2.52	37.55	57.31	54.30
LSD at 5%	0.05	0.75	0.64	0.85
Interaction effects:				
A * C	N.S.	N.S.	N.S.	*
B * C	N.S.	N.S.	N.S.	N.S.
A * B * C	N.S.	N.S.	N.S.	N.S.

3.2. Antioxidants Effects:

Results presented in Tables 1 and 2 indicated that germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index were significantly affected by studied antioxidants, while, Shoot Fresh Weight non-significant effected by studied antioxidants. Humic acid at 500 ppm surpassed other antioxidants in Germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index. Soaking in Humic acid at 500 ppm recorded the highest percentages of germination stress tolerance index (76.40%), shoot length stress index (80.92%), root length stress index (74.22%), shoot fresh stress index (76.79%), root fresh stress index (73.16%), shoot dry fresh stress index (70.68%), root dry surpassed other antioxidants in Germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index. Soaking in Humic

3.3. Salinity Stress Effects:

The results indicated that germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry stress index, root dry stress index was significantly affected by studied salinity concentration as shown in Tables 1 and 2. The results showed that salinity level of 100 mM exceeded all salinity concentration in germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index, shoot fresh stress index, shoot dry fresh stress index, root fresh stress index. Increasing salinity concentration up to 300 mM decreased germination stress tolerance index, shoot length stress index, root length stress index, root fresh stress index, shoot fresh stress index, shoot dry stress index and root fresh stress index by 52.4, 38.6, 40.4, 39.5, 47.6 and 49.8 %, respectively

Table 2: Means of root fresh stress index, root height stress index, shoot dry stress index, root dry stress index and shoot fresh stress index as affected by cultivars, antioxidants and salinity levels.

Characters / Treatments	Root fresh stress index (RFSI) %	Shoot fresh stress index (SFSI) %	Shoot dry stress index (SDSI) %	Root dry stress index (RDSI) %
Giza 178	72.20	83.62	71.73	61.39
Egyptian Hybrid 1	71.60	76.57	70.77	63.20
Sakha 101	79.11	70.08	61.46	67.42
Sakha 104	50.83	67.78	64.74	56.93
Sakha 106	72.89	61.52	56.88	52.48
LSD at 5%	1.08	0.66	1.84	1.74
Control	72.69	74.14	67.30	63.15
Humic acid at 500 ppm.	73.16	76.79	70.68	63.93
Ascorbic acid at 100 ppm.	69.98	75.64	67.47	61.88
Folic acid at 15 mM	64.48	65.12	66.70	58.60
Salicylic acid at 100 ppm.	66.32	67.86	53.44	53.07
LSD at 5%	1.08	0.66	1.84	1.74
A * B	*	*	*	*
0 mM	87.77	87.36	89.24	86.32
100 mM	72.50	74.94	67.30	61.12
200 mM	63.95	66.70	57.26	50.41
300 mM	53.03	58.65	46.68	43.28
LSD at 5%	0.34	0.59	1.64	1.56
A * C	*	*	*	*
B * C	N.S.	N.S.	N.S.	N.S.
A * B * C	N.S.	N.S.	N.S.	N.S.

3.4. Interaction Effects:

3.4.1. Interaction between cultivars and antioxidants effect:

The results indicated that germination stress tolerance index, shoot length stress index, root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index was significantly affected by the interaction effect between studied cultivars and antioxidants concentrations as illustrated in Figs. 1, 2, 3, 5, 6 and 7. The results indicated that the highest promptness index (4.88%), germination stress tolerance index (81.25%), root length stress index (80.29%), were gotten from soaking Sakha 106 cultivar in Humic acid at 500 ppm as illustrate in Figs 1, 2, 3, and 4. However, the lowest. promptness index (2.52%), germination stress tolerance index (37.34%) and root length stress index (60.16%) were gotten from soaking Giza 178 cultivar in Salicylic acid at 100 ppm. The highest root fresh stress index (88.97%) and root dry stress index (76.15) was obtained from soaking Sakha 106 cultivar in Humic acid at 500 ppm as demonstrated in Fig. 5 and 8. The highest shoot dry stress index (95.5%) and shoot dry stress index (81.38%) was obtained from soaking Egyptian hybrid 1 cultivar in Humic acid at 500 ppm as illustrated in Fig. 6 and 7. The highest root fresh stress index was obtained from the interaction between Sakha 106 cultivar with seed soaking in ascorbic acid at 100 ppm.

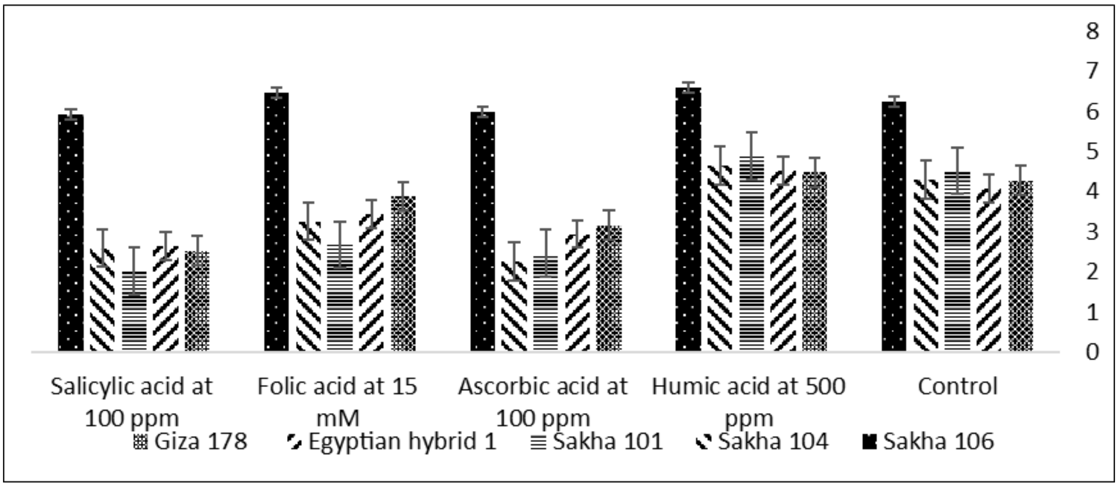

Fig 1. Means of promptness index as affected by the interaction between cultivars and antioxidants.

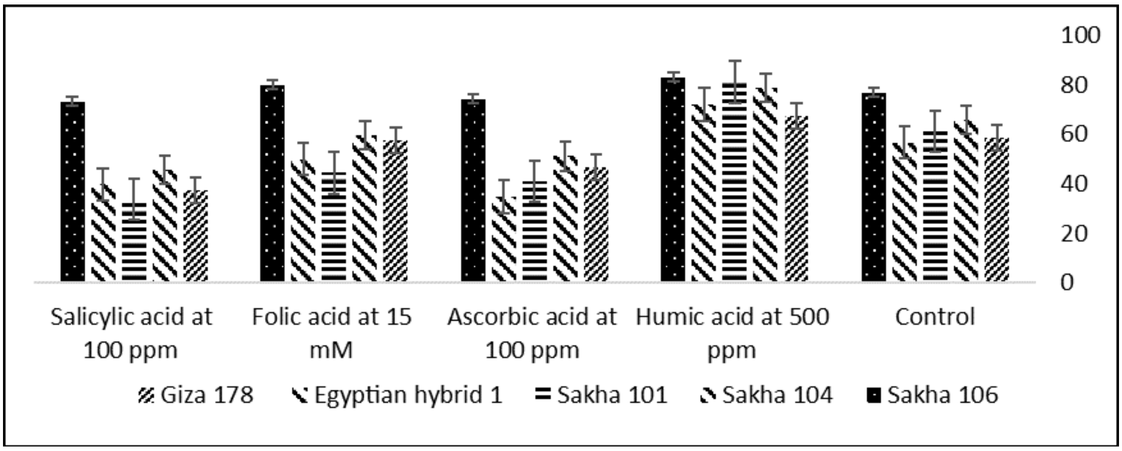

Fig. 2. Means of germination stress tolerance index as affected by the interaction between cultivars and antioxidants.

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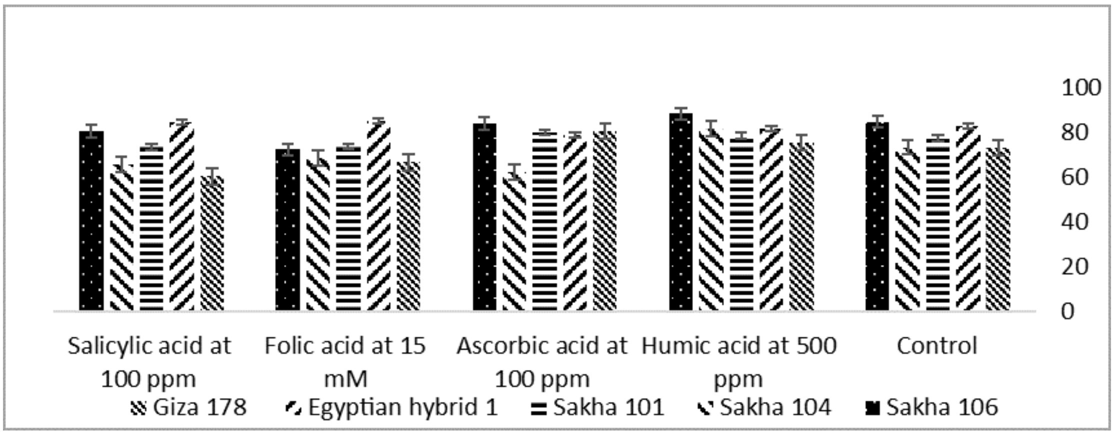

Fig. 3. Means of shoot height stress index as affected by the interaction between cultivars and antioxidants.

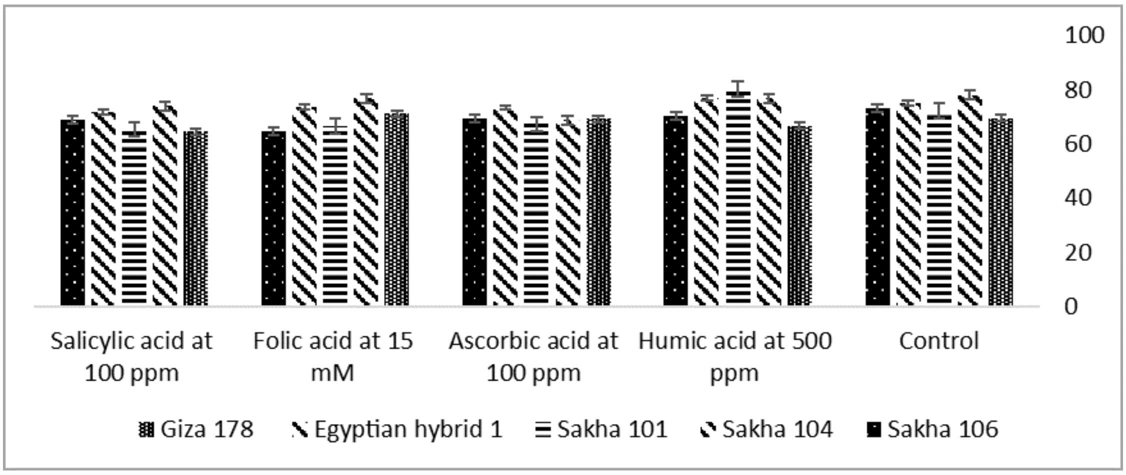

Fig. 4. Means of root height stress index as affected by the interaction between cultivars and antioxidants.

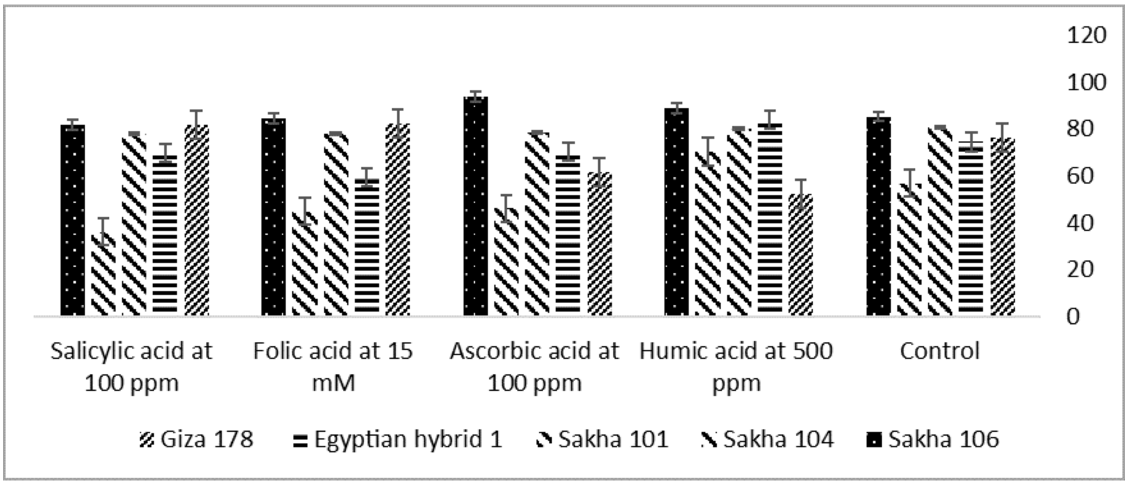

Fig. 5. Means of root fresh stress index as affected by the interaction between cultivars and antioxidants.

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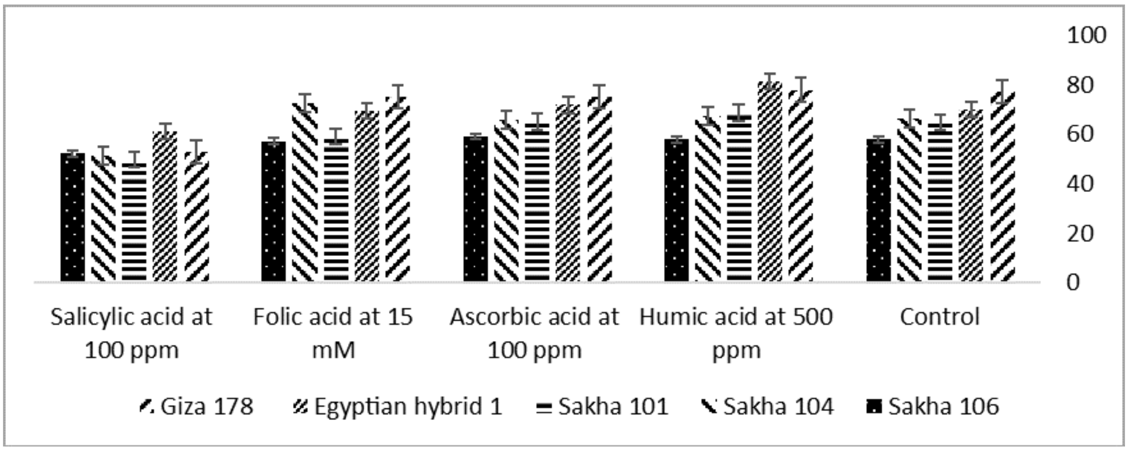

Fig. 6. Means of shoot dry stress index as affected by the interaction between cultivars and antioxidants.

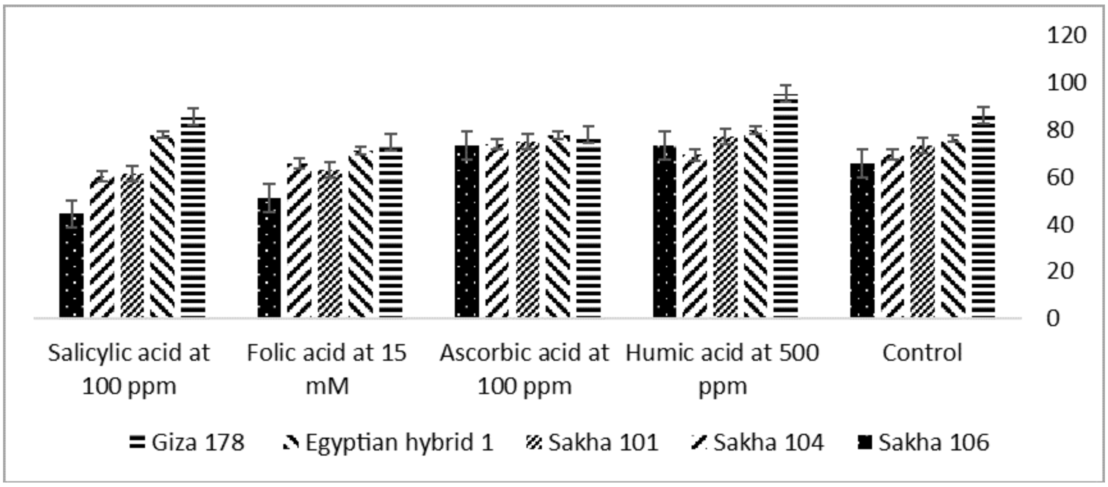

Fig. 7. Means of shoot fresh stress index as affected by the interaction between cultivars and antioxidants.

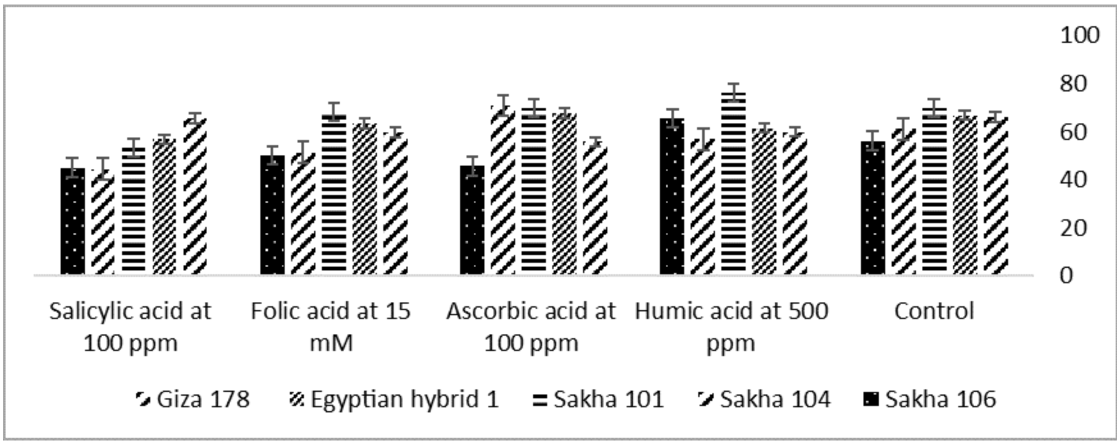

Fig. 8. Means of root dry stress index as affected by the interaction between cultivars and antioxidants.

3.4.2. Interaction between cultivars and salinity levels effect:

The results indicated that root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index and root dry stress index were significantly affected by the interaction effect between studied cultivars and salinity concentrations (Tables 1 and 2). While, germination stress tolerance index and shoot length stress index were insignificantly affected. The tallest root length stress index (96.40%) was recorded from without soaking of Sakha 104 cultivar, while the lowest percentages (50.51%) produce from soaking Giza 178 cultivar in 300 mM as demonstrated in Fig. 9. The highest percentages of root fresh stress index (98.48%)

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was obtained from without soaking of Sakha 106 cultivar, while, the lowest percentages (30.56%) was obtained from Sakha 104 cultivar and 300 mM as illustrated in Fig. 10. The highest percentages of shoot fresh stress index (90.33%) and shoot dry stress index (90.33%) was obtained from without soaking Egyptian Hybrid 1 and the lowest from Soaking Sakha 106 or Sakha 104 cultivars in 300 mM as illustrated in Figs 11 and 12. The highest root dry stress index (91.38%) was obtained from without soaking Sakha 101 cultivar and the lowest percentages (33.24%) was obtained from soaking in with salinity level of 300 mM of Na Cl as demonstrated in Figs 13.

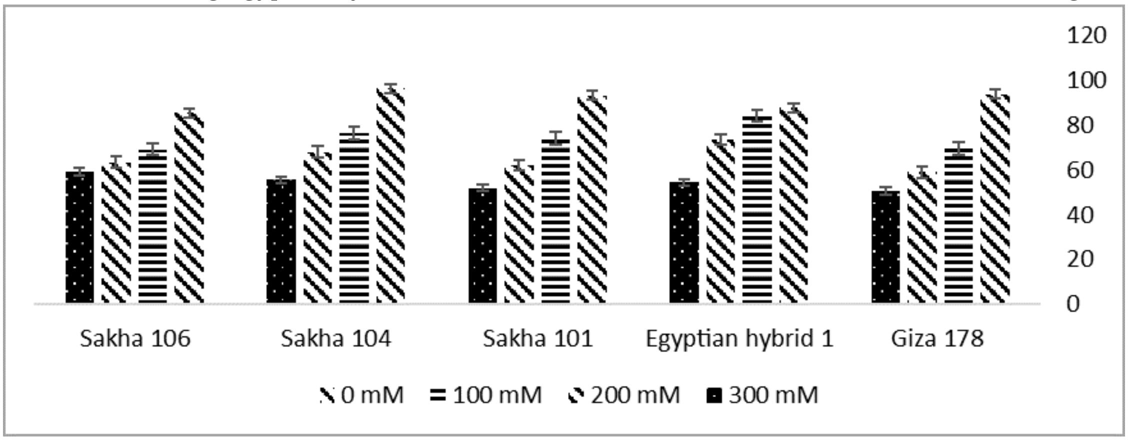

Fig. 9. Means of root height stress index as affected by the interaction between cultivars and salinity stress.

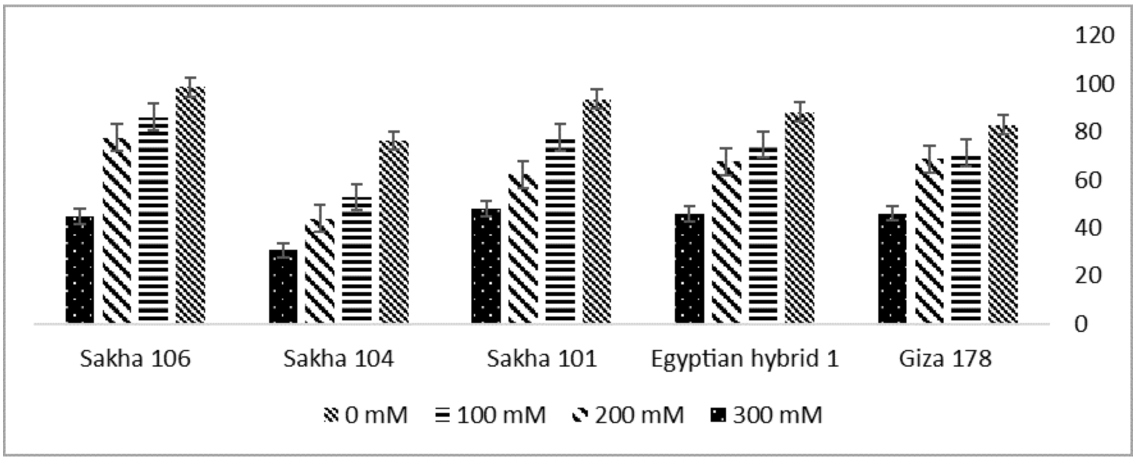

Fig. 10. Means of root fresh stress index as affected by the interaction between cultivars and salinity levels.

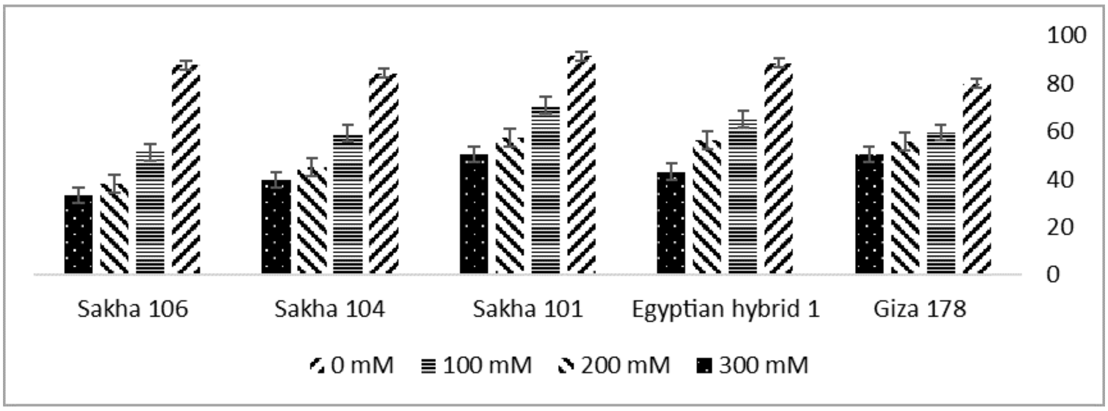

Fig. 11. Means of shoot dry stress index as affected by the interaction between cultivars and salinity stress.

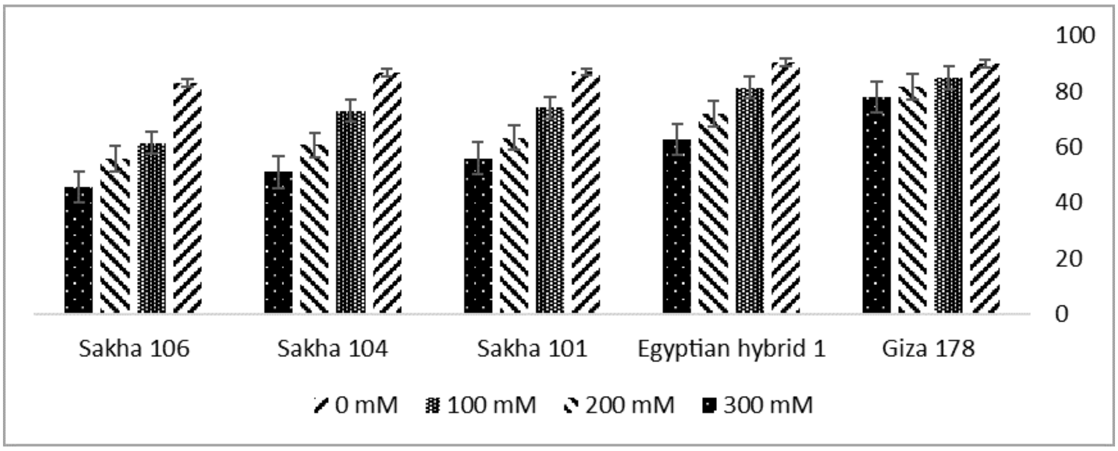

Fig. 12. Means of shoot fresh stress index as affected by the interaction between cultivars and salinity stress.

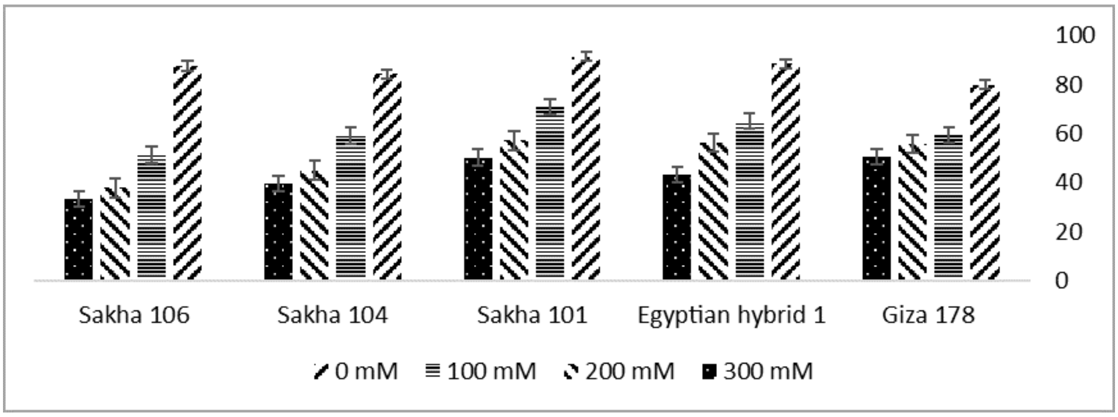

Fig. 13. Means of root dry stress index as affected by the interaction between cultivars and salinity levels.

3.4.3. Interaction between antioxidants and salinity levels effect:

With reference to the interaction effect between antioxidants and salinity levels on germination stress tolerance index, shoot length stress index, Root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index insignificantly affected as offered in Table 1 and 2.

3.4.4. Interaction between cultivars x antioxidants x salinity level effect:

The interaction effect between cultivars, antioxidants and salinity levels on germination stress tolerance index, shoot length stress index, Root length stress index, shoot fresh stress index, root fresh stress index, shoot dry fresh stress index, root fresh stress index insignificantly affected as illustrated in Tables 1 and 2.

IV. CONCLUSION

It could be concluded that in order to maximize physiological indexes parameters by priming seeds of Sakha 106 cultivar in Humic acid at 500 ppm. It can be used in breeding program to boost production in Egyptian territory.

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Effects of Climate Change Adaptation Measures on Groundnut Production Efficiency in Benue State, Nigeria

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***Abstract*— *This study assessed the effects of climate change adaptation strategies on groundnut production efficiency. The population for the study consists of all groundnut farmers in Benue State. Primary data were collected from 205 sampled groundnut farmers using multistage sampling technique. The data were analysed using descriptive and inferential statistics. The result showed that the average age of the respondents was 36 years. Groundnut farming in the study area was dominated by the male. Majority of the farmers were married with an average of 6 persons per household. The study reveals that 82.9% and 74.1% of the respondents do not have access to extension services and credit respectively. The result of the stochastic frontier analysis revealed that the average technical efficiency of groundnut production was 0.90. The respondents were aware of climate change and adopted measures to cope with the changing climate. The inefficiency model showed that adoption of improved/multiple varieties and planting of trees to cope with climate change significantly increased inefficiency at 5% level of significance; off-farm employment significantly increased inefficiency at 10% level of significance; adjustment of/multiple planting dates and alternative tillage practices significantly decreased inefficiency at 1% level of significance. Inadequate access to credit and extension services hindered appropriate use of adaptation measures, hence, there is need to emphasize adequate education with the help of extension agents to facilitate the farmers' adaptation to climate change and there is need also for government to support credit facilities to help improve farmers' capacity to adapt to climate change.*
***Keywords*—climate change, adaptation measures, technical efficiency, groundnut production.**

I. INTRODUCTION

Agriculture is highly exposed to climate change, as farming activities directly depend on climate condition. The pattern of the effects of climate change are dependent on latitude, altitude, type of crop grown and livestock reared (Khanal, 2009). Mark *et al.*, (2008) highlighted some direct impacts of climate change on agricultural system as; seasonal changes in rainfall and temperature, which could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest and disease populations; alteration in evapotranspiration, photosynthesis and biomass production; and alteration in land suitability for agricultural production.Food production including access to food is projected to be highly compromised by climate variability and change (Intergovernmental panel on climate change, IPCC, 2007).

High variation in environmental factors such as temperature, rainfall and others affect crop growth negatively and certain crops get positively affected due to changes in environmental factors. Rise in temperature for example helps to grow crops in high altitude areas and towards the poles for example. In such areas, an increase in temperature extends the length of potential growing season, allowing earlier planting, early harvesting and opening the possibility of completing two crops cycles in the same season (Khanal, 2009). High growing season temperature can significantly impact agricultural productivity, farm incomes and food security (Battisti & Naylor, 2009).

Adaptation is one of the policy options for reducing the negative impact of climate change (Kurukulasuriya & Mendelsohn, 2006). Adaptation refers to all adjustments in behaviour or economic structure that reduce vulnerability of the society to changes in the climate system including its current variability and extreme events as well as long-term climate change (Smit *et al.*, 2000). Adaptation to climate change necessitates that farmers first notice that the climate has changed and then identify useful adaptation and implement them (Maddison, 2006). Common adaptation methods in agriculture include the use of new crop varieties and livestock breeds that are more suited to drier conditions, irrigation, crop diversification, mixed crop and livestock farming system, change of planting dates, diversification from farm to non-farming activities, increase use of soil water conservation, changed use of capital, labour and trees planted for shade and shelter (Nhemachena& Hassan, 2007; Mendelsohn, 2006).Adaptation capacity is the potential or ability of a system, region or community to adapt to the effects or impact of climate change (Smit&Pilifosova, 2001). Adaptation strategies determine the productivity of the ecosystem.

Groundnut (*Arachis hypogaea L)* is also known as peanuts, pinders, manila nuts, earthnuts or gobbers (Beghin, *et al*., 2003). It is a member of the genus *Arachis* in the family *leguminosae* (*Fabacaea*) which has replaced the traditional bambara groundnut (*Vigna subterranean)* in some areas (Ashley, 1993). Groundnut is the 13th most important food crop and 4th in oil seed crop of the world. Groundnut is grown in different rainfall and temperature regimes on a variety of soils. Depending upon the location on the globe, climate change may benefit or adversely affect the productivity of this crop.

Groundnut seeds (Kernels) contains 40-50% fat, 20-50% protein and 10-20% carbohydrates (Food and Agriculture Organization, FAO, 2006). Groundnut kernels are consumed directly as raw, roasted or boiled kernels or oil extracted from the kernels is used as culinary oil. It is used as animal feed (oil pressing, seeds, green oil cakes and fertilizer). Groundnut seeds are nutritional source of vitamin E, niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium (FAO, 2006). The uses of groundnut plant makes it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries (FAO, 2006).

The results of studies carried out in the past in specific locations to determine the effects of climate change and climate change adaptation strategies directly depend on the extent of climate variation, crop and livestock response and specific adaptation strategies. Hence the need for this study which aims at revealing the farmers' perception of climate change; adaptation strategies adopted by the farmers; and estimating the technical efficiency of groundnut production and the effects of the adopted strategies on technical efficiency of groundnut production.

II. METHODOLOGY

The Study Area.

The study was carried out in Benue State, Nigeria. Benue State is located in the North-Central region of Nigeria between Latitudes $6^0 25'$ and $8^0 8'$ N and Longitude $7^0 47'$ and $10^0 0'$E. The state has a population of 4,252,641 people (National Population Commission, NPC, 2006). About 80% of its population is involved in agriculture and produces sesame, soybeans, groundnut, sweet potato, millet, rice, maize, sugar cane, oil palm, etc.

The State is bounded by Nasarawa and Taraba States to the North, Republic of Cameroun to the East, Cross River, Enugu and Ebonyi States to the South and Kogi State to the West (Benue State Agricultural and Rural Development Authority, BNARDA, 2010). Benue State has a tropical Climate, which exhibit two distinct seasons. The rainy season last from April to October while the dry season last from November to March. The average rainfall varies from 1750mm in the Southern part of the State to 1250mm in the North. The hot season comes in mid March and April with temperatures ranging from 32^0C to 38^0C and high humidity. Benue State is made up of three agricultural zones; Northeast, Northwest and Southern agricultural zones. The State has a total land area of about 30,955 square kilometres.

Sampling Technique

In order to achieve the aims of this study, structuredquestionnaires were used to collect primary data from 205 groundnut farmers in the study area. Multistage sampling technique was adopted. The first stage involved the purposive selection of two Local Government Areas (LGAs) from the Northeast and the Southern agricultural zones each and one LGA from the Northwest agricultural zone based on their predominance in groundnut production. The second stage involved the random selection of three groundnut farming communities from each LGA. In stage three, 45 and 43 respondents were randomly selected from Kwande and Konshisha LGAs respectively in the Northeast zone; in the Southern zone, 30 respondents were randomly selected from Obi LGA and 35 from Oju LGA; and in the Northwest zone, 52 respondents were selected from Gwer East at random.

Model/Variable Specification

Stochastic frontier production model

The data for this study were fitted into Cobb-Douglas production forms of stochastic frontier production model and the best form was selected through the use of generalized log-likelihood test after meeting the econometric requirements. Cobb-Douglas production form is implicitly stated as:

$$\text{In} y_i = \beta_0 + \sum \beta_i In\,(X_i) + (V_i - \mu_i) - - - - - (i)$$

The explicit form is stated as follows:

$$LnY= B_0 + B_1 LnX_1 + B_2 LnX_2 + B_3 LnX_3 + B_4 LnX_4 + B_5 LnX_5 + (v_1 - u_1).$$

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Where: Σ = sign of summation, Y_i = the output in Kilogram, Bi = parameters estimates, X_1 = total land area under groundnut production in hectares, X_2= total labour used in mandays, X_3= total quantity of fertilizer used in groundnut production in Kilogram, X_4= Total quantity of agrochemicals used in litres, X_5= total quantity of groundnut seeds used in kilogram, V_i = random errors that are assumed to be independent and identically distributed as $N(0,\sigma^2_v)$ random variables and μ_i= Non-negative technical inefficiency effects that are assumed to be independently distributed among themselves and between V_i such that μ_i is defined by the truncation of the $N(\mu_i,\sigma)$ distribution.

The technical inefficiency effects model:

The technical inefficiency effect, $\mu_i$is defined as:

$\mu i=\delta_0 + \delta_1 I_1 + \delta_2 I_2 + \delta_3 I_3 + \delta_4 I_4 + \delta_5 I_5 + \delta_6 I_6 + \delta_7 I_7$

I_1 - I_7= adaptation strategies adopted by groundnut farmers in the study area.

μ_i= inefficiency effect, I_1 = Improved/multiple varieties, I_2 = Adjustment of/multiple planting dates, I_3 = Alternative tillage practices, I_4 = Off-farm employment, I_5 = Planting of trees, I_6 = Contour terracing and I_7 = Fertilizer application. 1 if an adaptation strategy was adopted, 0 if otherwise. δ_0 and δ_i = coefficients (unknown parameters to be estimated along with the variance parameters δ^2 and γ). The varience of the random errors, δ_v^2 and that of the technical inefficiency effects δ_μ^2 and the overall variances of the model are related). The ratio $\gamma = {\delta_u^2}/{\delta_v^2}$ measures the total variation of output from the frontier which can be attributed to technical inefficiency. The estimates of the parameters of the stochastic frontier production function and the inefficiency model will be obtained simultaneously (Coelli, 1996).The technical efficiency is defined in terms of the ratio of observed output (Y_i) to the corresponding frontier output (Y_i) conditioned on the level of input used by the farmers (Battese & coelli, 1995). Hence the technical efficiency (TE_i) of the groundnut farmers will be expressed as:

$TE_i = {y_i}/{y_i^*}$ = f $(X_i,B)\exp(V_i-\mu_i)/f(X_i\beta)\exp V=\exp(-\mu i)$.

Where Y_i = Observed output, Y_i^* = Frontier output, TE_i = 0 to 1

III. RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Table 1 shows that majority (65.9%) of the groundnut farmers fell within the ages of 21-40 years. The average age of the farmers was 36 years. This means that groundnut farmers in the study area were in the economically productive age and groundnut production will tend towards an increase. The study reveals that groundnut farming was dominated (75.1%) by the male and this calls for increased participation of the female in groundnut production in the study area.The result reveals also that majority (61.1%) of the farmers were married with an average household size of 6 persons and this implies that, the farmers were responsible and family labour might be available. This study reveals that 95.6% of the respondents had formal education with an average of 10.4 schooling years. This means that respondents in the study area attended secondary school or its equivalent. This finding agrees with result of Ogundari (2008) that cash crop farmers in Nigeria had an average age of schooling of 10 years.Majority (54.6%, 82.9% and 74.1%)did not belong to any social group,have access to extension services and credit respectively. The limited access to extension services might create a gap between the farmers and useful information that could help them cope with climate change challenges and inadequate access to credit might have negative influence on farmers adaptive capacity.

Table 1: Distribution of theGroundnut Farmers According to their Socioeconomic Characteristics

Variables	Frequency	Percentage	Mean
Age			36.9
≤20	6	2.9	
21-40	135	65.9	
41-60	58	28.3	
≥61	6	2.9	
Sex			
Female	51	24.9	
Male	154	75.1	
Marital Status			
Single	49	23.9	
Married	129	61.5	

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Divorced	17	8.3	
Widowed	13	6.3	
Household Size			5.9
≤5	102	49.8	
6-10	88	42.9	
11-15	13	6.3	
≥16	2	1.0	
Level of Education			10.4
Non-formal	9	4.4	
Primary	45	22.0	
Secondary	110	53.7	
Tertiary	41	20.0	
Access to Extension Services			
No	170	82.9	
Yes	35	17.1	
Social Participation			
No	112	54.6	
1	44	21.5	
2	37	18.0	
≥3	12	5.9	
Access to Credit			
No Access	152	74.1	
Formal	3	1.5	
Informal	50	24.4	

Source: Field Survey, 2018

Years of Climate Change Awareness and Perception of Groundnut Farmers in Benue State

Table 2 reveals that 61.5% of the farmers were aware of climate change for at most 5 years, 32.7% were aware of climate change for 6-15 years, 3.4% were aware of climate change for 16-25 years and only 2.4% of the respondents were aware of climate change for at least 26 years. The study also shows that 62.0% of the respondents perceived that there was delayed and/or erratic rainfall during the period of climate change awareness, 56.1% perceived that there was high temperature, 45.4% perceived decreased rainfall, 49.3%of the farmers perceived increased incidence of pest and disease, 28.8%, 28.8%, 38.5%, 37.6% and 37.1% respectively perceived that there was wind effect, nutrient leaching, increased soil erosion, increased solar radiation and flood. Only about 17.1% of the respondents perceived that there was carbon (IV) oxide effect.

Table 2: Distribution of the Farmers by their Years of Climate Change Awareness and Perception

Variables	Frequency	Percentage	Mean
Years of climate change awareness			7.13
≤5	126	61.5	
6-15	67	32.7	
16-25	7	3.4	
≥26	5	2.4	
Climate change perception			
Delayed /erratic rainfall	127**	62.0	
High Temperature	115**	56.1	
Decreased Rainfall	93**	45.4	
Pest and Disease	101**	49.3	
Wind Effect	59**	28.8	

Nutrients Leaching	59**	28.8
Soil Erosion	79**	38.5
Solar Radiation	77**	37.6
Flood	76**	37.1
Carbon (iv) oxide	35**	17.1

Source: Field Survey, 2018
** Multiple Responses

Climate Change Adaptation Strategies Adopted by Groundnut Farmers in Benue State

The climate change adaptation strategies adopted by the respondents can be found on table 3 which reveals that 53.2% of the respondents adopted improved/multiple varieties as an adaptation strategy, 85.9% of the farmers used adjustment of/multiple planting dates during the cropping season and 60.0% of the farmers adopted alternative tillage practices to cope with climate change. About 86.3% of the farmers used contour terracing (planting across the slope) to control soil erosion, 22.0% adopted planting of trees and 54.1% of the respondents were involved in off-farm employment as source of income to aid farming activities. Only about 13.2% of the farmers applied fertilizer on their groundnut farms as a climate change adaptation strategy and none of the farmers adopted irrigation and shading to cope with climate change. This means that the farmers' awareness of climate change informed their decision to adopt adaptation measures to reduce the adverse effect of climate change.

Table 3:Distribution of the Farmers by Climate Change Adaptation Strategies Adopted

Variables	Frequency	Percentage
Improved/Multiple Varieties	109**	53.2
Adjustment of/Multiple Planting Dates	176**	85.9
Alternative Tillage Practices	123**	60.0
Tree Planting	45**	22.0
Contour Terracing	177**	86.3
Off-farm Employment	111**	54.1
Fertilizer Application	27**	13.1
Irrigation	-	-
Shading	-	-

Source: Field Survey, 2018
** Multiple Responses

Technical Efficiency for Groundnut Farming in Benue State

The result of technical efficiency is presented on table 4. The result of the Cobb-Douglas stochastic frontier model shows that there was variation in technical efficiency among the groundnut farmers in the study area. The technical efficiency varied between 0.24 (24.0%) and 0.97 (97.0%) with a mean of 0.90 (90.0%). The result shows that majority (75.0%) of the farmers had technical efficiency of at least 0.91 (91%), 22.0% had technical efficiency within 0.61 - 0.90, 1.5% and 0.5% of the farmers had technical efficiency within the range of 0.31 - 0.60and at most 0.30 respectively.This result means that there is little opportunity for increased efficiency about 0.1 given the present state of production technology. This result is similar to the result of Taphee and Jongur (2014) who obtained a mean technical efficiency of 0.97 in their study on productivity and efficiency of groundnut farming in Taraba State, Nigeria.

Table 4: Distribution of Technical Efficiency for Groundnut Farmers in Benue State

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Efficiency Index		Frequency	Percentage
≤0.30		1	0.5
0.31- 0.60		3	1.5
0.61- 0.90		47	22.9
≤0.91		154	75.0
Total		**205**	**100.0**
Minimum Efficiency	0.24		
Maximum Efficiency	0.97		
Mean Efficiency	0.90		

Source: Field Survey, 2018

The Effects of Climate Change Adaptation Strategies on Technical Efficiency of Groundnut Production in Benue State

The Cobb-Douglas stochastic frontier model with inefficiency effects was selected as the preferred model that best fit the data for the groundnut farmers. The Maximum Likelihood Estimates for the parameters are presented in table 5. Farm size was highly significant at 1% level of probability. The estimated value for the gamma (0.2689) and sigma square (0.2376) were all significant at 1% level of probability and this indicates that the technical inefficiency is highly significant for groundnut production activities. The gamma parameter shows the relative magnitude of the variation in output associated with technical inefficiency. The derived coefficients from the Maximum Likelihood Estimates represent the percentage change in the explained variable as a result of the percentage change in the explanatory variables.The inefficiency parameters establish that adjustment of/multiple planting dates and alternative tillage practices decreased inefficiency. Improved/multiple varieties, off-farm employment and planting of trees increased inefficiency of groundnut production in the study area.

Table 5: Maximum Likelihood Estimates (MLE) of the Stochastic Frontier production Function for Groundnut Farmers in Benue State

Variables	Coefficients	t-ratio
Production model	**Beta**	
Constant	7.0407	10.6460***
Farm Size	0.9030	6.6280***
Seed	0.0222	0.1813
Fertilizer	-0.0089	- 0.7767
Herbicide	0.0052	0.3644
Labour	0.0375	0.7720
Inefficiency model	**Delta**	
Constant	- 0.4673	- 1.1563
Improved/multiple Varieties	0.8728	2.4866**
Adjustment of/Multiple Planting Dates	- 0.7132	- 2.7528***
Alternative Tillage Practices	- 0.6159	- 2.7203***
Planting of Trees	0.5509	2.1556**
Contour Terracing	- 0.3037	- 1.3379
Off-farm Employment	0.4907	1.8391*
Fertilizer application	0.0109	1.0779
Diagnostic parameters		
Sigma Squared	0.2376	12.6788***
Gamma	0.2689	3.4587***
Log Likelihood Function	- 115.444	

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Source: Field survey, 2018

*, ** and *** represent 10%, 5% and 1% significant levels of probability respectively

IV. CONCLUSION

The result of this study established that groundnut farmers in the study area are aware of climate change and this informs their decision to adopt measures to cope with the changing climate. The adopted measures had influence on the efficiency of groundnut production. In spite of the efforts put in place by the farmers to adapt to climate change, inadequate extension service delivery and lack of access to credit hindered the appropriate use of adaptation measures; based on these, the following recommendations are made.

i. There is need to emphasize adequate educationwith the help of extension agents to facilitate the farmers' adaptation to climate change.
ii. Government should make efforts to support credit facilities to help improve farmers' capacity to adapt to climate change.

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The Utilization of Sweet Potatoes as Prebiotics on the Performance of *Lactobacillus* sp. in the Vanamei Shrimp Digestion (*Litopenaeus vannamei*)

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***Abstract*—*The use of probiotics (Lactobacillus sp.) in feed is one alternative that is done to improve immunostimulants, growth stimulants, and can be used as a balance of microorganisms in digestion.This study aimed to evaluate the growth performance of vanamei shrimp fed with the addition of Lactobacillus sp. with sweet potatoes in feed. This study used a completely randomized design (CRD) with 4 treatments and 3 replications. The treatment were by feeding with different sweet potato concentrations: A) The dose of sweet potato in feed was 0% (as control); B) The dose of sweet potato in feed was 10%; C) 1The dose of sweet potato in feed was 15%; and D) The dose of sweet potato in feed was 20%. Data were analyzed using variance analysis (ANOVA) and continued with W-Tuckey's further test. The research parameters were digestive enzyme activity, nutrient digestibility and growth. The results of the variance analysis showed the addition of various sweet potato concentrations with Lactobacillus sp. has no significant effect (p> 0.05) of the growth rate. The specific growth rate of vannamei shrimp ranges from 3.06 to 3.23% / day. Based on the results of the analysis on the utilization of sweet potatoes as a prebiotic on the performance of Lactobacillus sp. in the vannamei shrimpis (Litopenaeus vannamei) digestive tract can be concluded that the growth performance does not have a significant effect after being fed with the addition of Lactobacillus sp. and sweet potatoes in feed.*

***Keywords*— Enzymes, Digestion, Growth, Lactobacillus sp., Prebiotic, Probiotic.**

I. INTRODUCTION

The intensive system of vanamei shrimp farming in feed ponds is the largest component in shrimp farming. Emphasis on feed production costs is another alternative that is easy to obtain, cheap price and nutrient requirements in shrimp are still fulfilled so as to increase digestibility because if the digestibility level is high then feed efficiency increases (Putra, 2016). Shrimp require certain amounts of certain nutrients for growth, body maintenance and self defense against disease. These nutrients include protein, fat and carbohydrates (Zainuddin et al., 2009). One alternative is using probiotics (Suri, 2017).

Probiotics function as immunostimulants, growth boosters, and can be used as a counterweight to microorganisms in digestion (Khasani, 2007). One of the probiotics that is often used is Lactobacillus sp. Like the statement (Angelis & Gobbeti, 2011) Lactobacillus sp. including in the group of lactic acid bacteria so it is safe for digestion. In order for probiotics to grow well in the digestive tract, prebiotics are needed as nutrients. Prebiotics are generally carbohydrates (poly- and oligosaccharides) which cannot be digested in the host's digestive tract. High carbohydrate content can be found in tubers, one of which is sweet potato (Lesmanawati et al., 2013). Sweet potatoes contain ologisaccharides which have the potential to provide beneficial nutrients for microbial intestines (Marlis, 2008).

Sweet potato (Ipomoea batatas L) is a food crop with quite high productivity. Sweet potato productivity in Indonesia has increased from year to year. In addition to the content of beta carotene, anthocyanin, phenol compounds and dietary fiber and having a low glycemic index value, sweet potato is also very potential to be developed as a prebiotic source mainly due to its oligosaccharide content (Lesmanawati et al., 2013). Sweet potato fiber extract (ESU) has been shown to contain Fructo-Oligosaccharide (FOS) and Raffinosa and is able to enhance immunity and increase the composition of beneficial bacteria Bifidobacterium sp. and Lactobacillus sp. (Suri, 2017).

Descriptively, the prebiotic treatment of sweet potato extract in synbiotics gave better performance on absolute weight growth, daily growth rate, survival rate, and vanamei shrimp feed conversion ratio compared to control treatment. In addition, the results of research by Mustafa (2017) showed that feeding with sweet potato prebiotics contributed significantly to the activity of amylase enzymes, carbohydrate digestibility and vanamei shrimp digestibility. Based on the results of these studies, it is necessary to conduct further research on the utilization of sweet potato as a prebiotic on the performance of Lactobacillus sp. in the digestive tract of shrimp vanamei. The purpose of this study was to evaluate the growth performance of vanamei shrimp fed by adding Lactobacillus sp. and sweet potatoes in feed.

II. MATERIALS AND METHODS

Time and Place

This research was conducted from December to February with the location of the trial treatment at the Brackishwater Aquaculture Center Takalar (BPBAP). Analysis of enzyme activity and analysis of digestibility levels were carried out at the Research and Development Center for Brackish Water Cultivation (BPPBAP) Maros. Feed making and probiotic analysis at the Takalar Brackish Aquaculture Fisheries Center (BPBAP).

Research Containers The

The containers used in this study were container boxes 63.1 cm x 41.4 cm x 30.7 cm with a volume of 50 L as many as 12 pieces, which were placed in the room (indoor) and each was equipped with resikurlasi. Tubs and all equipment used are first disinfected with chlorine and neutralized with nitrosulfate. Sterile containers are each filled with seawater that has been filtered with a salinity of 27-32 ppt.

Test Animals

The test animals used in this study were juvenile shrimp vanamei (Litopenaeus vannamei) which was taken from the Payau Takalar Aquaculture Fisheries Center with a weight of ± 1.1 g / head, with a stocking density of 50 per liter.

Artificial Feed and Prebiotics The

The feed used was formulated with nutritional composition according to the needs of vanamei juvenile shrimp and sweet potato flour was added as a prebiotic. The formulation of feed raw materials is presented in (Table 1), while the results of the proximate analysis of treatment feed are presented in (Table 2). The bacteria that will be used as probiotics are Lactobacillus sp. isolated from yakult at the Hasanuddin University Faculty of Marine and Fisheries Pests and Diseases Laboratory with a colony density of 2.14 x 109 CFU / mL.

Table 1. Formulation of feed used

IngredientsRaw materials	Composition (%) A	B	C	D
Fishlocal	40	40	40	40
Soybean flour	22	22	22	22
Corn flour	10	10	10	10
Sweet potato flour	0	10	15	20
CMC	20	10	5	0
Fish oil	4	4	4	4
Vitamin and Mineral mix	4	4	4	4

Description: A (control), B (addition sweet potatoes of 10%), C (addition sweet potatoes of 15%), D (addition sweet potatoes of 20%)

Table 2 Proximate analysis of feed treatment

No.	Treatment	Content (%) Air	Crude protein	Crude fat	Crude Fiber	BETN	Abu
1.	Feed A	10.05	30.25	10.27	4.25	45.26	9.97
2.	Feed B	8.63	31.98	11.05	3.63	45.19	8.15
3.	Feed C	7.94	32.37	11.03	3.41	47.23	5.96
4.	Feed D	11.27	30.31	9.95	2.66	52.11	4.97

Description: 1. Except of water, All fractions are analyzed in dry materials; 2. BETN = Extra Material without Nitrogen

Experimental Design and Treatment The

This study was designed in Completely Randomized Design (CRD) with 4 treatments and 3 replications each. Thus there are 12 experimental units. The treatment is: A) Sweet potato dosage in 0% feed (control); B) The dose of sweet potato in feed is 10%; C) 15% dose of sweet potato in feed; D) The dose of sweet potato in feed is 20%.

Observation

Parameters The research parameters included enzyme activity (α-amylase & protease), nutrient digestibility and growth of vannamei shrimp. Observation of the activity of α-amylase &protease enzymes is guided by the method of Bergmeyer and Grassi (1983). The activity of the α-amylase & protease enzyme is measured using the following formula:

$$Enzyme\ activity\ \alpha amylase\ /\ protease\ = \left(\frac{Act - Abl}{Ast - Abl}\right) \times \frac{P}{T}$$

Description:
Act = Sample absorbance value
Abl = Absorbance value blank
Ast = Standard absorptive value
P = Dilution factor
T = Incubation time in days

Analysis of feed nutrient digestibility was carried out by indirect method, using an indicator of chromium oxide (Cr2O3) of 1% mixed evenly in feed. Chrome feces collection is done every day until 1 g of dried feces. Analysis of chromium using a Shimadzu UV-VIS 2401PC spectrophotometer. The chromium concentration in feces can be calculated based on the formula according to Takeuchi (1988) as follows:

$$Nutrient\ digestibility = 100 - 100\left[\times \frac{(ax\ b')}{(\ a'xb)}\right]$$

Description: a =% Cr2O3 in feed
a ' =% Cr2O3 in feces

Growth value is obtained from the formula Hardjamulia et al. (1986):

$$SGR = \frac{lnWt - lnWo}{T} \times 100$$

Description:
SGR = average growth rate for specific weights (%)
lnWo = average initial growth rate (g)
lnWt = average final growth rate (g)
T = time used during the experiment (g)

Data on growth and enzyme activity obtained were analyzed using variance analysis (ANOVA) while nutrient digestibility data and water quality parameters were analyzed descriptively based on the feasibility of live vanamei shrimp.

III. RESULTS AND DISCUSSION

Digestive Enzyme Activity The

The results of variance analysis (ANOVA) showed the treatment of feeding with the addition of sweet potato concentration and *Lactobacillus* sp. no significant effect ($p > 0.05$) on the activity of protease and amylase enzymes in the vanamei shrimp digestive tract (Table 3). In Table 3 shows the highest protease enzyme activity at 15% prebiotic sweet potato concentration, that is (0.09 u / mL) and amylase enzyme (0.46 u / mL).

Table 3. Average digestive enzyme activity (u / mL)

Treatment		Digestive enzyme activity (u / mL)	
		Protease	Amilase
A	Sweet potato dose in feed 0%	0.06 ± 0.005^a	0.33 ± 0.041^a
B	Sweet potato dose in feed 10%	0.07 ± 0.012^a	0.41 ± 0.031^a
C	Sweet potato dosage in feed 15%	0.09 ± 0.013^a	0.46 ± 0.097^a
D	Sweet potato dosage in feed 20 %	0.07 ± 0.008^a	0.43 ± 0.039^a

Description: The same letter shows no significant effect between treatments at the level of 5% (p> 0.05).

Nutrient digestibility

The results of the variance analysis (Anova) showed feed treatment with the addition of sweet potato concentration and *Lactobacillus* sp. no significant effect ($p > 0.05$) on nutrient digestibility of vanamei shrimp (Table 4). Digestion values describe the amount of nutrients in digestible feed. The high digestibility of protein and crude fiber produced in feeding fe ed concentrates 15% sweet potatoes in feed due to increased enzyme activity in the digestive tract o f the test shrimp (Table 4).

Table 4. Average nutrient digestibility of vanamei shrimp during maintenance.

Treatment	Digestibility (%)		
	Protein	Rough Fiber	BETN
A. Sweet potato dosage in feed 0%	70,214	56,034	93,602
B. Sweet potato dose in feed 10%	61,654	73,308	90,885
C. Doses of sweet potato in feed 15%	80,085	76,869	90,989
D. Doses of sweet potato in feed 20%	78,157	71, 101	81,538

Description: Different superscript letters in the same column show significantly different results (P> 0.05).

Specific Growth Rate The

The results of the variance analysis showed that the treatment of adding various sweet potato concentrations with *Lactobacillus* sp produced a growth rate that had no significant effect (p> 0.05), (Table 5). Based on the table above, it can be seen that the specific growth rate of vanamei shrimp ranges from 3.06-3.23% / day, thus that all sweet potato concentrations (prebiotics) can be utilized by vanamei shrimp to provide the same response rate of growth for all treatments.

Table 5. Average specific growth rate (% / day)

Treatment	Specific Growth Rate (% / day)
Dosage of sweet potatoes in feed 0%	3.12 ± 0.280^a
Doses of sweet potato in feed 10%	3.06 ± 0.557^a
Dosage of sweet potato in feed 15%	3.23 ± 0.456^a
Sweet potato dosage in feed 20%	3.06 ± 0.569^a

Description: The same letter shows no significant difference between treatments at the level of 5% (p> 0.05)

This study shows growth in the treatment of the addition of *Lactobacillus* sp. into sweet potatoes is thought to be due to the ability of probiotics *Lactobacillus* sp. found in the vanamei shrimp digestive tract increases the activity of digestive enzymes so that the use of feed and digestive processes can be more selective. In addition, it is suspected that the given prebiotics also contribute to maintaining a bacterial population that supports shrimp growth performance, so the application of prebiotics and probiotics is very suitable for shrimp (Lesmanawati et al., 2013).

The results obtained in accordance with the statement of Aslamyah (2006) which states that one of the mechanisms of probiotics is to improve growth performance by increasing the nutritional value of feed through increased activity of digestive enzymes in the digestive tract of shrimp. Enzymes produced by microbes found in probiotics are amylase, protease and lipase enzymes. These enzymes that hydrolyze complex molecules such as breaking down carbohydrates, proteins and fats into simpler molecules make it easier for the digestion and absorption of nutrients in the digestive tract of fish (Putra, 2016). The secreted enzymes will increase as the bacterial population increases. The use of this enzyme which then increases the digestibility of feed, so that it directly affects the growth and survival of vanamei shrimp.

Fish growth is closely related to the availability of protein in feed, because protein is an energy source for vanamei shrimp and protein is also a nutrient that is needed by vanamei shrimp. According to Suprapto (2005) that the speed of growth depends on the amount of feed consumed, water quality and other factors such as heredity, age, endurance and the ability of the fish to utilize feed. The amount of feed given is very important because if too little will result in slow fish growth and competition for feed will occur which results in variations in the size of the fish produced. Conversely, if too much feed will cause environmental pollution and inefficient.

The water quality for the whole treatment is at the same optimum optimum range for vanamei shrimp. This is supported by an increase in the growth of test shrimp. The temperature of maintenance media is 29-32.5 °C, salinity ranges from 30-35 ppt, pH range obtained during research 7-8. The dissolved oxygen content of the media obtained during maintenance ranged from 4.35-5.80 ppm, the ammonia (NH_3) content was 0.06-0,019 ppm.

IV. CONCLUSION

Based on the results of the analysis of research on the use of sweet potatoes as a prebiotic on the performance of *Lactobacillus* sp. in the vanamei shrimp digestive tract (*Litopenaeus vannamei*) it can be concluded that the growth performance of vanamei shrimp does not have a significant effect after being fed with the addition of *Lactobacillus* sp. and sweet potatoes in feed.

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Evaluation of the effect of Rimsulfuron and Linuron on weed infestation and potato yield

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***Abstract*— A potato weeding trial was conducted during the 2017 growing season. The purpose of this experimentation is to evaluate the effect on weed infestation and impact on potato yield of tow herbicides: Linuron as preemergence herbicide and Rimsulfuron as postemergence herbicide. Results showed that the best potato yields are obtained by treatments that gave the best weed control. Linuron with a rate of 187.5 g/ha has shown excellent efficacy exceeding 93% of weed control and giving yields exceeding 46.3 tons / ha. Treated plots with Rimsulfuron at 15 g/ha gave in average 78% of weed control and may be recommended when the pre-emergence weed treatment is missed.*

***Keywords*— Potato, Weed, efficacy, yield, Rimsulfuron, Linuron.**

I. INTRODUCTION

Potato (*Solanum tuberosum* L.) is a perennial plant native to South America and belongs to the *Solanaceae* family (Skiredj et *al*., 2002 ; Chafik & Taleb, 2012). It is one of the world's fourth most important food crop after rice, wheat and corn (More & *al*., 2016). Potato tubers are very nutritive because they are rich source of starch, vitamins and minerals. It was introduced in Morocco in the nineteenth century, currently it is cultivated intensively throughout the growing season (Fahad & *al*., 2012). Total annual potato production is estimated at 1.5 million tons, representing around 25% of national vegetable production and consumption (Guennouni, 2011). It covers an annual area of 60000 ha in Morocco (Guennouni, 2011). It is considered the first in terms of area and production (Fahad & *al*., 2012 ; Hafidi & *al*., 2012). Potato exports are mainly to the European Union (France, Holland and Spain) and Russia (Hormatallah & *al*., 2012). This crop is important because it contributes to job creation in rural areas and to the satisfaction of population food needs (Kharmach, 2012). The Larache area (Nothern Morocco) occupies the fourth place in Morocco in terms of potato production with an area of 6400 ha and a production of 156 000 tons with an average yield of 31.5 tons / ha (MAPMDREF, 2017). To increase potato yields in terms of quantity and quality requires the improvement of seed varieties, irrigation, fertilization, disease control, insect control and weed control (Chibane, 1999). In fact, weeds can reduce yields through competition for water and nutrients or hinder the harvesting process and become a host of insects and diseases. Broadleaf weeds largely dominate the adventitious flora of the potato with about 85% of total weed species (Chafik & Taleb, 2012 ; Tanji & *al*., 2012a). In the Larache region, the most abundant species in the potato fields are *Cyperus Rotundus, Digitaria sanguinalis, Setaria verticillata , Amaranthus deflexus, Protulaca oleracea* (Tanji et *al* ., 2012b). Hilling and hoeing are among the main techniques for controlling weeds, and the scarcity and high cost of labor makes these operations problematic and expensive. So to overcome this problem, chemical weeding is relatively less dependent on labor and saves time and money. The interval between planting and the emergence of the potato is relatively sufficient to allow the emergence of weeds (Stephens, 1962). Therefore, weed control at the beginning of the cycle is very important. However, some weeds may appear in the middle of the cycle and can affect potato yields, which may require the need for post-emergence herbicide application. In this context, comes the interest of this research work which aim to evaluate herbicide efficacy of pre-emergence (Linuron) and post-emergence (Rimsulfuron) herbicides and their impact on potato yields.

II. MATERIAL AND METHODS

A potato weeding trial was conducted at the Larache INRA Research Station Morocco during 2017 growing season. The average annual rainfall is about 700 mm concentrated for almost all between October 15th and April 15th. The soil texture is sandy. The crop was planted on March 17, 2017. Pre-emergence treatment were carried out at March 20, 2017. Post-emergence treatments were carried out on April 17, 2017. The experimental design is a random block with four repetitions. The size of the elementary plot is 3m x 8m. Each block consists of four elementary plots: three treatments in addition to a non-weed control. The treatments are carried out with Backpack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200L. Observations of efficacy are made a month and a half after planting on a scale ranging from 0 to 100%. At the end of the cycle, the yield is evaluated with a quadrat of 3 m ^{2}. Statistical analyzes are performed with *SPSS* software *version 21*.

Table 1: Applied herbicides

Herbicide active ingredient	Dose per ha	Observation
Rimsulfuron	10 g / ha	Application at the 2 to 5 leaves stage of the crop
Rimsulfuron	15 g / ha	Application at the 2 to 5 leaves stage of the crop
Linuron	187,5 g / ha	Application in pre-emergence

III. RESULTS AND DISCUSSION

1. Weed flora Infestation

Weed flora in the experimental site was diverse, the dominant botanical families are: *Amarantaceae, Poaceae, Cyperaceae and Polygonaceae*. Dominant weed species were: *Amaranthus blitoides, Amaranthus deflexus, Amaranthus retroflexus* (Table 2).

Table 2: Weed flora in experimental site

Scientific Name	Common Name
Amaranthus blitoides S. Watson	MAT AMARANTH
Amaranthus deflexus L.	LARGE-FRUIT AMARANTH
Amaranthus retroflexus L.	RED-ROOT AMARANTH
Avena sterilis L.	WILD OAT
Bromus rigidus Roth	RIPGUT BROME
Cynodon dactylon (L.) Pers.	BERMUDA GRASS
Cyperus esculentus L.	YELLOW NUTSEDGE
Cyperus rotundus L.	NUT GRASS
Dactyloctenium aegyptium (L.) Willd.	EGYPTIAN CROWFOOT GRASS
Digitaria sanguinalis (L.) Scopoli	HAIRY CRABGRASS
Eleusine indica (L.) Gaertner	INDIAN GOOSEGRASS
Malva parviflora L.	CHEESEWEED
Misopates orontium (L.) Raf.	CORN SNAPDRAGON
Physalis pubescens L.	HAIRY NIGHTSHADE
Polygonum aviculare L.	COMMON KNOTGRASS
Portulaca oleracea L.	COMMON PURSLANE
Senecio vulgaris L.	GROUNDSEL
Solanum nigrum L.	BLACK NIGHTSHADE
Sonchus oleraceus L.	SOWTHISTLE

2. Herbicide efficacy on weeds

Statistical analysis revealed a very highly significant difference between treatments (table 3). Plots treated with Linuron showed the best efficacy by recording very good efficacy with 93% of weed control. In fact, the plots treated with Linuron was clean of weed throughout the growing cycle. Treatment with Rimsulfuron at 10 g / ha gave low efficacy (53%). As a result, this dose cannot be recommended for potato weed control. The dose of 15 g / ha of Rimsulfuron gave acceptable efficacy recording 78% of weed control. Thus, this dose may be recommended when pre-emergence weed control is missed or ineffective.

Table 3: Herbicide efficacy on weeds

Treatment	Efficiency (%) at 45 DAT *
Rimsulfuron (10 g / ha)	53 c
Rimsulfuron (15 g / ha)	78 b
Linuron	93 a
Pα = 0.05	< 0.00

** DAT: days after treatment*

3. Effect of treatments on potato yield

a. *Number of tubers / plant*

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Statistical analysis revealed significant differences between treatments for their effect on the number of tubers per plant (table 4). Indeed, significant differences were revealed between Linuron and other treatments including the control. Linuron treated plots recorded 13.4 tubers per plant while the control recorded 8.1 tubers / plant. No significant difference was recorded between Rimsulfuron at 10g / ha, Rimsulfuron at 15g / ha and the control was recorded.

Table 4: *Effect of treatments on the number of tubers / plant*

Treatment	Number of tubers / plant
Rimsulfuron (10 g / ha)	10.1b
Rimsulfuron (15 g / ha)	9.1 b
Linuron	13.4 a
Control	8.1 b
Pα = 0.05	*< 0.00*

b. Average weight of tubers

Statistical analysis revealed highly significant differences between treatments in their effect on average tuber weight (table 5). Indeed, significant differences were revealed between Linuron and the other treatments including the control since the plots treated with Linuron recorded an average tuber weight of 129.6 g while Rimsulfuron at 10 g / ha, Rimsulfuron at 60 g / ha and control recorded weight means of tubers respectively 74.9 ; 95 and 75 g / tuber. In fact, it is important to mention that no significant difference was recorded between Titus at 40 g/ha and the control.

Table 5: Effect of the treatments on the average weight of the tuber (in g)

Treatment	Average weight of the tuber (g)
Rimsulfuron (10g /ha)	74.9 c
Rimsulfuron (15g /ha)	95.0 b
Linuron	129.6 a
Control	75.0 c
Pα = 0.05	*< 0.00*

c. Total yield (Tons / ha)

Statistical analysis revealed highly significant differences between the yields obtained by different treatments (table 6). The best yield was obtained by Linuron with an average yield of 46.3 tons / ha. No significant difference was recorded between Rimsulfuron at 10 g / ha, Rimsulfuron at 15g / ha and the control. In fact, plots treated with Rimsulfuron at 15 g / ha recorded 22.8 tons / ha and treated plots treated with Rimsulfuron 10 g / ha recorded 20.2 tons / ha while the control recorded the lowest yields with an average of 16.2 tons / ha.

Table 6: Effect of Treatments on Total Potato Yield (Tons / ha)

Treatment	Total yield (Tons / ha)
Titus 40 g	20.2 b
Titus 60 g	22.8b
Linuron	46.3 a
Control	16.2 b
Pα = 0.05	*< 0.00*

4. Correlation between treatment efficiency and yield components

Table 7: Correlation between Herbicide efficacy and potato yields

		Efficiency	Yield (Tons / ha)	Average weight of the tuber	Number of tubers per plant
Herbicide efficacy	Correlation of Pearson	1	0.779 *	0.912 **	0.532

	Sig. (bilateral)		0.013	0.001	0.141
Yield (Tons / ha)	Correlation of Pearson	0.779 *	1	0.934 **	0.905 **
	Sig. (bilateral)	0.013		0.000	0.001
Average weight of the tuber	Correlation of Pearson	0.912 **	0.934 **	1	0.707 *
	Sig. (bilateral)	0.001	0.000		0.033
Number of tubers per plant	Correlation of Pearson	0.532	0.905 **	0.707 *	1
	Sig. (bilateral)	0.141	0.001	0.033	

**. The correlation is significant at the 0.05 level (bilateral). **. The correlation is significant at the 0.01 level (bilateral).*

The correlation coefficient shows a significant positive correlation between herbicide efficacy and total yield per hectare and a highly significant positive correlation between herbicide efficacy and average weight of tuber / plant weight. However, there is no significant correlation between the herbicide efficacy and the number of tubers per plant. In addition, positive and highly significant correlations were recorded between the total yields per hectare on the one hand and the average weight of the tuber and the number of tubers per plant on the other hand (table 7).

IV. CONCLUSION

This study has shown that the best potato yields are obtained by treatment giving the best efficacy. Plots treated with Linuron at 750 g / ha showed very good efficacy exceeding 93% of weed control and registered potato yields exceeding 46.3 tons / ha. Linuron application resulted in a yield difference of 30.1 tons / ha compared to potato yields recorded in control plots. This reveals the influence of weeds that severely affects potato yields and the importance of controlling weeds in pre-emergence. Treatment with Rimsulfuron at 15g / ha may be an alternative when the pre-emergence treatment is missed or ineffective.

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Performance Analysis of Fisheries Processing Product Group of Government in Bulukumba Regency

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***Abstract*— *The purpose of this study was to identify the performance of a group of fisheries processing companies assisted by the government, in this case, the Department of Marine and Fisheries, namely to look at the input performance of production volume and execution of product sales output. This research was conducted for three months from November 2018 to February 2019 in Bulukumba Regency. The method used is descriptive research using qualitative and quantitative approaches. The data taken is primary and secondary data using interview and observation methods. The results of the performance efficiency test of the marine and fisheries service assisted groups are quite efficient.*

***Keywords*— Input performance, Output performance, Group performance efficiency.**

I. INTRODUCTION

The fisheries group is a collection of key actors that consist of fishers, fish farmers, and fish processors who are informally bound based on harmony and mutual needs. Within the sphere of influence and leadership of a chairperson of the leading marine and fisheries actors. Bulukumba has ten groups of fishery processing companies under the auspices of the maritime and fisheries service as many as ten groups [1]

The raw materials used in processing fisheries products are fish and seaweed (*EuchemaCottoni*). In the process of processing, each group of fishery product processors is still traditional, so production is still limited, and the marketing carried out is always local. According to Damayanti 2015 [2], performance measurement is carried out to determine the extent of achievement of a worker. Work unit, or an organization to evaluate work processes and efficiency in carrying out previously set targets. Therefore, to find out and identify the performance of fisheries product processing groups assisted by the Marine and Fisheries Office in Bulukumba Regency, this research was conducted.The formulation of the problem in this study is as follows is What is the performance of input, output and efficiencyof the performance from government-assisted fisheries processing groups. Research purposes isKnowing and Recognizing the performance of inputs and output from the government-managed fisheries processing groups and Analyzing the efficiency of the production of government-managed fisheries processing groups.

II. RESEARCH METHODS

2.1 Time and Place

The study conducted in November 2018 - February 2019 in Bulukumba Regency, South Sulawesi Province, Indonesia. The sample is 20 members of the fisheries product processing group assisted by the marine and fisheries department in Bulukumba Regency. This type of research is descriptive with qualitative and quantitative approaches. The data taken is primary data and secondary data.

2.2 Data collection technique

The method used in data collection includes interviews and direct observation. The study used a questionnaire as a tool in data collection.

2.3 Data analysis

Measuring group performance is used analysis of input performance and output performance, to measure performance efficiency used performance efficiency formula (Mahmudi, 2010):

The following formula calculates the input and output performance values:

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$$Input\ Performance\ Value = \frac{Achievement\ performance\ input}{\text{input Performance Input}} \text{ x } 100\%$$

$$Output\ Performance\ Output = \frac{\text{Achievement Performance Output}}{\text{Output Performance Target}} \text{ x } 100\%$$

Performance measurement in terms of efficiency:

$$Efisiensi = \frac{\text{Output Performance Value}}{\text{Input Performance Value}} \text{ x } 100$$

Information:

< 90% = Highly Efficient

90-99% = Efficient

100% = Low Efficient

>100% = Not Efficient

III. RESULTS AND DISCUSSION

The performance or work performance is the result of work in quality and quantity achieved by an employee in carrying out his duties following the responsibilities given to him [3] According to Sukisno, the input is a form of a critical and systematic examination process. That carried out by an independent party that has been trusted to evaluate real data and become a report for feared parties. The output is the result achieved in a certain period [4]

3.1 Input Performance

The value of input performance is a percentage comparison between the achievement of input performance and input performance targets. The performance achievement is the average monthly production target while the performance achievement is the average realization of the monthly production target of each government-assisted group as follows:

Table 1. Value of Performance Input of the Guidance Groups of the Marine and Fisheries Agency

No.	Type of Business	Input Performance Value		Presentation (%)
		Performance Target	Achievement of Performance	
1	Pindang Fish	1620	1595	98
2	Smoked Fish	1600	1500	94
3	Shredded & Fish ball	125	108	87
4	Seaweed Crackers	83	67	81

Source : Data From the analysis, processed 2019

3.2 Output Performance

The output performance value is a percentage comparison between output performance and output performance targets. The achievement of output performance is the average target of the production value and monthly sales value. While the performance achievement is the realization of the production target value and the monthly sales value of each government-assisted group of business types as follows.

Table 2. Value of Output Performance of the Guidance Group of the Marine and Fisheries Service

No.	Type of Business	Output Performance Value		Presentation (%)
		Performance Target	Achievement of Performance	
1	Pindang Fish	1558	1595	102
2	Smoked Fish	1550	1500	97
3	Shredded & Fish ball	125	108	86
4	Seaweed Crackers	83	67	81

Source : Data From the analysis, processed 2019

3.3 Performance Efficiency

Based on the results of the input performance values and output performance values, the performance efficiency value of the business groups assisted by the marine and fisheries services of the type of business is in table 3.

Table 3 Performance Efficiency Values of the Guidance Groups of the Bulukumba, Regency Marine and Fisheries Agency.

No.	Types of Business	Output Performance Value (%)	Input Performance Value (%)	The efficiency of Performance (%)
1	Pindang Fish	102	102	100
2	Smoked Fish	97	97	100
3	Shredded & Fish ball	86	87	100
4	Seaweed Crackers	81	81	100

Source : Data From the analysis, processed 2019

The results showed the calculations in table 3. The performance of the Bulukumba regency's fostering marine and fisheries group that consist of pindang fish, smoked fish, abon, fish meatballs, and seaweed crackers is low. With an average performance efficiency of 100%, which means group performance quite efficient.

IV. CONCLUSION

The performance of the product processing group from the Marine and Fisheries agency of Bulukumba Regency consists of pindang fish, smoked fish, abon, fish meatballs, and seaweed crackers. An average performance efficiency of 100%, which means that the group's performance is quite efficient.

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Marketing Analysis of Processed Fishery Products using Interactive Media

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***Abstract*— This study aims to analyze marketing of processed fishery products by using interactive media in Makassar conducted in April - June 2019 took place in the city of Makassar. Data was collected through interviews, observations, questionnaires and literature study. The research method in this study is a descriptive analysis will present a general overview of SMEs marketing of processed fish products as a whole by focusing on marketing by using interactive media. Samples are processed fishery products 8 SMEs located in the city of Makassar with criteria using the owners use at least 2 social media and has been operating for less than 5 years. The results showed that social media are the most widely used in the sales activity (75%) is WhatsApp, Facebook and Instagram. Group 2 media (12.5%) only uses WhatsApp and Facebook and group 4 media (12.5%) using WhatsApp, Facebook, Instagram and Line.. The percentage of consumers prefer buying fishery products in a row is a promotion, place, price and product.*
***Keywords*— Fishery Products, Promotion Mix, Interactive Media, Digital Marketing**

I. INTRODUCTION

Fishery product processing business is one part of the Agroindustry expected strong competitive and able to survive in a relatively long period of time. But in the era of free trade or globalization requires companies fisheries improve productivity and product quality that still exist in the competition. Therefore, in the development of enterprises, especially SMEs required in order to plan or formulate a proper strategy to improve the business management system (Pranowo 2015). Ibrahim et al., (2013), business continuity seen from the economic dimension, one of the economic driver direct business are market opportunities, production and marketing costs. Alma (2013) explains that marketing management is a process to improve the efficiency and effectiveness of marketing activities undertaken by individuals or by companies.

The fact that the field show most SMEs in Indonesia, has some of the same problems, one of which is the lack of knowledge about marketing, due to the limited information that can be reached by SMEs on the market. Setiwati (2014) suggested the research results (Effect of E-Marketing In Online Business Using Social Media) that Online Marketing Strategy positive effect on earnings of Micro, Small and Medium Enterprises (SMEs) in Central Java. Siswanto, (2013) describe the presence of social media with all its advantages and proven to provide facilities that are not less interesting than any other media that requires a high cost in use. If optimal, social media can create a brand image (brand image) for SMEs and satisfaction that will have an impact on loyalty.

The accessibility and interactivity of the Internet to bring dramatic changes in the paradigm of conventional marketing. Internet changing the way organizations to design, processing, manufacture, market, and deliver the product. Wider scope of competition also requires integration and coordination between the departments of information, marketing, customer service and other departments. (Chandra, Greorius., Fandy Tjiptono. 2012). At present, the world economy, especially developing countries such as Indonesia, are moving towards a digital economy. Technological developments into the first drive these changes. The world organization OECD (Organization for Economic Cooperation and Development) said that digital innovation is claimed to bring countries closer to sustainable prosperity (Kurniawan, 2017).

The survey results Indonesian Internet Service Provider Association (APJII) internet penetration in Indonesia throughout 2017. Figures internet penetration has increased over the previous year, an increase of approximately 54.68 percent or touch the figure of 143.26 million users through a variety of devices (APJII, 2018) It is an opportunity and an advantage in marketing the processed fishery products. The use of social media right and true will to minimize time and earn more profits. Theresia Pradiani (2017) describe an increase in orders from consumers by sales using social media. However, the use of social media still need to be developed to make innovations in promoting cottage industry results to be more interesting. Thus, through this research is expected to provide an overview of the development of marketing strategies for businesses of processed fishery products so that it can continue to compete in the future.

II. RESEARCH METHODS

This research was conducted for 3 months, from April to July 2019 in the city of Makassar. In this research using descriptive analysis will present a general overview of processed fishery products marketing of micro small and medium enterprises (SMEs) as a whole by focusing on marketing by using interactive media. And to determine consumer response to marketing acceptance of processed fishery products used questionnaire (via google forms). Samples have 8 UMKM with criteria located in the city of Makassar, has been operating less than 5 years and Owner actively using social media at least 2 which include YouTube, Facebook, Whatsapp, Instagram, Line & Twitter.

III. III. RESULTS & DISCUSSION

A. Product Marketing Micro Small Medium Processed Fishery Products in Makassar

1. Product and price

Every small and medium micro enterprises processed fishery products in Makassar has many product variants. Among them there are products that must be processed again for consumption and there are direct consumption. There are different variants of foods and beverages such as fish balls, nuggets fish, "otak-otak", bull without thorns, seaweed crackers, crackers squid, fruit syrup seaweed and others. Here are details of the main products and at what price.

Table 1. Types of products and prices for micro and small and medium enterprises processed by fishery products

Group	Main Product	UMKM	(g)	Price(Rp)
Food	Abon Tuna	J1	250	25.000
	Abon Gabus	J2	100	35.000
	Abon Tiara	J3	130	25.000
	"Otak-otak"	J4	900	120.000
	Otak-otak desniel	J5	250	500.000
Snacks	Squid crackers	J6	80	15.000
	Seaweed crackers	J7	300	35.000
Drink	passion fruit syrup seaweed	J8	500	35.000

Source: Primary Data, 2019

2. Social Media

Social media pointed out that in January this year 2017 Indonesia ranked third as the world's largest social media users. Social media users in Indonesia reached 27 million users and increased as much as 34%. It is evident that Internet users in Indonesia use sosial media means to obtain the necessary information. WeAreSocial.net & Hootsuite In 2017, the development of Internet usage in Indonesia is very rapid, which grew 51% within one year. With a growth rate that far exceeds the growth rate of Internet usage in the world, namely 10%, Indonesia ranks second biggest internet users universal. The percentage of Internet users who use each platform (based survey) is as follows: Youtube: 88%, Whatsapp: 83%, Facebook: 81%, 80% of Instagram

With the information technology network connected to the global Internet provide opportunities in marketing products or services. Internet and networking features interesting social media applications is one of the promotional tools are better and cheaper, especially in running a business or businesses. In addition to using a mobile phone, some SMEs which are already used more than two social media.

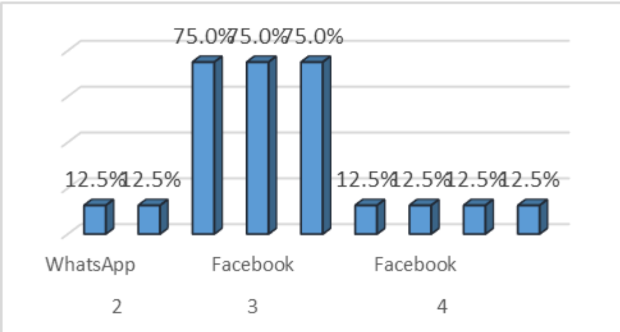

Fig 1. Percentage usage of social media in small and medium micro enterprises processed fishery products in Makassar

The results showed that each manager of SMEs do not use all the social media (6) in promotional activities. Group 3 Media are the most widely used (75%) that is WhatsApp, Facebook and Instagram. Group 2 media (12.5%) only uses WhatsApp and Facebook and group 4 media (12.5%) using WhatsApp, Facebook, Instagram and Line. Here the percentage of active social media use of micro and small and medium enterprises in the city of Makassar in promotional activities of processed fishery products

B. Percentage increase in sales

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The sales volume of the sales expressed in number of sales amount of physical force or the amount of money that must be achieved. In a company marketing objective is to increase the volume of profitable sales to generate revenue within the meaning optimally and increase profits. The sales volume is a measure that indicates the number or size of the amount of goods or services sold. The following graph average sales before and after the use of social media on SMEs processed fishery in Makassar.

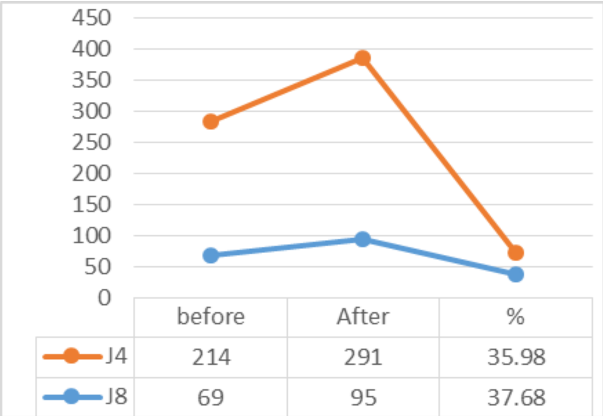

Fig 2. Percentage increase in sales in J4 and J8 SMEs.

The results showed an increase only in two SMEs. Of the average sales before and after the use of social media use social media there was an increase of Sales. At J4 and J8 SMEs increased by 37.68% and 35.98%. J4 on SMEs SMEs and MSMEs using three media J8 using four media.

C. Response and consumer acceptance

1. The use of social media on consumer

One key to success for all businesses is to get to know its customers more closely. Social media makes it easier recognition process than before. Basically, social media has changed the way consumers interact and how companies market their products. The presence of social media as a channel of communication can help process transactions quickly. Here's an overview of social media are used by consumers in buying processed fishery products in Makassar

Basically, social media has changed the way consumers interact and how companies market their products. The presence of social media as a channel of communication can help process transactions quickly. Here's an overview of social media are used by consumers in buying processed fishery products in the city of Makassar.

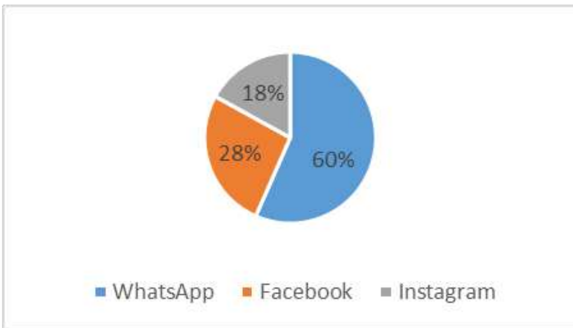

Fig 3.Percentage of social media use in consumer products processed fishery

Research, social media are the most widely used 60% is whatsapp, a social media interaction which most consumers utilize to communicate in order to get a quick response. However some consumers find privacy in buying the product and feel simply by using social media (Facebook and Instagram) as a promotion manager in the transaction. the second largest is Facebook (28%) and the last is Instagram (18%).

2. Response and consumer acceptance of the purchase processed fishery products.

Sumarwan also promoted (2014:377) consumer purchasing decisions are decisions that include consumer decisions about what to buy, whether to buy or not, when to buy, where to buy and how to pay for it. It should be considered before making a purchase decision is the desire that has been rounded to buy the product. And Zanjabila (2017) proved that social media marketing significantly influence purchasing decisions.

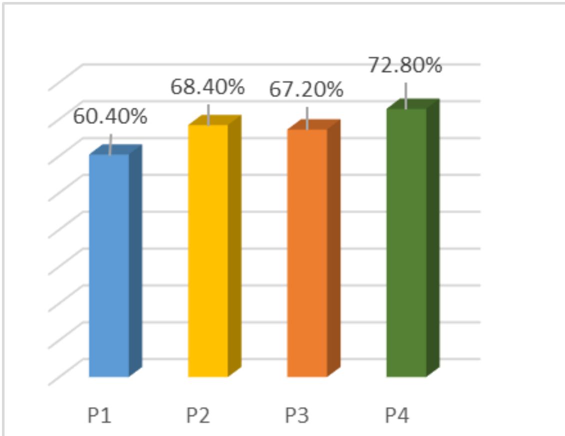

Fig 3. Percentage of reasons consumers buy products Fishery

The diagram shows that the main reason for the Promotion of 72.80% while among sellers use social media, has good reviews and is promoted by the account reliable. 68.40% choose the place and 67.20% and 60.40% product price for good taste, standardization of products, form an attractive logo and brand famous. In (Erawati, 2015) states that the promotion influential on purchase decisions in accordance with the opinion of Alma (2013: 181) which is the main purpose of the campaign is to inform, attract, and then influence the increase in sales. A promotional activity if done properly can affect consumers about where and how consumers spend their opinions.

IV. CONCLUSION

The marketing activities of micro and small and medium enterprises in fishery products processed in Makassar using interactive media show that not all social media are used in promotional activities. Social media is Whatsapp and Facebook Instagram 33.3% and 29.20% of the most widely used, Line 4. 20% and 0% Youtube and Twitter. The results indicate an increased percentage of sales only on 2 SMEs. The percentage of consumers prefer buying fishery products in a row is a promotion, place, price and product.

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Performance of Compost from Waterthyme (*Hydrilla verticillata*) in Bok Choy Growth (*Brassica chinensis*)

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***Abstract*— *Waterthyme (Hydrilla verticillata) has a rapid growth rate in freshwater, especially rivers and irrigation channels, hence it becomes a disturbing factor and needs periodic cleaning.Dry H. verticillata contains nitrogen of 3.29%, phosphorus of 0.52%, and potassium of 6.34%.The utilization of H. verticillata as compost has great potential, but there has not been found intensive research on the subject.This study aimed to examine the ability of H. verticillata as an alternative raw material for compost fertilizer in the bok choygrowth.This study used a Randomized Complete Block design (RCB) with a single factor by analyzing the data using ANOVA and continued with further tests using Least Significant Different (LSD).P0 (control) was 100% soil, P1100% cow manure, P2 100% waterthyme, and P3 50% waterthyme + 50% cow manure.Bok Choy have optimal growth (88 g plant mass, 5g root mass) in compost applications with a composition of 100% waterthyme (H. verticillata) with a moisture content of 21.24%, pH 8.50, C 9.09%, C/N ratio 4.07, N 2.25%, P 1.38%, K 1.38%, and organic matter 15.67%.*

***Keywords*— Hydrilla verticillata, compost, bok choy, alternative material.**

I. INTRODUCTION

Bok choy vegetables are popular among Indonesian, consumed by all people from the lower to the upper class. Bok choy can grow well both in the lowlands and highlands. It has high economic value after cabbage, cauliflower, and broccoli. Bok choy is estimated to come from China and has been cultivated since 2500 years ago, then spread widely to the Philippines and Taiwan[1].

Its growth is affected by the type of fertilizer used. Farmers usually use chemical fertilizers to get maximum growth and yield but ignore the side effects[2]. Therefore, to replace this habit, pne alternative solution is by utilizing organic fertilizer from *Hydrilla verticillata* water thyme.

The Riam Kanan Reservoir is utilized by the government and the local community for a water reservoir, power plants, aquaculture, agriculture, mining, transportation, and others.The utilization of the Riam river might brings negative impact on water quality [2].The high pollutant load discharged by the community causes a surge in thegrowthof*H. verticillata*. Nitrogen, Phosphate, pH, metals, and sunlight can accelerate the growth of waterthyme [2].*H.verticillata* can grow at high densities (more than 10 tons of dry weight per hectare - 1 year - 1, or more); and can block and damage natural wetlands[3].

H.verticillata has a moisture content of 90.42% (wb) [4] with the organic carbon content of 14.47% (wb) [5], and the nitrogen content of 45% (wb), so it has the potential to be used as compost fertilizer.

Compost is one of the organic fertilizers used in agriculture to reduce the application of inorganic fertilizers.Compost can improve the physical properties and microbiology of the soil [2].Composting is the process of converting biodegradable residues into hygienic and stable products. Compost from *H. verticillate* contaminated with heavy metals can be applied to plants. The remains pollutants such as heavy metal that is harmful to the environment and other elements will be transformed into less harmful substance[6].

The utilization of organic materials is currently considered the best effort in improving the productivity of marginal soils, including acid soils.Compost contains nutrients such as nitrogen and phosphate in the form of argon, protein, and humus complexes, whichare very difficult to absorb by plants [7].Some ways that have been done to improve nutrient status in compost are such as adding natural ingredients of bone flour, dried blood flour, banana bark, and biofertilizer [2].Em4 was discovered by Higa and James in 1997.Fermentation of organic substance by effective microorganisms (EM) produces lactic acid and amino acids, which can be absorbed directly by plants as antibiotics that can suppress the growth of harmful microorganisms.

II. RESEARCH METHOD

The materials used in this study were *Hydrilla verticillata*, cow manure, tub soil, palm sugar, EM4 activator liquid, and Bok choy seeds (*Brassica oleracea*). The tools used were large plastic bags (trash bag), tarps, weight balance, stationery, plastic clips, gloves, scissors, stirrers, buckets, measuring cups, label papers, and pH meter.

The research design used a Randomized Complete Block design (RCB) consisting of 6 treatments. Treatments are presented in Table 1.BasedonTable 1, eachtreatmentconsistedofthreereplicationshencethere were 18 treatment units. Data from observations on various treatments were analyzed using theANOVA test with the help of SPSS 19 with a significance level (α) <0.05.If there is a difference (significant effect), then it will be followed by the Least Significant Difference Test (LSD), but if there is no difference (no significant effect), further analysis is not needed.

Table 1. Formulationofcompostfertilizertreatment

Treatment	Concentration Comparison
Po	100% soil
P1	100% cow manure
P2	100% *H. verticillata*
P3	50% *H. verticillata* + 50% cow manure

Research Implementation

Composting processing

Compost production was based on a predetermined concentration.Rice bran and Em4 solution as a starter were added to ingredients that have been mixed with certain concentrations before and then fermented for 14 days.During the fermentation, compost was reversed.To maintain the temperature in the range of 40-50ºC, the fermenter should always be opened and reversed, after the temperature drops, the fermenter is closed again.

Compost that has been fermented for 14 days and mature compost has the criteria of being odorless anddark in color [8]. The compost was then tested for Nitrogen (N), Phosphorus (P), and Potassium (K) content.The mature compost was then applied as a growing medium for Bok choy plants.

Soil Processing

The soils used came from the Practice Land. The soil was then separated from the attach leaf trash or dirt

Seed Nursery

The nursery media consisted of a mixture of soil and cow manure with a ratio of 2:1.The seeds were spread evenly and then covered with soil thinly and watered.At the age of ±14 days, the seeds were transferred into the polybag.

Preparation of Planting Medium

Preparation of planting media using three replications, five treatments, and one control. Each combination with a different type of treatment was put into a 5 kg polybag, size 35 cm x 35 cm, with a certain concentration of cow manure, waterthyme compost, and soil with a ratio of 1:2:1.

Planting and Maintenance

The seeds of cauliflower and lettuce were grown for ± 14 days before being transferred to a polybag that had been filled with cow manure, compost, and soil that has been left for one night. Polybags containing soil media, cow manure, and compost were given holes with the same depth, and each hole was filled with bok choy seeds and watered.Maintenance was done twice a day at morning and evening. Maintenance includes watering and cleaning weeds.

Data Collection

Data collection was done once a week. The changes observed were as follows:

Plant Height

Plant height was measured from the surface of the planting medium to the growth point, measured using a ruler.

Leaf Counting

Leaves counting was carried out during the growth period and calculated once a week during the planting period. The calculated leaves were those that have opened perfectly, consisting of stems and leaves.

Leaf Width

Leaf width was measured during the growth period and was carried out once a week during the planting period by using a ruler from the surface of the planting medium tothegrowingpoint.

Weight of plant canopy and fibrous roots

Measurements were conducted after the harvest period. The plant canopy and fibrous roots were weighed using a digital analytical balance.

III. RESULTS AND DISCUSSIONS

Chemical Composition of Compost Fertilizer

The observation showed that waterthyme compost (*Hydrilla verticillata*) contained Nitrogen (N), Phosphorus (P), and Potassium (K).The compos tanalysis based on several treatments I spresented in Table2.

Table. 2. Analysis of compost fertilizers based on SNI 2004

No	Examination	Unit	Average Treatment				SNI 2004
			Po	P1	P2	P3	
1	N	%	0.29	2.23	2.25	0.99	0.4
2	P	%	0.02	0.39	0.56	0.53	0.1
3	K	%	0.04	0.63	1.38	0.32	0.2
4	pH		7.46	8.15	8.5	7.95	6.80-7.49

Basedon Table2, it is identified that several parameters are in accordance with SNI 2004 quality standards.These parameters are used to determine the quality of *H.verticillata* compost.Compost application can improve soil physical properties and microbiology[8].Nutrient content in compost such as nitrogen and phosphate is in the form of complex compounds of argon, protein, and humic, which are very difficult to absorb by plants[7].Nitrogen (N) from NPK is required by plants for the growth of shoots, stems, and leaves.Phosphorus (P) functions in stimulating the growth of roots, fruits, seeds, while Potassium (K) to increase plant resistance to pests and diseases[9]. A good pH range for plants based on SNI-2004 is between 6.80-7.49, while based on the Department of Agriculture 2011 is between 4-9. In that range, plants can grow optimally.

Number of the Leaf

Leaves are the place where photosynthesis takes place, which is to convert sunlight energy into a food-producing source used in the growth, development, and production of harvesting materials[10].

Statistical analysis showed that all treatments have no significant effect on the number of leaves (α <0.05) with a significance value on the First Week (W1) of 0.926, W2 of 0.891, W3 of 0.968, and M4 of 0.631.It is presumed that the concentration of compost fertilizer did not affect the number of leaf plants based on the ANOVA test, but it affected the number of nutrients contained in it.[11].

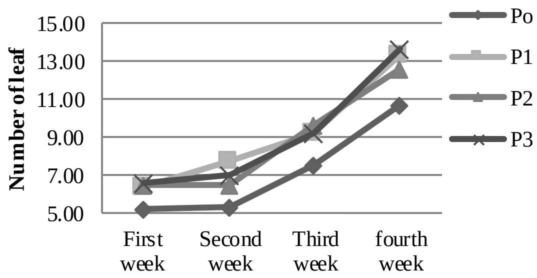

Fig.1: Number of the leaf.

The RiamKanan Reservoir is utilized by the government and the local community for a water reservoir, power plants, aquaculture, agriculture, mining, transportation, and others.The utilization of the Riam river might brings negative impact on water quality [2].The high pollutant load discharged by the community causes a surge in thegrowthof*H.verticillata*. Nitrogen, Phosphate, pH, metals, and sunlight can accelerate the growth of waterthyme [2].*H.verticillata* can grow at high densities (more than 10 tons of dry weight per hectare - 1 year - 1, or more); and can block and damage natural wetlands[3].

The highest P2 valuewas 14.08 in thefourthweek (W4), andthelowestvalue Po was 10.67 (Figure 1). 100% of *H. Verticillata* compost produces the highest value compared to100% soil(Po).It is possible because P2 has a higher N content (2.25%) than the research conducted by Marwan et al. [13] (1.37%).The content of N in Po was only 0.29%. This is what causes the difference in the number of leaves in Bok choy.

Diameter of the Leaf

Leaf diameter is a determinant in the absorption of sunlight so that the photosynthetic rate is determined based on leaf diameter.The wider the diameter of the leaves, the more sunlight will be absorbed so that the rate of photosynthesis is also higher.On the contrary, the smaller the diameter, the less amount of sunlight absorbed in photosynthesis [10].

ANOVA statistical analysis showed that all treatments have a significant effect on leaf diameter (α <0.05) with a significance value on the First Week (W1) of 0.017, W2 of 0.014, W3 of 0.022, and W4 of 0.017.It may be caused by a varied amount of N element uptake in each treatment [12].

The BNT further test (p-value <0.05) showed that the leaf diameter with the treatment of 100% soil concentration was 5.28.This treatment was significantly different from the treatment of 100% waterthyme compost, namely 7.26.Increased in diameter indicates that the sunlight absorption rate is increasing so that the photosynthesis process continues rapidly [10].

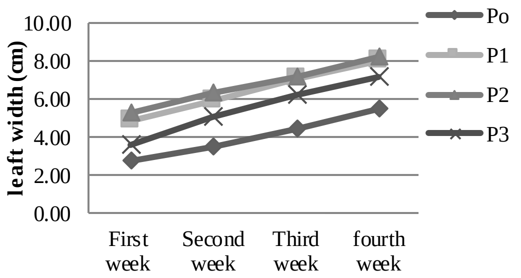

Fig.2. Leafdiameterofbok choy.

Figure 2 shows an increase in the diameter of Bok choy leaves from the first week (W1) to the seventh week (W7).It is estimated that Bok choy has adapted since the planting period.The analysis showed that N content in *H.verticillata* waterthyme compost was 1.74%.Other researchers found that the N level in *H.verticillata* waterthyme was 1.37% [13], while in cow manure was 0.41% [6].

The highest value in P2 (8.21 cm) was obtained in the fourth week (W4), and the lowest value of Po was 5.52 cm.P2 with the application of 100% *H. verticillata* waterthyme compost has the highest value compared to Po 100% soil.It is in line with the content of N in P2 of 2.25% and Po of 0.29%.N element will affect leaf diameter, stem growth, number of leaves, roots, and others [14]. The variation in the average leaf diameter is due to the comparison between different treatments and the number of N elements in compost.

Weight of the Plant

Plants that absorb optimal macro and micronutrients will promote optimal growth.In addition, the high availability of nutrients will increase the growth of vegetative organs, so that plant growth becomes optimal, whereas low nutrients will result in non-optimal growth[5].

ANOVA statistical analysis showed that all treatments had no significant effect on plant fresh weight (α <0.05) with a significant value of 0.100.It is possibly due to the comparison of the concentration between treatments based on nutrients found in the growing media.Availability of N elements will affect plant weights [14].

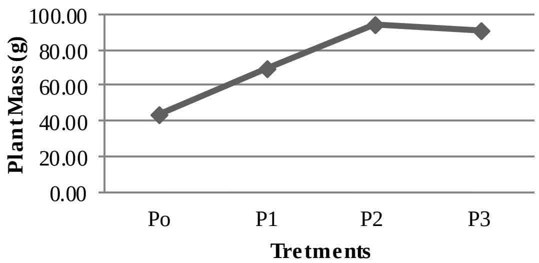

Fig.3: Weight of bokchoy.

Figure 3 shows that Po has the lowest weight value of 25.67 grams, while the highest value is in P2 of 93.75 grams.Po with 100% soil concentration produces the lowest value. This is presumably due to the availability of balanced or unbalanced macro and micronutrients, and NPK content.Nutrients availability is very needed in plant growth.NPK nutrients will increase Bok choy weight, and it indicates optimal growth [15].

Weight of the Roots

The fresh weight of roots determines plant growth based on the amount of nutrient uptake and will affect the development of plants based on the photosynthetic on leaves [16]. ANOVA statistical analysis showed that all treatments did not significantly affect the fresh weight of plant roots (α <0.05) with a significant value of 0.255.It is likely due to the identical amount of macro, micro, and water uptake, so that root growth becomes uniform.In addition, the treatment concentration did not affect the amount of K nutrient prepared in the media [1].

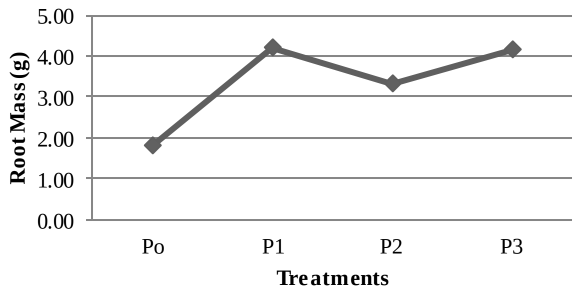

Fig.4: Weight of bokchoy's roots.

Figure 4 shows that the application of 25% cow manure produces a root weight of 4.20 grams.It is higher compared to the application of 100% soil, which is only 1.82 gram. Variations in plant weights are caused by variations in the type of planting media.The lowest value is considered to occur because of the nature of the soil, which cannot bind water [1].The high value is caused by the availability of nutrients and sufficient water so that the growth and rooting weight are good.Availability of NPK nutrients will increase the weight of Bok choyroots [15].

IV. CONCLUSION

The NPK content in P1, P2, and P3, is in accordance with SNI 2004 except for Po. The best treatment is obtained from the application of 100% compost from *H. verticillata* waterthyme. The parameters produced are higher than the application of cow manure or soil.

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Effect of Carbon Sources and Their Various Concentrations for Optimize in *In vitro* Micro propagation of Banana *Musa* (spp.) Basrai

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***Abstract*— *Banana fruit is the second vital food crop. Although the significant business crop value, the major production restrain is the accessibility of reliable and harmless material for planting. For in vitro growth of excited tissues, sources of carbon have been considered as one of the most significant factor. Types of sugars and concentrations are identified to affect the in vitro protocol success. Crop micro propagation is also facing the challenges which require to be addressed in order to improvement in its production. In this study, influence of three carbon sources such as (dextrose, sucrose and sorbitol) used to increase Murashige and Skoog medium at four applications control, 15, 30, 45 and 60g/l respectively. This study is accomplished at the laboratory of tissue culture of Plant Pathology Section, Sindh Agricutlure Research Insitute, Tandojam, Pakistan in 2017. Randomized Block Design (RBD) method with 3 replications was used for each treatment. Results indicated that sucrose give maximum result as compared to dextrose and sorbitol. Though, significant result was found in sucrose 30g/l as compared to dextrose and sorbitol concentrations.*

***Keywords*— Carbon sources, Concentrations, Media, Micro propagation, Banana Musa (spp.) Basrai.**

I. INTRODUCTION

Banana fruit crop is a significant all over the world because it gives an important income source in local and international trade (Frison et al., 1997). Banana is the general name of genus *Musa* (spp). And it has a great nutritional and profitable value in world. It is great supply of carbohydrates and proteins and supply of vitamins (Vit A, C, E, K, B1, B2, B3, B6 and B9) and minerals such as, calcium, magnesium, sodium, potassium, besides with trace amounts of carotenoids, iron and zinc (KTL, 2007). It also has been found useful against breast and colorectal cancer (Zhang, 2009; Deneo-Pellegrini et al., 1996). Banana ranked as the 2nd most vital fruit crop and it accounts approximately 22% of fresh fruit (Pua EC, 2007).

During the early nineties, in the banana fields of Sindh, Pakistan, a mysterious disease spread which occupied more than 60% area, and due to which 90% production declined. Later, the disease was recognized as banana bunchy top disease produced by banana bunchy top virus (BBTV). Virus vector is *Pentalonia nigonervosa* which contaminated plants and provide typical bunchy top emergence, which is owing to the failure of stand stiff and leaves flexibility. Due to the production heavy loss, farmers changed to other crops like cotton and sugarcane but from these crops they were not able to get high income, as compared to get from banana. So, to get the planting material which is disease free for re-cultivation of fields, all efforts were diverted, which were damaged by the bunchy top virus (BBTV) of banana. One way was to introduce the healthy germplasm from out of the country, but importing of germplasm could not adjust to the local soil or the environment. Another approach was the cleaning of existing germplasm and grows at much high rate, so that the farmer's requirements may be fulfilled (Aish Muhammad et al., 2004).

Technology of TC provides mass propagation and clean material for planting. Production of banana under *in vitro* techniques is a greater technology over conventional method (Sucker-propagated) with respect to best yield, consistency, disease-free material for planting and true to type plants. Mass reproduction of TC (tissue culture) plants could be prepared in a short time. They are affordable to transport than conventional suckers and the coupling with virus indexing allows for protected movement, trade and protection of germplasm. In addition, bananas produced using the tissue culture techniques are stated to be more energetic, higher yielding and make better quality fruits than those gives by conventional way (Hwan, 1976).

The crop is vegetative propagated by the help of different types of sucker's. However, this is time consuming method and gives the inadequate number of planting material. Methods of plant tissue culture and plant cell have helped in fast banana varieties multiplication and employing floral apices or tips of shoot (Cronuer and Krikorian 1986). For rapid propagation of clone meristem culture offers an efficient method production of materials free from virus and germplasm preservation in plants (Hwang Shinchuan et al., 2000; Helliot et al., 2002). Banana through the methods of *in vitro* propagation has been stated by a number of workers by different techniques and sources of explants (Jalil et al., 2003; Wong et al., 2006; Shirani et al., 2007). Since the germination frequency of seed is very low, embryo culture is favored for classical breeding experiments. Shoot tip culture major applications are mass clonal propagation and germplasm conservation. In mass clonal propagation existing shoot tips are stimulated to rapidly multiply while as in germplasm conservation multiplication rate is slowed down (Vuylsteke, 1993).

Mass propagation of preferred genotypes, some clonal variation methods, genetic engineering and other biotechnological approaches can be used for the development of banana crop which is established on consistent protocols of plant renewal. TC also plays a significant function in germplasm protection, distribution, and safe interchange of internal material for planting and newly chosen quick propagation of hybrid cultivars. A number of scientists have stated the rejuvenation of Musa spp. through micro propagation (Cronauer & Krikorian, 1986; Jarret, 1986; Diniz et al., 1999; Nauyen and Kozai, 2001; Krishnamoorthy et al., 2001; Kagera et al., 2004; Muhammad et al., 2004; Roels et al., 2005; Madhulatha et al., 2004). Under *in vitro* condition shoots growth and multiplication are affected by a lot of factors, one of which factor is the adding of source of carbon to the medium (Ill wan and Korban, 1998). Carbon sources gives as osmotic and energy agents to support the growth of the plant tissues (Lipavska and Konradova, 2004). Under *in vtro* conditions, on the growth of plants there are different ideas on the useful result of different carbon sources (glucose, fructose and sucrose). In the tissue culture, 2 to 5% sucrose is the mainly accepted carbohydrate used (Bridgen, 1994). *Linum usitatissium*, at 4% concentrations showed that medium supplemented with monosaccharide's glucose or fructose (Cunha and Fernandes-Ferreira, 1999). Though sucrose has been the carbohydrate in the vast majority of work on i*n vitro* shoot induction and shoots development in woody species, it is not always the most efficient carbon source for these purposes. Thus, the carbohydrate requirements have yet to be defined and optimized in micro propagation system (Cuenca & Vieitez, 2000). Excised tissues explants demand a constant energy supply to support the growth, allied physiological actions, multiplication and differentiation, (Gurel and Gulsen, 1998).

In common, the majority of the studies concerning tissue culture are performed with sucrose as the only source of carbon across the plasma membrane due to its efficient uptake. Under *in vitro* plant growth conditions, glucose also has stated the diverse effects. This study suggests a rapid banana *Musa* (spp.) basrai multiplication protocol using different concentrations of sucrose medium, dextrose and sorbitol. These study findings might be useful for micro propagation establishment of banana methods to produce rapid clones under *in vitro* growth condition.

II. MATERIALS AND METHODS

Experiment was assessed at the TC laboratory of Plant Pathology Section, Sindh Agriculture Research Insitute, Tandojam, Pakistan. Randomized Block Design (RBD) was used for this study to investigate the carbon sources, their concentrations for evaluate and optimize for banana basrai *Musa* (spp.) protocol under *in vitro* micro propagation condition.

Suckers were collected from Thatta district. The extra tissues were detached by trimming away the leaf basis corm tissues and outer leaf sheaths until a 5 to 7 cm cube enclosing the shoot apex obtained. The cubes of tissues were then washed for about 1 hour under tap water running. Under laminar air flow cabinet, the cubes were then disinfected for thirty min by soaking in viable bleach (5.25 percent NaOCl) and diluted to thirty percent (v/v) and with 2 drops of Tween 20 per 100ml and followed by

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rinsing with distilled water for three times in autoclave (Ganapathi et al., 1992).

Explants were then placed on sterile Petri dishes till the explants size reached about 1.5 to 2 cm of length, all brown tissues from the surface and outer leaves were detached and then explants cultured in the propagation media (Ganapathi et al., 1992). Consisted of full MS basal Salts effectiveness and full MS vitamins mixture with five milligram per litter BAP, 0.2 milligram per liter NAA, seven gram per litter agar and additional Phosphate (KH2Po4 17 g/l), the pH was used to 5.7 ± 0.1 with NoaH and HCL prior to adding agar (Murashige & Skoog, 1962). By autoclaving at 121°C and under a pressure of 15 psi, all the media and dishes were sterilized for 20 min (Ganapathi et al., 1992). In pure ethanol, forceps and the dissecting blades were dipped and exposed to gas flame and with help of 70% ethanol, laminar air-flow chamber was cleaned by spraying and wiping. Before 15 min of use laminar air-flow was switched on. During the night, ultra violet lamp was switched on in culture room.

Depending on experiment objective, either in dark or light chamber, the culture was maintained less than 16 hours light exposure of 1000 lux. The temperature of culture room was maintained at 25 ± 2 degree Celsius using white cool fluorescent lamps. We used basrai explants for the propagation of culture. Different concentrations of Sucrose, dextrose and sorbitol sugar were added to media i.e. 0 (control), 15, 30, 45 and 60g/l.

III. RESULTS AND DISCUSSION

In this study, influence of sucrose, dextrose and sorbitol sugars as carbon source and their varied concentrations were evaluate after six weeks of culture on the basal medium of MS.

3.1. Effect of sucrose sugar as carbon source and their various concentrations:

Results stated that 30g/l sucrose give maximum growth in all parameters respectively. However, 30gram per litter value of sucrose was considerably higher than the other values followed by 15g/l, control recorded low value (Table 1 and figure 1). 30g/l sucrose produces best results in all parameters; number of shoots (per explants), shoot length (cm), number of roots (per explants) and root length (cm). Our findings are conformity with other experts (Helliot et al., 2002) who stated that concentrations of sucrose at 30gram per litter gave significantly maximum shoots mean number in phase of Patchouli banana multiplication. (Jalil et al., 2003) who reported that the concentrations of sucrose (30 and 40g/l) advantage for clonal propagation of *Musa* (spp.) resulting in maximum growth parameters and number of suckers evaluated. (Noreldaim Hussein, 2012) stated that sucrose 3.0% was mainly optimum as expressed by better growth vigor at both systems of root and shoots tip culture of banana. (Buah et al., 2000) reported that sucrose at 30 g/l demonstrated the highest number of leaf RGR in sago. (Ekhlas Morfeine, 2014) reported in banana (*Musa spp*. cv Shima) the highest shoots number was acquire by 30gram of sucrose/l. This value was considerably greater than other values but 15gram of sucrose/l and 45gram of sucrose/l were not significant. (Madhulatha et al., 2006; Hussein, 2012) stated that sucrose has been the most usually used source of carbon for a great number of species of plants containing banana. However, (Li and Wolyn 1997) studied that addition of sucrose in the media stimulated both shoots as well as growth of root. These authors noted that a specific sources of carbon concentrations that carried highest multiplication. They emphasized the need of using different concentrations of sugar for improving the achievement of micro propagation.

3.2. Effect of dextrose sugar as carbon source and their various concentrations:

30g/l dextrose gave best results than other values followed by 15g/l; low value was again recorded by control (Table 2 and figure 2). Our findings are agree with (Ekhlas, 2014) who stated that both 45 gram per liter and 60 gram per liter of glucose and dextrose level energizing multiplication and were different source of carbon energy for propagation of *Musa* (spp.). **(**El-mana, 1999) also found the helpful reactions of dextrose or glucose as source of sole carbon energy in the cultures of strawberry.

3.2. Effect of sorbitol sugar as carbon source and their various concentrations:

Since highest growth was recorded on 45g/l of sorbitol sugar concentration as carbon source followed by 30g/l. Control recorded 0 values in all parameters (Table 3 and figure 3**).** Carbohydrates like sorbitol, glucose, galactose and maltose) may show greater to sucrose and can also be used in particular situation. Quantitatively, pervious results declare the decrease of the optimum sucrose to 3.0% level of concentration (Novak et al., 1986; Mateille and Foncelle, 1988). Sugar help as a major transfer of metabolites and is responsible for the nutrient uptake through the osmotic processes from the medium (Lalonde et al., 1999**).** Vasil et al., 1982 stated that tissue culture method involves the establishment of different tissue or cell under an appropriate culture condition, following regeneration of plants and *in vitro* proliferation of cell. Collapse in most tissues or plant cell to get complete plants under *in vitro* circumstances is due to lack of appropriate method and inadequate information about nutrient media and other physical and chemical circumstances, which are necessary for proper development of cells, tissues and organs (Johri, 1982). The difficulty of rising diseases can be managed by propagating banana propagation through TC (Ali et al., 2011). Sugar supplies in any of the procedure of TC, in conditions of quantity, kind and differ in species, variety and plant growth stage (Singh and Shymal, 2001; Chun et al., 2008; Gurel and Gulsen, 1998). (Buah et al., 2000) recommended that fructose is not appropriate for in vitro culture in several banana varieties. In 'Shima' variety of banana, glucose and sucrose were established to be evenly appropriate. Fructose, on the other hand, was found to give the poorest results for all studied parameters. The basic aspects of carbon consumption, cell metabolism and TC that was not understood previously (Romano et al., 1995).

Authors distinguished that a precise carbon sources concentrations that carried highest growth. They emphasized the need of using unusual concentrations of sugar for improving the achievement of micro propagation.

4. FIGURES AND TABLES

4.1. Figures

Fig.1: Effect of different concentrations of sucrose sugar on micro propagation of banana Musa (spp.) Basrai explants after 6 weeks of incubation.

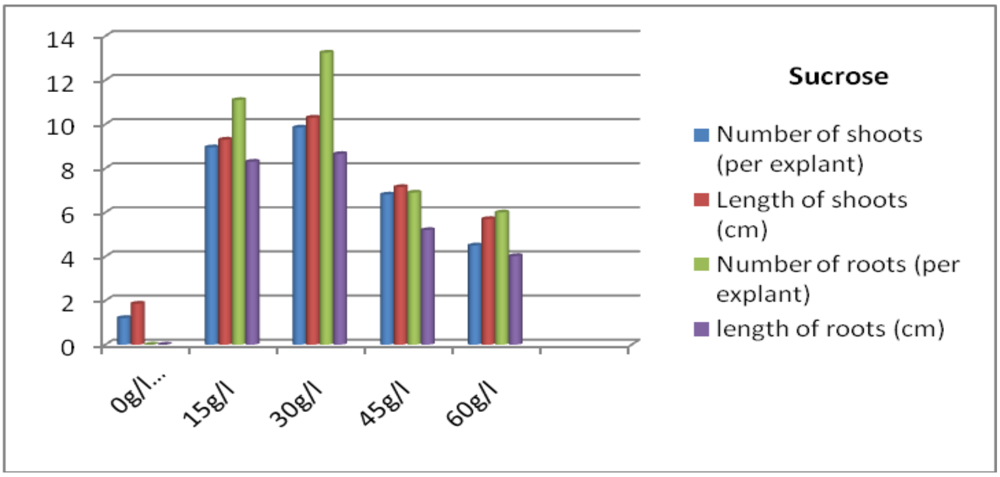


Fig.2: Effect of different concentrations of dextrose sugar on micro propagation of banana Musa (spp.) Basrai explants after 6 weeks incubation.

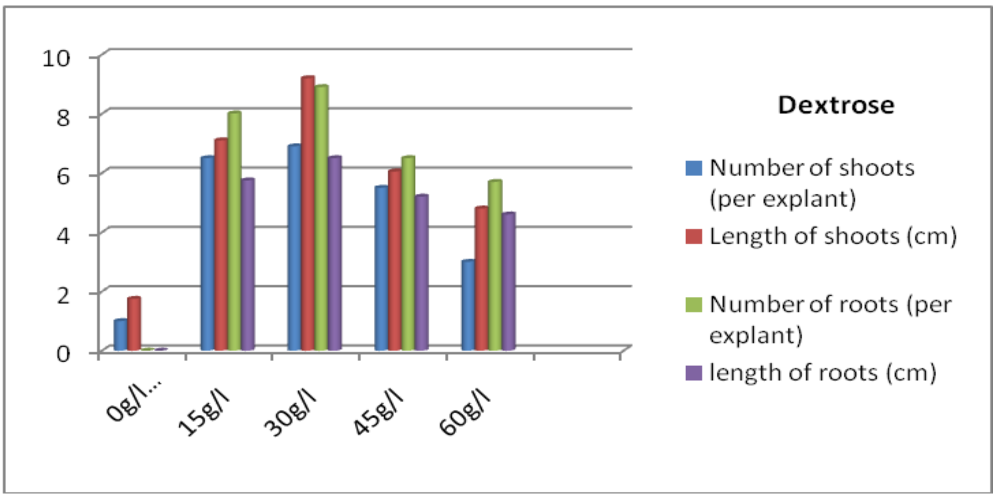
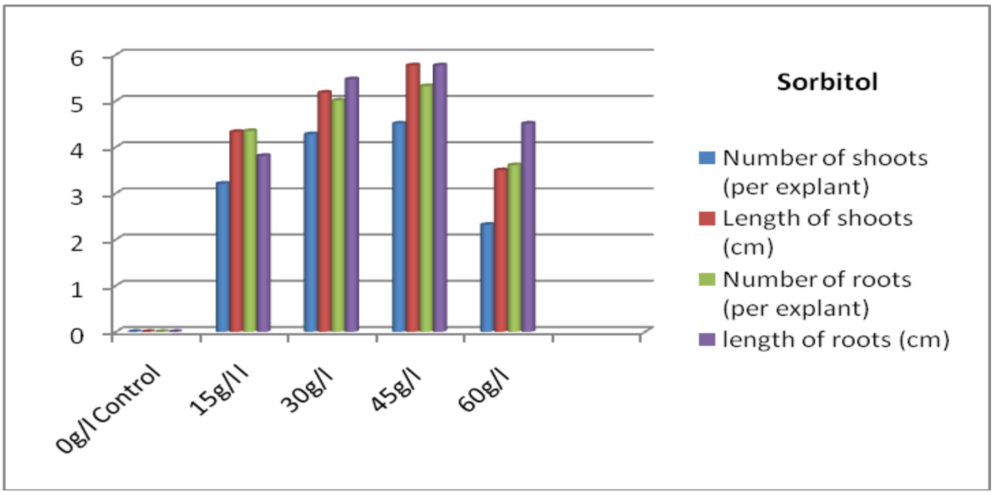


Fig.3: Effect of different concentrations of Sorbitol sugar on micro propagation of banana Musa (spp.) Basrai explants after 6 weeks incubation.



4.2. **Tables**

Table. 1: Influence of sucrose sugar concentrations on banana shoot explants growth under in vitro condition after 6 week of incubation.

Sucrose Concentration (g/l)	Number of shoots (per explants)	length of shoot (cm)	Number of roots (per explants)	Length of root (cm)
0	1.21 E	1.86 E	0.00 E	0.00 E
15	8.95 B	9.30 B	11.1 B	8.30 B
30	9.85 A	10.30 A	13.25 A	8.65 A
45	6.81 C	7.15 C	6.9 C	5.20 C
60	4.50 D	5.70 D	6.00 D	4.020 D
LSD	0.0608	0.0360	0.0346	0.0306
CV	0.1355	0.0801	0.0772	0.0681

Means within the same column followed by same letters are significantly different

Table. 2: Influence of dextrose sugar concentrations on banana shoot explants growth under in vitro condition after 6 week of incubation.

dextrose concentration (g/l)	Number of shoots (per explants)	length of shoot (cm)	Number of roots (per explants)	Length of root (cm)
0	1.00 E	1.75 E	0.00 E	0.00 E
15	6.50 B	7.10 B	8.01 B	5.75 B
30	6.90 A	9.20 A	8.90 A	6.50 A
45	5.50 C	6.05 C	6.50 C	5.20 C
60	3.00 D	4.80 D	5.70 D	4.60 D
LSD	0.0320	0.0253	0.0213	0.0207
CV	0.0714	0.0564	0.0474	0.0460

Means within the same column followed by same letters are significantly different

Table. 3: Influence of sorbitol sugar concentrations on banana shoot explants growth under in vitro condition after 6 week of incubation.

Sorbitol concentration (g/l)	**Number of shoots (per explants)**	**length of shoot (cm)**	**Number of roots (per explants)**	**Length of root (cm)**
0	0.00 E	0.00 E	0.00 E	0.00 E
15	3.21 C	4.33 C	4.35 C	3.81 D
30	4.28 B	5.18 B	5.01 B	5.47 B
45	4.51 A	5.77 A	5.32 A	5.77 A
60	2.32 D	3.50 D	3.61 D	4.51 C
LSD	8.944	0.0114	0.0126	0.0112
CV	0.0199	0.0253	0.282	0.0249

Means within the same column followed by same letters are significantly different

IV. CONCLUSION

We established suitable media with composition of different concentrations of sucrose, dextrose and sorbitol as a carbon source of banana basrai *Musa* (spp.) for micro propagation under *in vitro* circumstances. Demonstrated that higher growth vigor of sucrose 30g/l in all parameters as compared to dextrose, sorbitol and their variance concentrations. Sucrose 30g/l most optimum for banana tissue culture of *Musa* (spp.) basrai multiplication. Banana micro propagation through TC is consistent solution to the farmers that farmers facing. So, *in vitro* propagation techniques are efficient to overcome these challenges.

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Methionine Modulated Bioavailability of Inorganic Zinc ($ZnSO_4$. $7H_2O$) in Common Carp (*Cyprinus carpio* L.) Through Diets Containing Tricalcium Phosphate

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Abstract– *The present work has been conducted to study the efficacy of methionine for the intake of dietary inorganic Zinc ($ZnSO_4$. $7H_2O$) in the fingerlings of common carp (Cyprinus carpio L.). The experiment was performed in triplicate for which young ones of common carp of average 3.39±0.68g weight and 6.02±0.25 cm length were stocked in the indoor glass aquaria (60× 30 ×30cm) @11 fish/ aquarium. Five diets including control (D_1) and four experimental diets (D_2 to D_5) were formulated. In treatment diets D_2 and D_3 $ZnSO_4.7H_2O$ was added @88.4 and 176.8mg/kg, while in D_4 and D_5 $ZnSO_4.7H_2O$ was added @88.4 and 176.8mg/kg along with 1% DL Methionine to observe its role in uptake of zinc. Crude protein content in the experimental diets ranged between 36.68 - 39.14%, while zinc concentrations in diets (D_1 to D_5) were recorded 31.80, 57.40, 61.60, 56.60 and 62.80 mg kg^{-1}, respectively. Highest growth w.r.t. net weight gain was recorded (4.01g) and SGR (0.92%), feed conversion ratio (2.42) and protein efficiency ratio (1.08) was also recorded highest in fish fed with diet D_5. Moisture content (%) in fish flesh ranged between 77.20 – 78.90, protein 14.80 – 16.70, lipid 1.75 – 2.73, ash 1.82 – 2.61 and carbohydrate 1.13 – 1.92%, among the fish fed with diet D_1 to D_5. Zinc concentration was recorded significantly high in muscle (36.90 mg kg^{-1}), liver (60.40 mg kg^{-1}) and bone (109.56 mg kg^{-1}). The present study indicates that Zn uptake in different tissues has been significantly improved due to addition of methionine in the formulated diets for young ones of common carp.*

Keywords— Common carp, Cyprinus carpio, Methionine, Tricalcium phosphate, Zinc uptake.

I. INTRODUCTION

Minerals serve as an essential requirement for the variety of functions, as both intra and extra cellular components. Zinc is an essential micro mineral which is directly or indirectly involved in a wide variety of physiological processes including growth, development, reproduction and immune function (Watanabe *et al*., 1997). In fish, its deficiency leads to poor growth, high mortality, erosion of fins and skin, low content in bone (Takeuchi *et al*., 2002). Common carp (*Cyprinus carpio L.*) is an important fresh water carp, cultured across the world as food fish. Success of fish culture depends on rearing of quality seed, fed with nutritionally balanced diet and good management practices. For quality seed production with high survival rate, young

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ones must be fed with supplementary diets containing all essential nutrients in balanced quantity. Fish meal is always considered as one of the best protein sources containing all essential amino acids, hence are widely used in fish feed. Common carp requires high levels of dietary protein during early stage of life cycle, for this addition of supplementary protein of animal origin in the formulated diets is a common practice. Rendered (recycled) by-products from animal waste serve as cheap source of quality protein (El Seyed 1998), but their application is limited due to low digestibly and restricted bioavailability of nutrients as it tends to bind with organic compounds and forms insoluble complexes, due to presence of certain limiting factors (Cho *et al*., 1982; Gill, 2000). Diets containing animal protein especially fish meal as protein source contains Tricalcium phosphate (TCP), which acts as inhibitory factor for Zn uptake in fish (Davis *et al*., 1993).

Organic compounds or chelated forms are important source of trace minerals, because they protect trace elements from forming insoluble complexes (such as phytate and TCP) in the digestive tract and facilitate transport across the intestinal mucosa (Ashmead1993). During production process of fish meal, calcareous compound present in fish converts into calcium phosphates and their derivatives (Butler and Gross, 2017), even though fish scales also form a variety of calcium phosphate salts (Belouafa *et al*., 2017). Methionine is such sulfur containing amino acids essentially required in fish diets, especially those containing high levels of plant protein source (Mai *et al*., 2006). Being a wide cultivable fish species in India as well as in the world, common carp is still not well studied fish species with respect to response against the inhibitory effect of TCP, more over to find out the possibilities to mitigate the negative effect of TCP through amino acid modulation.

Keeping in view the above facts, the present work had been conducted to study the efficacy of methionine to enhance uptake of Zinc as $ZnSO_4 . 7H_2O$ in the fingerlings of common carp (*Cyprinus carpio L.*).

II. MATERIALS AND METHODS

The experiment was conducted at the Department of Aquaculture, College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The experiment was conducted in triplicate through rearing the youngones of common carp of average 3.39±0.68g weight and 6.02±0.25 cm length in the indoor glass aquaria (60× 30 ×30cm) @11 fish/ aquarium. Five diets including one control (D_1) and four experimental diets (D_2 to D_5) were formulated and prepared by mixing different ingredients such as casein, dextrin, gelatin, fish meal, sodium alginate, soybean meal, oil, carboxy methyl cellulose, Zn free mineral, vitamin mix, zinc sulphate ($ZnSO_4.7H_2O$), TCP and DL-methionine as per ratio given in table 1. Fishes were fed with prepared experimental diets in crushed crumble form in two split doses @ 2% (each time) of fish body weight (BW) for 90 days. Physico-chemical parameter of water was observed for temperature, pH, dissolved oxygen, total alkalinity and total hardness as per standard methods given in APHA (2005).

Proximate composition of feed was carried out as per AOAC, 2000, while proximate composition of fish flesh was estimated for soluble protein Lowry *et al*. (1951), lipid Folch *et al*. (1957), moisture and ash AOAC, (2000) methods. Zinc concentration in flesh, liver and bone was analysed through atomic absorption spectrophotometer (Elico) as per standard method as described by Jorhem and Engman, (2000).

Growth, in terms of gain in net weight and length was calculated on the basis of difference in values at the start and termination of experiment. Specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER) was calculated as per formula given below:

$$\text{SGR (\% increase in weight /day)} = \frac{\ln \text{Final body wt. (g)} - \ln \text{Initial body wt. (g)}}{\text{Number of days}} \times 100$$

$$\text{FCR} = \frac{\text{Feed given (g)}}{\text{Weight gain (g)}}$$

$$\text{PER} = \frac{\text{Weight gain (g)}}{\text{Protein intake (g)}}$$

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Table. 1: Composition of feed ingredients in experimental diets (%)

Ingredients	Diets				
	D_1 Control (0mg Zn kg^{-1})	D_2 (20mg Zn kg^{-1})	D_3 (40mgZn kg^{-1})	D_4 (20mg Zn kg^{-1})	D_5 (40mg Zn kg^{-1})
	D_1	D_2	D_3	D_4	D_5
Casein	20	20	20	20	20
Dextrin	30	30	30	30	30
Gelatin	8	8	8	8	8
Fish Meal	10	10	10	10	10
Sodium Alginate	12	12	12	12	12
Soybean Meal	8	8	8	8	8
Soybean Oil	2	2	2	2	2
Carboxy Methyl Cellulose	5	5	5	5	5
Zinc Free Mineral*	3	3	3	3	3
Vitamin Mix**	2	2	2	2	2
$ZnSO_4.7H_2O$ (mg/kg diet)	0	88.4	176.8	88.4	176.8
Tri Calcium Phosphate***	0	2	2	2	2
DL Methionine***	0	0	0	1	1

*$FeSO_4.H_2O$: 41.16, $CuSO_4$:0.51, $CaCO_3$: 20.58, KIO_3: 10.56, $MgSO_4$: 44.50, $MnSO_4.H_2O$: 2.29, NaCl: 17.15(g kg^{-1} diet).

**Vitamin B2: 1.25g, Vitamin B6: 0.5g, Vitamin B12: 6.25 mg, Biotin: 12.5mg, Cal. Pantothenate: 1.25g, Niacinamide: 37.5g, Base: q.s. (g 100g^{-1})

***Added as over and above 100%

STATISTICAL ANALYSIS

Data recorded for Physico-chemical parameters of water, Body weight and growth parameters of fish, biochemical composition of flesh and change in zinc concentration (mg kg^{-1}) in different tissues were analysed by two-tailed bivariate Pearson's correlation coefficient for average values, standard deviation and correlation coefficient using one way ANOVA by SPSS 16.00 software.

III. RESULTS AND DISCUSSION

Fish, being an aquatic vertebrate is directly influenced by water quality parameters for their survival and growth. During the experimental period, physico-chemical parameters of water like temperature, pH and dissolved oxygen (DO) varied within the desirable range for fish culture as suggested by Boyd (1990) and Bhatnagar and Devi (2013) for warm water fish species. However, total alkalinity and hardness were slightly higher than optimum range but no negative effect in terms of behavioral changes recorded in fish. Details of the water quality recorded during the study period are given in table 2.

Table. 2: Physico-chemical parameters of water

Parameters	Range
Temperature (°C)	29.1 – 29.6
pH	8.41 – 8.48
Dissolved oxygen (mg l^{-1})	7.96 – 8.64
Total alkalinity (mg l^{-1})	260.00 – 271.00
Total Hardness (mg l^{-1})	275.00 – 287.00

Proximate composition estimation of feed helps to assess nutritional value of feed. Crude protein content in the fish fed with different experimental diets ranged between 36.68-39.14%, while zinc concentration in diets (D_1 to D_5) ranged 31.80, 57.40, 61.60, 56.60 and 62.80 mg kg^{-1}, respectively (Table 3). Among experimental diets, highest crude protein content recorded in D_5, followed by D_4, it may be possibly due to addition of methionine, which is itself a nitrogen containing biomolecule i.e. an essential amino acid. In prepared diets, higher concentration of zinc recorded as compared to rate of addition, which may be due to Zn content already available in different feed ingredients in different ratio, naturally. Garling and Wilson (1976) suggested that 25 – 36% crude protein as optimum level in diets for the warm water fishes, while Jader and Al-Sulevany (2012) reported the highest growth in common carp juveniles, when fed with 30% crude protein. Paul and

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Giri (2015) advocated the protein requirement in-between 25-35% for the optimum growth of fish. Singh *et al*. (2018) reported the highest growth in young ones of common carp @ 35% Crude protein level. In present study, protein content in experimental diets was within the range of protein requirement of common carp suggested by different workers.

Table. 3: Proximate composition (%) of formulated diets (on DM basis)

Proximate composition parameters	Diets				
	D_1	**D_2**	**D_3**	**D_4**	**D_5**
Moisture	8.88	8.98	9.12	8.66	8.54
Crude protein	36.68	37.12	36.28	38.66	39.14
Crude fat	2.12	1.98	2.22	2.44	2.56
Ash	9.14	9.28	11.00	10.62	11.24
Crude fiber	3.41	3.43	3.42	3.52	3.50
NFE	39.76	39.20	37.95	36.10	35.01
Zn (mg kg^{-1})	31.80	57.40	61.60	56.60	62.80

*Variation in proximate composition may be due to addition of TCP in D_2, D_3 and TCP with methionine in D_4 and D_5.

The growth in fish stocked during experimental period was assessed as increment in terms of net weight gain (NWG), specific growth rate (SGR) and efficiency of feed was assessed as feed conversion ratio (FCR) and protein efficiency ratio (PER) for each treatment (Table 4).

In fishes fed with different experimental diets, highest weight gain recorded in fish fed with D_5 diet, however in D_3 diet fed fish lowest growth rate was recorded, which may be possibly due to negative effect of tricalcium phosphate and no element/ carrier was added to cater the negative effect of TCP, however in treatment D_2 and D_4 in between highest and lowest growth rate recorded, which may be either due to less concentration of TCP or negative effect was mitigated due to addition of methionine. Similarly SGR, FCR and PER values also improved in fish fed with D_5 diet, it may be due to addition of methionine. The values recorded in present study were well close to the observations recorded by different workers. Sultana *et al*.(2001) reported the SGR in between 2.53 – 3.24, FCR 1.22 – 1.78 and PER 1.68 – 2.48 in common carp fry fed with 33.34% crude protein @ 5% body weight (BW) for 45 days. Kiaalvandi *et al*.(2011) reported the FCR in between 4.76 – 6.25 and PER 0.38 – 0.47 in common carp juveniles (8.6 g) fed with 26 – 28% crude protein @ 5% BW daily while Jader and Sulevany (2012) recorded the SGR 0.71 – 0.87, FCR 2.27 – 3.01 and PER 0.79 – 1.05 in juveniles of common carp when fed with 25-35% crude protein.

Table.4: Body weight (BW) and growth parameters of fish in different treatments during the experimental period (Mean ±SE)

Parameters	Diets				
	D_1	**D_2**	**D_3**	**D_4**	**D_5**
NWG	2.85±0.69	2.96±0.50	2.19±0.24	3.35±0.89	4.01±0.42
SGR	0.56±0.12	0.72±0.21	0.48±0.65	0.69±0.20	0.92±0.13
FCR	4.54±0.90	5.68±2.86	5.68±1.78	3.71±1.05	2.42±0.30
PER	0.64±0.13	0.71±0.25	0.56±0.13	0.81±0.23	1.08±0.12

The caracas composition of fish flesh analysed to evaluate changes in moisture, soluble protein, lipid, ash and nitrogen free extract (NFE) content w.r.t. growth and different experimental diets given during experimental period. The flesh samples were taken at the time of stocking and termination of experiment. With the progress of experiment, significant improvement in soluble protein, lipid, ash and NFE content recorded (Table 5). After termination of experiment, in fish flesh moisture content (%) ranged between 77.20 – 78.90, protein 14.80 – 16.70, lipid 1.75 –

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2.73, ash 1.82 – 2.61 and carbohydrate 1.13 – 1.92% among fish fed with experimental diets i.e. D_1 to D_5. Soluble protein content was recorded significantly higher ($P \leq 0.05$) in fish flesh fed with diet D_5, which indicates protein is not only digested but also absorbed and assimilated well in the fish flesh.

Table.5: Changes in biochemical composition (%) of common carp flesh (Mean± SE) fed with different diets

Parameters (%)	Initial	Diets				
		D_1	D_2	D_3	D_4	D_5
Moisture	$82.10^{a}\pm0.27$	$78.90^{b}\pm0.24$	$78.10^{cd}\pm0.35$	$78.00^{cd}\pm0.49$	$77.60^{de}\pm0.14$	$77.20^{e}\pm0.02$
Total proteins	$13.60^{d}\pm0.08$	$14.80^{c}\pm0.06$	$15.60^{b}\pm0.00$	$15.60^{b}\pm0.03$	$16.60^{a}\pm0.06$	$16.70^{a}\pm0.15$
Total lipids	$1.97^{cd}\pm0.21$	$2.73^{a}\pm0.06$	$2.27^{bc}\pm0.08$	$2.00^{cd}\pm0.00$	$2.08^{c}\pm0.03$	$1.75^{d}\pm0.05$
Ash	$1.40^{e}\pm0.05$	$1.82^{d}\pm0.07$	$2.52^{ab}\pm0.01$	$2.32^{c}\pm0.01$	$2.48^{b}\pm0.00$	$2.61^{a}\pm0.01$
Total carbohydrates	$0.77^{de}\pm0.27$	$1.67^{abc}\pm0.24$	$1.41^{abc}\pm0.17$	$1.92^{a}\pm0.07$	$1.13^{cd}\pm0.21$	$1.70^{ab}\pm0.31$

* Values with different alphabetical superscripts differ significantly within row ($P \leq 0.05$)

Zinc concentration in flesh, liver and bone analyzed at the start of experiment and after termination of experiment to access its uptake in different tissues at different concentration levels. Zinc concentration in fish flesh ranged in between 20.10 – 36.90, in liver 20.10 – 62.20 and in bone 89.70 – 109.56 mg kg^{-1} at the time of termination in diets D_1 -D_5, however at the time of stocking it was 18.60, 17.40 and 84.70 mg kg^{-1} in flesh, liver and bone, respectively (Table 6). Significantly high ($P \leq 0.05$) concentration of zinc in fish flesh fed with D_6 diet recorded, it may due to added Zn supplement at higher levels. In addition to this, it may also possible that absorption of zinc might be absorbed through gut in the presence of methionine. In liver, highest levels of Zn concentration recorded in fish fed with diet D_4.

Table. 6: Changes in zinc concentration (mg kg^{-1}) in different tissues of common carp (Mean± SE)

Fish organs	Initial	Diets				
		D_1	D_2	D_3	D_4	D_5
Flesh	$18.60^{f}\pm0.14$	$21.20^{d}\pm0.01$	$20.10^{e}\pm0.02$	$25.40^{c}\pm0.02$	$35.70^{b}\pm0.02$	$36.90^{a}\pm0.03$
Liver	$17.40^{f}\pm0.01$	$20.10^{e}\pm0.01$	$35.60^{d}\pm0.01$	$36.40^{c}\pm0.01$	$62.20^{a}\pm0.00$	$60.40^{b}\pm0.01$
Bone	$84.70^{f}\pm0.005$	$89.70^{e}\pm0.05$	$96.42^{c}\pm0.01$	$94.92^{d}\pm0.02$	$106.70^{b}\pm0.01$	$109.56^{a}\pm0.01$

* Values with different alphabetical superscripts differ significantly within row ($P \leq 0.05$)

IV. CONCLUSION

In the present study, high NWG, SGR, FCR, PER and soluble protein in fish fed with diet D_5 indicates feed containing even though 1% methionine helps in improving growth parameters, better feed utilization, absorption and assimilation of nutrients particularly protein, in the body of fish. Similarly, Zinc uptake was also improved in fish fed with diet D_5, which gives an indication that methionine, helps to improve zinc absorption and accumulation in body even though from its inorganic source i.e. $ZnSO_4 \cdot 7H_2O$ and mitigates the negative effect of TCP up to certain extent.

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Urban Tree Planting: Implication on Sustainable Forest Management in Idi-Shin, Oyo State

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Abstract— *The role of urban tree planting cannot be overemphasized as it design features in an urban area. However, the act of sustaining the continuous urban tree planting within and around the urban residents has become a challenge. Therefore, this study aim at investigating urban tree planting and it implication on sustainable forest management in Idin-shin area. Idi-shin was purposively selected for this study. A total of 2,963 people resides in the area and this was computed by projecting the population from the 1991census result obtained from the National Population Commission of Oyo state. Furthermore, 2.5% sampling intensity was used to select 74 respondents for the study. Primary data were collected with the aid of structured questionnaire. Data was analyzed using descriptive statistics and the logistic regression analysis. Results showed that majority of the respondents were between 32-50years with 32.4%, female (56.8%), married (50.0%), had tertiary education (54.1%) and most of them were civil servants (32.5%). It was also revealed that most (90.5%)of the respondents have idea on urban tree planting; this they(28.4%) got from watching television although these information comes on occasional basis (64.9%). Majority (56.8%) of the respondents have planted trees before and 81.9% of them confirmed that tree planting is not difficult, as such 72.7% agreed to engage in tree planting in their residence. Mango tree was the most common tree species planted in the residence of Idi-shin. Tree planted prevent wind (TPPW) and urban tree serve as shade (UTSS) was the most significant benefits of urban tree planting with odds-ratio of 3.18 and 2.13 respectively. Therefore, proper urban planning and community involvement in urban tree planting are important for sustainable forest management to be realized.*

Keywords— ***Urban tree planting, Sustainable forest management, Residents, Attitude, Perception.***

I. INTRODUCTION

According to McPherson (2006), urban forestry is the care and management of single tree and tree populations in the urban settings for the purpose of improving the urban environment. Urban forestry plays an important role in the ecology of human habitats in many ways. These includes: filtering of air and water, provision of shelter to animals and recreational areas for people. They are critical in cooling the urban heat effect (Kellent and Wilson, 1993). Furthermore, the benefits of urban tree planting includes beautification, reduction of storm water runoff, reduction of air pollution, reduction of energy cost through increased shade over buildings, improve wildlife habitat and mitigation of urban environmental impact (Wilson, 2011). In addition, the presence of tree reduces stress and contribute to the healthy lifestyle of urban dwellers (Maller *et al*, 2008). The shade of tree and other urban green spaces make place for people to meet, socialize and play.

Urban tree planting, been one of the key factor in urban forestry that enhance urban ecological balance cannot be over emphasized (Hastre *et al*., 2006). It is however, worthy of note that some residents in the urban area due to ignorance find it very easy to remove green areas and tree stands in and around the residents for various purposes which include constructions of roads, building of estates, offices, schools etc. without replacement. This consequently leads to environmental problems such as erosion, greenhouse effect, global warming, pollution, drought, loss of biodiversity etc. Therefore, this study aim at investigating urban tree planting and its implication on sustainable forest management with a view to encouraging participation in urban tree planting in the study area.

II. METHODOLOGY

Study area

Idi-shin is an area in Southwestern Nigeria. Idi-shin lies on latitude 7^0 40'87'N and longitude 3^0 8'56' E, at an

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altitude of 336m and with the rainfall pattern ranging from 1,300mm – 1,500mm. The average temperature is about 37.2^0 and average range is about 75 – 100 % (McPherson, 2006).

Sampling procedure

Idi-shin was purposively selected for this study. A document indicating the population of the area for 1991 was obtained from the National Population Commission (N.P.C.) of Oyo state and from this document a projection of 2018 population size for the area was computed using the formula:

$Pn = Poert$……………………….. (1)

Where: P_n = Final population, P_o = Initial population, e = exponential. r = growth rate (3.2%), t = time internal (x – 1996) years, t = 21 years

Therefore, the total population for 2018 was 2,963 people. Furthermore, 2.5% sampling intensity as adopted by Diaw *et al* (2002) was then used to select respondents for this study. This indicated that where the population is less than 500, 10% sampling intensity was adopted, population above 500 but less than 1000, 5% sampling intensity was adopted while population above 1000, 2.5% sampling intensity was used. A total of 74 respondents were randomly selected for this study.

Method of data collection

Both primary and secondary data was used for this study. Primary data was collected with the aid of structured questionnaire while the secondary data was obtained from the N.P.C. census document. The questionnaire was designed to obtain information on the level of awareness of residents on urban tree planting, participation of residents on urban tree species, common tree species and the benefits of urban tree planting to residents of the area.

Data analysis

Data was analyzed using descriptive statistics and the logistic regression analysis. The logistic regression is expressed below;

Y=exp (bo+b1x1+b2x2+……………b7x7)/1+exp (bo+b1x1+………b7x7)……… (2)

Where:

Y= Benefit of urban tree planting (BUTP) (dependent variable)

Independent variables are:

x1=Urban tree prevent erosion(U.T.P.E)

x2= Urban tree beautify the environment (U.T.B.E)

x3= Urban tree serves as income (U.T.S.I)

x4= Urban tree serves as shade (U.T.S.S)

x5= Urban tree serves in purify the air (U.T.S.P.A)

x6= Urban tree provide medicinal value (U.T.S.M.V)

x7=Urban trees prevents wind from destroying things in the environment (U.T.P.W)

III. RESULTS AND DISCUSSION

Demographic information of respondents in the study area

Table 1: Demographic characteristics of respondents

Demographic characteristics	Frequency	Percentage
Age		
10- 20	12	16.2
21-30	21	28.4
31-50	24	32.4
51-65	12	16.2
65 and above	5	6.8
Total	74	100
Gender		
Male	32	46.2
Female	42	56.8
Total	74	100
Marital status		
Single	27	36.5
Married	37	50.0
Widowed	5	6.8
Divorced	5	6.8
Total	74	100
Educational status		
No formal education	5	6.8

Primary	5	6.8
Secondary	10	13.5
Tertiary	40	54.1
Others	14	18.9
Total	74	100
Occupation		
Civil servant	34	32.5
Artisan	29	24.4
Farmers	11	17.8
Others	26	25.3
Total	74	100

Source: Field survey, 2019

Table 1 showed the demographic information of the respondents in the study area. The age distribution revealed that majority (32.4%) of the respondents were between the ages of 31- 50 years while the least percentage (6.8%) of the respondents were between the ages of 65 and above. This is an indication that younger folks prefers to reside in the urban environment than the rural areas and this can be attributed to the fact that the urban area are better equipped with infrastructural facilities which contribute to good standard of living.The result on gender revealed that 56.8% of the respondents were female while 43.2% of the respondents were male, this might be due to the fact that the males are always busy sourcing for alternative means of sustaining their homes and as a result are not always at home while the females (though might be working) are mostly home makers and as such carry out most of the plantings activities in the residence they reside in.

The findings also showed that 50.0% of the respondents were married while 6.8% of the respondents were divorced and widowed respectively. This is also an indication that most planting in the urban area are carried out by the married for one purpose or the other in their places of residence. It was also observed that 54.1% of the respondents had tertiary education while 6.8% of the respondent had no formal education and primary education respectively. This is a clear indication that majority of respondents living in the study area areelites.Furthermore, the study also showed that 32.5% of the respondents were civil servants while 17.8% of the respondents were farmers. This implied that most respondents are engaged in white collar jobs and other businesses to sustain themselves and as a result may pay less attention to the planting of trees.

Level of awareness of residents on urban tree planting in the study area.

Table 2: The level of awareness of residents on urban tree planting in the study area

Level of awareness	Frequency	Percentage
Do you have idea on tree planting?		
Yes	67	90.5
No	7	9.5
Total	74	100
If yes, how did you get this information?		
Mass media	18	24.3
Forest extension	10	13.3
Internet	4	14.9
Discussion	10	13.3
Television	21	28.4
Chat	11	6.8
Total	74	100
How often do you get the information?		
Frequently	26	35.1
Occasionally	48	64.9
Total	74	100

Do you have any idea on importance on tree planting?		
Yes	65	87.8
No	9	12.2
Total	74	100
Is tree planting necessary in your environment?		
Yes	67	90.5
No	6	9.5
Total	74	100
Do you have interest in tree planting?		
Yes	60	79.1
No	14	20.9
Total	74	100

Source: Field survey, 2019.

Table 2 showed the level of awareness of respondents to tree planting. It was revealed that 90.5% of the respondents were aware of tree planting while 9.5% of the respondents were not aware of tree planting. This implied that most of the respondents in the study area in one way or another have access to information on tree planting.The table also showed that 28.4% of the respondents gotthe information from watching the television, this was closely followed by those respondents that got information from the mass media with 24.3% while a few 6.8% of the respondents got the information through chatting with friends. This might be due to the fact that television and mass media are the commonest means of getting information among majority of individuals.

However, the findings indicated that 64.9% of the respondents get the information occasionally.The percentage of respondents who had idea on importance of tree planting were about 87.8%. More so, 90.5% of the respondents affirmed that tree planting is necessary in the study area while 9.5% of the respondents responded in the negative. This is a clear indication that information on tree plantings are not always announced and broadcasted on regular basis as compared to other programmes. As a result, this had made people less concerned on daily basis when the issue of tree planting is mentioned.

With reference to the purpose of planting trees, 53.0% of the respondents stated that trees were planted for the purpose of wind break while a few respondents (3.0%) planted trees for recreational purposes (Figure 1). This implied that many respondents planted trees to protect their homes from the action of wind. This affirmed the findings of Maller *et al.*, (2008) that many people planted trees because it serves as wind break.

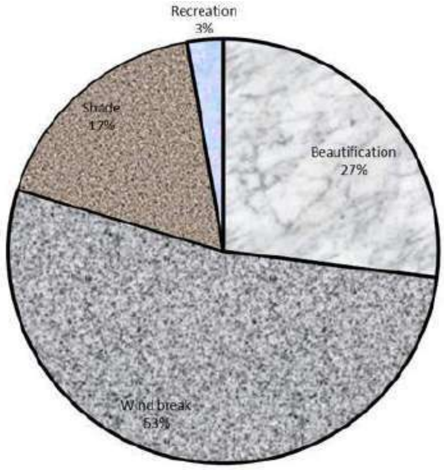

Fig.1: Response on purpose of planting trees in the study area

Moreover, the result also indicated that 79.7% of the respondents have interest in tree planting while 20.3% of the respondents do not have interest in tree planting in the study area (Table 2). Therefore, the reasons given for lack of interest in tree planting in the study area were lack of fund (35.7%), stress (21.4%), lack of space (21.4%), time consuming exercise (14.3%) and slow growth of trees (7.1%) (Figure 2).This corroborated the findings of Pickett *et al.*, (2008) who stated that due to some hazards involved with presence of trees in the urban area, residents may develop negative attitude towards the planting of trees in their environments.

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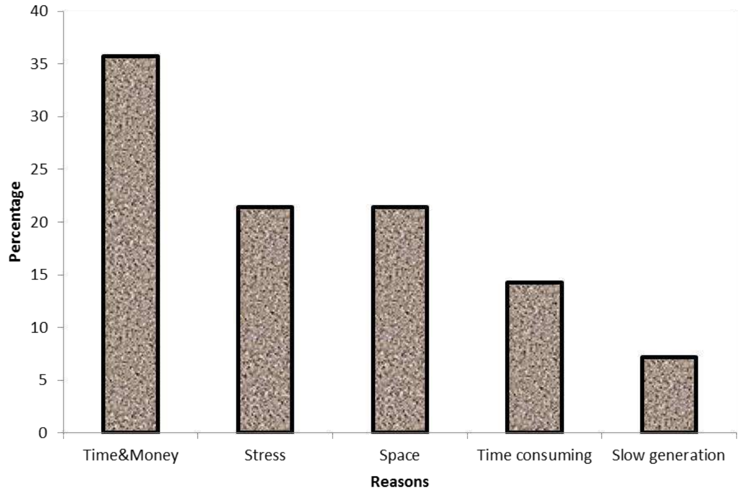

Fig.2: Response on reasons for lack of interest in planting of trees in the study area.

Participation of residents on urban tree planting in the study area

Table 3: Participation of residents in urban tree planting in the study area

Participation of residents	Frequency	Percentage
Is there tree(s) in your residence?		
Yes	62	83.8
No	12	16.2
Total	74	100
If yes, who planted them?		
Yourself	10	16.1
Parents	8	12.9
Naturally existing	44	71.0
Total	62	100
Have you planted tree before?		
Yes	42	56.8
No	32	43.2
Total	74	100
How did you get the species planted?		
Raised by you	5	11.9
Bought	7	16.7
Donated to you	12	28.6
Others(specify)	18	42.9
Total	42	100
Is planting tree difficult?		
Yes	14	18.9
No	60	81.9
Total	74	100
Is there space in your residence?		
Yes	55	74.3
No	19	25.7
Total	74	100
If yes, would you like to engage in tree planting?		
Yes	40	72.7
No	15	27.3
Total	55	100

Source: Field survey, 2019

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Table 3 showed that 83.8% of the respondents have tree(s) in their residence while 16.2% of the respondents have no tree(s) in their residence. Furthermore, the table also revealed that 70.9% of the respondents have naturally existing trees in their compounds. This implies that respondents are not really committed in the planting of trees except for those trees that grew naturally and are allowed to remain due to the benefit the respondents derive from them (Pickett *et al*., 2008). However, the result showed that 56.8% of the respondents have not planted tree(s) before while 43.2% of the respondents have planted tree(s) before. This they (81.9%) acclaimed that the exercise was not difficult while a few (18.9%) of the respondents stated that tree planting was a difficult task. Though, 74.3% of the respondents stated that there was enough space for planting tree in their residence and would like to engage in tree planting while 27.3% of the respondents stated that they don't have space in their compounds and may not be able to engage in the exercise.

Common tree species planted in the study area

Table 4: Common tree species identified in the study area

S/N	Scientific names of species identified	Common names	Local name (Yoruba)	Number of occurrence	General uses
1	*Morinda lucida*	Morinda	Oruwo	8	Medicinal purposes
2	*Peltophorum pterocarpum*	Copper pond	Igi copper	1	Medicinal purposes, shade
3	*Mangifera indica*	Mango	Mangoro	19	Fruit, medicinal, shade, income
4	*Gliricidia sepium*	Gliricidia	Agunmaniye	15	Income, medicinal, fruit
5	*Tectona grandis*	Teak	Teak	9	Shade, pole, income
6	*Gmelina arborea*	Bench wood	Gmelina	9	Shade, windbreak
7	*Anogeissus leiocarpa*	Africa birch	Africa birch	6	Shade, wind break
8	*Anacardium occidentale*	Cashew	Cashew	13	Fruits, shade, medicinal purpose
9	*Shorea roxburghii*	Temak	Shorea	7	Fruit production, income, shade
10	*Eucalyptus torelliana*	Cadaga tree	Cadaga	3	Timber production, shade, income
11	*Casuarina equisetifolia*	Christmas tree	Ahoyaya /Igi irin	2	Ornamental plant, income
12	*Terminalia catappa*	Almond tree	Igi fruit	6	Relaxation, wind break
13	*Cedrella odorata*	Spanish cedar	Kado	3	Beautification
14	*Hildegardia barteri*	Mast	Okurugbedu	3	Erosion control
15	*Terminalia ivorensis*	Terminalia	Black afara	3	Shade, income
16	*Zanha golungensis*	Muchenya(shona)	Igi-idan	6	Recreation, windbreak
17	*Polyalthia longifolia*	Masquerade tree	Asoko	7	Beautification, income
18	*Theobroma cacao*	Cocoa	Koko	3	Medicinal use
19	*Cordia allitoctora*	Salm wood	Ecuador laurel	2	Shade, relaxation
20	*Elaeis guineensis*	Palm tree	Igi ope	4	Beautification, income
21	*Khaya senegalensis*	Africa mahogamy	Djalla	5	Income, shade
22	*Citrus paradise*	Grape	Grape	7	Fruit, medicinal
23	*Xylia xylocarpa*	Iron wood	Igi irin	4	Shade, timber production
24	*Triplochiton scleroxylon*	Obeche	Arere	8	Shade, income
25	*Cola nitida*	Kolanut	Obi	5	Income, medicinal value
26	*Delonix regia*	Flame of the forest	Panseke	4	Beautification, shade
27	*Moringa oleifera*	Drum stick	Moringa	3	Medicinal purposes

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28	*Holarrhena floribunda*	False rubber tree	Igi rubber	2	Shade, medicinal
29	*Nauclea diderrichii*	Brimestone	Okuta dan	5	Shade, income
30	*Cassia fistula*	Golden rain	Amaltas	4	Shade, income, medicinal purposes

Source: Field Survey 2017

Table 4 showed the common trees species identified in the study area. *Mangifera indica* (mango) was the commonest tree species in the residence of most respondents.This may be due to the fact that mango is one of the commonest fruit trees known to many people and this is coupled with the fact that it provides fruits, shade, serve for medicinal purposes and generate income from their sales. This therefore, supported the findings of Vincent (2013) that tree planted within the environment can be a source of sustenance for the people who care for them. Other tree species identified in the area includes: *Gliricidia sepium, Anacardium occidentale, Morinda lucida, Tectona grandis, Gmelina arborea, Nauclea diderrichii, Delonix regia* etc. These trees served various purposes; such as for provision of shade, windbreaks, medicinal purposes, income generation, timber production, beautification etc. (McPherson *et al.*, 2002).

Benefits of urban tree planting to residence in Idi-shin

Logistic regression analysis for the benefit of trees for urban tree planting to residents of Idi-shin area

The binary regression model obtained for the benefit of trees for urban tree planting to residents in Idi-shin area.

U.T.B=-0.98+ 0.04UTPE - 1.64UTBE - 1.69UTSI + 0.76UTSS - 1.75UTSPA + 0.23UTSMV +1.16TPPW……………………………………………………………………(3)

N =74, Final loss =15.30, Chi-square (df, 7) = 6.00, P = 0.5402

Odd ratio (unit change): Constant (0.37); UTPE (1.04); UTBE (0.19); UTSI (0.18); UTSS (2.13); UTSPA (0.17); UTSMV (1.26); TPPW (3.18).

Where:

BUTP= Benefit of urban tree planting, UTPE= Urban tree prevent erosion, UTBE= Urban tree beautify the environment, UTSI= Urban tree serves as income, UTSS= Urban tree serves as shade, UTSPA= Urban tree serves in purifying the air, TPPW= Tree planted prevent wind from destroying things.

The model presented above for the benefit of urban tree planting to residents in Idi-shin gave overall significant fit to the data judging from $\chi2$ value that was significant at $p<0.05$. However, Tree planted prevent wind (TPPW) was the most significant benefit of urban tree planting in the study area with odds-ratio of 3.18.This was followed by Urban tree serves as shade (UTSS) with odd-ratio of 2.13(Table 5). Implyingthat the factors with odds-ratio approximately 2 and above have the likelihood of constituting the benefit of urban tree planting in Idi-shin area (Deeks, 1996)

Table 5: Logistic binary nature for the benefit of trees for urban tree planting to residents of Idi-shin area

Dependent Variable: Benefit of Urban Tree Planting (BUTP)(Yes = 1, No = 0)

Independent variable	Co-efficient	Odd ratio
U.T.P.E	0.04	1.04
U.T.B.E	-1.16	0.19
U.T.S.I	-1.69	0.18
U.T.S.S	0.76	2.13*
U.T.S.P.A	-1.75	0.17
U.T.S.M.V	0.23	1.26
T.P.P.W	1.16	3.18*
Model $\chi2$ ((df, 7) = 6.00, P = 0.5402		

*= significant at p< 0.05

IV. CONCLUSION

Urban forest plays a vital role in making the environment conducive for better living as it provide numerous environmental, economic and social benefits. Therefore, efforts should be made to create more awareness on tree planting in the urban areas. Activities such as World Environment Day and other Campaigns programmes on the awareness of tree planting should be given serious priority to enlighten the residents on the need to imbibe the habit of tree planting in the study area. Likewise, Research Institute and other related field should make it a point of duty that residents around the environment are enlightened on tree species and their importance to ensure protection, conservation and sustainability of these species.

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Analysis of Exchange Rate and Interest Rate Policy Instruments' Dynamics on Agricultural Growth in Nigeria

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***Abstract*— *This research analyzed the dynamics of exchange rate and interest rate policy instruments on agricultural growth in Nigeria for the period 1980-2018. Specifically the study examined the causal relationship between exchange rate and agricultural growth; analyzed the instantaneous and compound growth rate of exchange rate, interest rate and agricultural growth and examined the impact of exchange rate and interest rate policy instrument on agricultural growth. .Data were obtained from Central Bank of Nigeria (CBN) Statistics Data Base;and Food and Agriculture Organization Statistical data (FAOSTATS).From the findings, There exist a unidirectional relationship between exchange rate and interest rate with agricultural growth (P<0.05). The instantaneous growth rate for agricultural output(P<0.05); exchange rate (P<0.05) and interest rate were 5.9%; 17.02% and 0.61%with compound rate of growth of 6.08%; 18.55% and 0.62%.Exchange rate policy instrument yielded significantly (P<0.05)positive impact of 2.85% while a proportionate rise in interest rate significantly (P<0.05) decreased agricultural growth by -1.83% (P<0.05). Thus, macroeconomic policy instruments dynamics which revolved around aggregate price stability impacted agricultural growth. It was recommended exchange rate should be stabilized and interest reduced to encourage investment in agriculture, hence growth.*
***Keywords*— exchange rate, interest rate, agriculture and policy instruments.**

I. INTRODUCTION

In spite of Nigeria's rich agricultural resource endowment; there has been a gradual decline in agriculture's contributions to the nation's economy (Manyong et al., 2005). In the 1960s, agriculture accounted for 65-70% of total exports; it fell to about 40% in the 1970s, and crashed to less than 2% in the late 1990s, by 1985, only 37% of the 1970 output was achieved, but by 1988 and 1989, respectively, output reached 79% and 86% of the 1970 level (Maduekwe, 2008). Between 2003 and 2007 its average share of the national real GDP was 41.5%, but there was a reverse of this trend. Agricultural share to GDP dropped from 42.20% in 2007 to 40% in 2010 and to a lower rate of 35% in 2013 (Ajudua, Ojima, and Okonkwo, 2015; Central Bank of Nigeria CBN, 2013). The average agricultural growth rate for 2004–2007 was 7% but dropped to 5.2% from 2008-2013 (Ajudua, Ojima and Okonkwo, 2015). According to Ugwu and Kanu (2012) Nigerian agriculture growth rates was 7.4% 7.2% and 6.5% in 2006, 2007 and 2008 respectively. Of the growth in the 2003 to 2007 period, the crop, livestock, fishery and forestry subsectors contributed 90%, 6%, 3% and 1% respectively. Government activities are usually organized, directed and executed within the framework of policies. Macroeconomic policy makers utilize general instruments in executing their policies. General policy instruments are tools that policy makers utilize to achieve their goal similar to pliers, spanners, and screw drivers in the hands of the mechanic. General policy instruments are further classified into monetary and fiscal policies. Interest rate is a good example of monetary policy instrument that has variously been used in Nigeria.

Exchange rate and interest rates as monetary policy instruments basically target the control of supply and demand for money. However any attempt to regulate these affects virtually all sectors of economy particularly the agricultural sector. For instance the devaluation of the Naira affected virtually every facet of Nigerian economy

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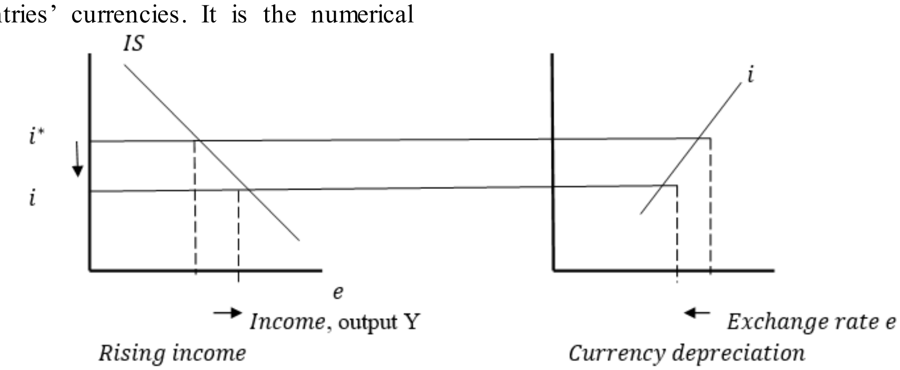
and many have linked the rise in foreign exchange to the rise in prices of goods particularly food.Preliminary also observations showed that macroeconomic policy instruments in Nigeria have become defective over time with its attendant consequences: The value of the Naira against the Dollar keeps depreciating, the interest rate is unstable, the expenditure on agriculture and income are on the decline despite the rise in inflation (Agu, Idike, Okwor, and Ugwunta, 2014; Ugwu et al., 2012).The value of the naira against the US dollars has depreciated throughout the 80's. It depreciated from N0.61 in 1981 to N2.02 in 1986 and further to N7.901 in 1990. The policy of fixed exchange rate pegged the Naira at N21.886 in 1994. But further deregulation pushed it from N86.322 to $1.00 in 1999. The US Dollar has persistently gained weight against the Naira to the extent that the present value of the naira against the Dollar is now N362.86=$1.00 as at May 2018 (CBN, 2018 and NBS, 2018). This development heralded the decline of agricultural production and the resultant drop in both volume and value of traditional export commodities as well as private domestic investment (FAO, 2017; Adubi and Okunmadewa, 1999). Interest rate which facilitates the establishment of agricultural business through availability of credit and finance for start-up, investments, and expansion (Ammani and Aliyu, 2012) has continued to rise leading to low access to credit, productivity and growth (Ochalibe, Abu and Audu, 2013). These raise questions on the effectiveness of exchange rate and interest rate policy instruments in Nigeria with dire implications for the economy as a whole and the agricultural sector in particular if not addressed.

II. THEORITICAL AND EMPIRICAL FRAMEWORK

Exchange rate is the price of one country's currency in terms of other countries' currencies. It is the numerical value of a country's domestic currency at any given time in relation to countries in which the home country has foreign or trade links (Nwankwo, 1980). A reduction of the nominal rate is an appreciation; an increase in the nominal rate is a depreciation or devaluation. A shift in exchange rate will have effect on certain economic variables such as interest rate, money supply etc (Okoduwa, 1997). This means that exchange rate is a strong determinant necessary for any economic well-being of Nigeria. In a market-friendly environment, exchange rate must respond to the market forces of demand and supply. The exchange rate, when applied in conjunction with other macroeconomic policies leads to the achievement of the goals of price stability, improved and sustained economic growth, reduced unemployment and balance of payment stability (Caballero and Corbo, 1989). Exchange rate policy targeted at stabilizing the value of naira may affect the prices of goods and services which may have impact on agricultural growth and resource sustainability.This influence, in turn curbs inflation, increase employment and maintains a healthy value of money (Agu et al., 2014). Policy fluctuations are likely, in turn, to determine economic performance and agricultural growth as a sector.Monetary policy under the floating exchange rate: Figure 1 shows the effects of expansionary monetary policy (a lower policy rate) stimulates investment and this effect is reinforced by a currency depreciation that stimulates net exports in an open economy. The policy change also has consequences for the equilibrium on the money market. The lower interest rate raises money demand both because of its direct effect on money demand and because of and the indirect effect via higher income (Floden, 2010).



(a) The goods market (b) The foreign exchange market

Fig.1: Monetary expansion under floating exchange rates

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Suppose the government stimulates domestic spending by increasing government expenditure purchases or by cutting taxes since such expansionary fiscal policy increases planned expenditure it shifts the curve to the right (Floden, 2010). This can be seen as shown in figure 3 below:

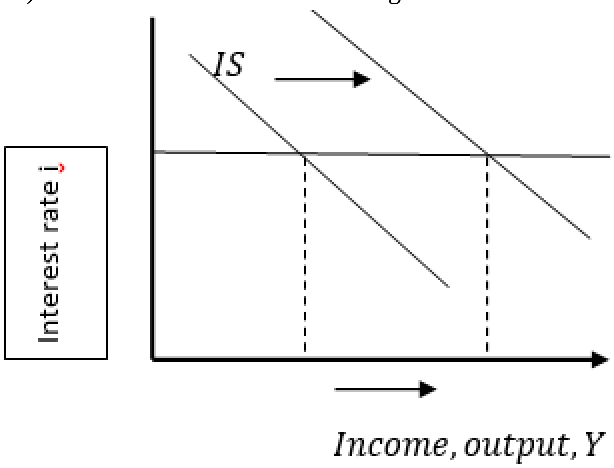

Fig.3: A fiscal expansion under floating exchange rates

According to Floden (2010)the outcome is that income increases if the CBN holds the interest rate constant. Investment, the exchange rate and the net exports are unaffected since the interest rate is held constant. Private consumption increases since household disposable income increases. On the money market higher income implies, higher money demand. The CBN must therefore let money supply increase if it holds the interest rate constant. Interest rate is currently constant at 18% and it remains largely to be seen the consequences of the action of the government of Nigeria particularly on agricultural sector. Agriculture is typically a sector which is most exposed to the influence of foreigntrade because almost all of its products are either exported or importable, or they are close substitutesin production or consumption with products which are importable or exportable. Cushman (1988); Chambers and Just (1991) indicated a significant depressive effect of exchange risk. However Abel (1983) showed that if one assumes perfect competition, convex and symmetric costs of adjusting capital, and risk neutrality, investment is a direct function of price (exchange rate) uncertainty. Hence, agriculturalprices are largely determined by those of international markets and by the filterthrough which the latter are transmitted to the domestic economy, which is the exchange rate. The summarized policy effects of Mundell-Fleming model is shown in Table 1:

Table 1: The Mundell-Fleming Model: Summary of Policy Effects

	Exchange –Rate Regime					
	Floating			Fixed		
Policy	Y	E	Nx	Y	E	Nx
Fiscal expansion	↑	0	0	↑	-	0
Monetary expansion	↑	↓	↑	-	-	-
Devaluation	-	-	-	↑	↓	↑

The table 1 shows the direction of impact of various economic policies on income Y, the exchange rate e, and the trade balance Nx. The arrow signs indicate the direction of movement of the variables. 0 indicates no effect and dash indicates that the policy or variable cannot be used. Maskus (1986) compared the effects of exchange rate risk across major sectors of an economy, e.g., manufactured goods, agriculture, chemicals and others and found that aggregate bilateral agricultural trade (the United States and its major western trading partners) is particularly sensitive to exchange rate uncertainty. It implies that exchange rate fluctuations affect agricultural as well. Therefore, policy makers are expected to consider this perspective when exchange rate policy instrument is to be use. The disability nature of foreign exchange subsidy (premium) is the fundamental reason why unification of exchange rate is canvassed as a short to medium term objectives of exchange rate management (Akpan and Atan, 2011).

Theory of Exchange Rate and Interest Rate on the Economy

Mundell-Fleming model shows the impact of policy and of domestic and foreign shocks on output and the balance of trade in the short-run. Mundell-Fleming model has been described as the dominant policy paradigm for studying open economy monetary and fiscal policy. It relies on the following assumptions:

MF1: Prices and wages are fixed: hence inflation and expected inflation are zero and real and normal interest rates are equal.

MF2: The home economy is small: This means the home economy cannot affect the world interest rate of world output.

MF3: Perfect capital mobility and perfect asset substitutability: i.e. residents of the home economy can buy and sell bonds of the foreign country (with the interest rate) in unlimited amounts at 100% transactions costs. There is no difference in risk between bonds. This implies that uncovered interest parity holds.

The equation for aggregate demand proposed by the Mundell-Fleming model of a large open economy is $Y = C(Y - T) + I(r) - G + NX_e$……………………….(1)

C (Y – T) represents consumption as a function of disposable income, defined as income less taxes.

I (r) represent investment as a function of the interest rate, where an increase (.) the interest rate decreases investment

G represents government spending, which is predominantly unaffected by interest rates

NX_e represents net export defined as exports less imports as a function of the real exchange where an increase in the real exchange rate decreases net exports

Y is the total amount of goods and services purchased by consumers, business, and the government taking into account foreign trade Y = CIDP = Aggregate Demand = Aggregates Supply = National income = Total output.

According to the Mundell-Fleming model, an open economy can be described of four equations

$Y = C(Y - T) + I(r) - G + NX_e$
IS……………………………….. (2)

$e = {}^{(1+i)E_{e'}}/_{1+i^*}$ i
IRP………………………………(3)

$\varepsilon = {}^{eP}/_{P^*}$
RER……………………………. (4)

$r = i - E\pi$
FISHER………………………… (5)

the equation (2) describes equilibrium in the goods market, equation (3) is the interest rate parity condition which describes equilibrium in the money market for foreign exchange (e) and equation (4) just states the definition of real exchange rate (e) the final equation (5) is the fisher equation stating the relation between the real interest rate(r) which is determined by the central bank. T and G are fiscal policy variables, i is the foreign interest rate, Ee is the expected future exchange rate, eP and P* are domestic and foreign price levels respectively and $E\pi$ is the inflation expectation. The four (4) equations above then determine the equilibrium values for the four endogenous variables which are income(Y) the nominal exchange rate (e) the real exchange rates (E) and the real interest rate (r). One lesson from the Mundell-Fleming model is that the behavior of an economy depends on the exchange-rate system it has adopted. Other policy fluctuations along with the exchange rate are likely, in turn, to determine economic performance and in the context of this work, agricultural growth as a sector.

III. METHODOLOGY

The study utilized secondary source of data . Data on Gross Domestic Product (GDP), exchange rate, interest rate, were obtained from CBN Statistics Data Base (Finance and real sector.Data for the study were analyzed through the application of both descriptive and inferential statistical tools. Unit root test (ADF) was adopted as a pre-estimation technique. After the estimation, a diagnostic test of misspecification, robustness/ heteroscedasticity were carried out to assess the validity of the empirical model. The study adopts a survey design. Unit Root Test, and Granger Causality Pre-estimation tests were carried out to avoid spurious parameters. After the estimation, a diagnostic test of misspecification, robustness/heteroscedasticity, autocorrelation and multicollinearity were carried out to assess the validity of the empirical model. Objective I was achieved using Granger Causality Test. Objective II was achieved using Trend analysis growth model while Objective III was achieved through the use of distributed lag model.

3.1 Unit Root Test -Augmented Dickey-Fuller (ADF) Model

The AugmentedDickey–Fuller (ADF)test consistsof estimating the following regression:

$\Delta y_t = x'_t\beta + \delta y_{t-1} + \sum_{i=1}^{p} \Delta y_{t-p} + \varepsilon_t$…………….. (6)

Where Δ= difference operator; y=vector of the n variables (i.e. interest rate, exchange rate, government expenditure, etc); x = optional exogenous regressors which may consists of constant or a constant and trend; p = number of lags; ε_t= error term. Null hypothesis: H_o: $\delta = 0$ (i.e., there is a unit root or the time series is non-stationary, or it has a stochastic trend).Alternative hypothesis: H_1: $\delta < 0$ (i.e., the

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time series is stationary, possibly around a deterministic trend). If the ADF statistic is greater than the critical value at 5% level of significance, that means the series is stationary, if the ADF statistic is less than the critical value at 5% level of significance, it means the series is non-stationary.

3.2 Growth trend Model

$Yt = Y_0 (1 + r) t$ ………………………………………. (7)

Where Y_t= rate of agricultural growth;Y_0 = rate of agricultural growth in a base year; r = compound rate of growth of Y; t = time in chronological years in natural log form we have

$InY_t = lnY_0 + tln(1 + r)$ ……………………………… …(8)

Substituting InY_0 with β_1 and Ln(1 + r) with β_2, we re-write equation as

$InY_t = \beta_1 + \beta_2 t$ …………………………………….... (9)

Adding the disturbance term to equation we obtain

$InY_t = \beta_1 + \beta_2 t + \mu t$ …………………………………. (10)

Equation (10) is a growth rate model developed for this study. A semi-log growth model was developed for this study instead of a linear trend model because the point of interest in this study is both absolute and relative change in the parameters of interest. The most important parameter in equation (10) is the $coefficient \beta 2$. This is the coefficient of the slope which measures the constant proportional or relative change in Y for a given absolute change in the value of the regressor, t. Multiplying $\beta 2$ by 100 gives the instantaneous growth rate at a point in time.

$IGR = \beta_2 \times 100$……………………………………….. (11)

Where: IGR= Instantaneous growth rate

According to Gujarati (2009) β_2 is the least-square estimate of the coefficient of the slope $\beta 2$, then taking the anti-log of β_2 and subtracting 1 from it and then multiplying the difference by 100 give the compound growth rate (CGR) over a period of time:

CGR = [antilog β_2 – 1] x 100 ……………………….(12)

If the coefficient β_2 is positive and statistically significant or negative and statistically significant there is acceleration or deceleration in growth process respectively. If β_2 is not statistically significant there is stagnation in the growth process.

3.3 Dynamic Model: Finite Distributed Model

$InAgth_t = b_0 + b_1 Inforex_t + b_2 Ini\_rate_t + b_3 Ininf_t + b_4 lnmss_t + e_t$..(13)

Where *In* = natural logarithm; $b_0 - b_9$ = parameters to be estimated; *Agrth* = is the annual aggregate agricultural contribution to GDP in millions of naira; *forex* = exchange rate measured as annual average exchange rate of Nigeria naira to one US dollars; *i_rate*= interest rate measured as weighted average of prime lending rate of commercial banks *infl* = inflation rate measured as the percentage change in the general price of all goods and services (%); mss = money supply measured as the total money in circulation broad money (M2 in ₦); $pcnstr_{t-1} =$ lag of policy instruments; e_t = is a stochastic error term that satisfies the normal classical regression assumptions. Macroeconomic policies that resulted in price distortion, promotion of market incentives associated with highly valued domestic currency may favor sustainability of resources through agricultural investment, increased labor productivity, utilizing land, labor and other resources. However, it may also lead to over-application of high external inputs, over-exploitation of resources depending on the level of utilization and the level of technology or other related factors. A priori, we assume that the interest rate is negatively related to agricultural growth while exchange rate could be positive or negative depending on the prevailing situation.

IV. RESULTS

4.1 Pre-Estimation Test :Unit Root Test

Table 2 reports the Unit root test results for Annual real Exchange rate in percent (*forex)* Prime lending rate of commercial rate (%)(*i_rate*); Money supply M2=broad money (*mss*) and Annual inflation rate-CPI for all items (*N_fla*).

Table 2: Results of aurgumented Dickfuller Unit root test

Variable	ADF Statistics Z(t)	Mackinnon critical value@5%	differenced level	P-value Z(t)	Remarks
Agrth	-3.668	-1.688	1(0)	0.003***	Stationary
Forex	-2.072	-1.688	1(0)	0.023**	Stationary
i_rate	-6.088	-1.688	1(0)	0.000***	Stationary

N_fla	-5.070	-1.688	1(0)	0.000***	Stationary
Mss	-4.723	-1.688	1(1)	0.000***	Stationary

Source: Computed from secondary data, 2018
Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

The results are summarized in the table 2. From the table, most the variables are stationary at order I (0) except money supply(*mss*) which is stationary at first difference. Therefore the null hypothesis of non-stationarity is rejected at 5% level of significance.

4.2 Granger Causality Test between Policy Instruments and Agricultural Growth

The result of the pair wise granger causality test between policy instruments and agricultural growth is presented in table 3.

Table 3: Granger pair wise causality test between policy instruments and agricultural growth

Null Hypothesis	Df	Chi2- Statistics	Probability	Decision
i_rate does not granger cause *agrth*	3	32.342	0.006***	Rejected
agrth does not granger cause *i_rate*	3	5.331	0.149	Not rejected
Inforex does not granger cause *Agrth*	3	20.497	0.000***	Rejected
Agrth does not granger cause *inforex*	3	5.307	0.151	Not rejected

Source: Computed from secondary data, 2018
Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

The result showed that there exist a unidirectional relationship between interest and agricultural growth on the one hand and exchange rate and agricultural growth on the other*:* (P=0.000<0.01) and (P=0.000<0.01) respectively which imply that change in exchange rate and interest rate policy instruments will affect agricultural growth just in Nigeria. Therefore the null hypothesis was rejected while the alternative hypothesis was not rejected. The implication is that all the variables indicated are causes changes in agricultural growth in Nigeria.

4.3 Instantaneous and Compound Growth Rate of Policy Instruments, Agricultural growth Rate and Sustainability Indicators

The result from trend analysis of agriculture output (*agrth*); Exchange rate (*forex); interest* rate (%)(*i_rate*); Money supply M2=broad money (*mss*); is presented in table 4.From the table the trend of policy instrument showed that there was acceleration in the growth in policy instruments but deceleration in money supply (mss) with no recorded stagnation during the period under review. The instantaneous growth rate (at a point in time) for agriculture (P=0.000<0.01) was 5.9%. This means that the relative change in agricultural output with respect to absolute change in the trend variable was 5.9% while the compound (over the period under review) rate of growth amounted to 6.08%.The implication is that there was a general improvement in the agricultural growth process in Nigeria during this period even though the growth may not be as expected. There was acceleration in growth for exchange rate (P=0.000<0.01), interest rate (P=0.198>0.1) with instantaneous and compound growth rate of 17.5%, 18.55%; 0.61%, 0.62%; respectively.

Table 4: Instantaneous and Compound Growth Rate

	Instantaneous growth rate%	Compound growth rate%	P-value
Agrth	5.90	6.08	0.000***
Inforex	17.02	18.55	0.000***
i_rate	0.619	0.62	0.198
Mss	-1.109	-1.02	0.000***

Source: Computed from secondary data, 2018
Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

Although efforts were made through the use of monetary and fiscal policies to improve macro-economic stability and stimulate growth (Oluwatobi and Ogunrinola 2011) the growth rate of exchange rate and interest rate may well suggest failure of policy instruments application in this regard. The implication of the empirical results is that the targets sets by the government of Nigeria are not achievable since government has not utilized macroeconomic policy instruments such that revenue generation is increased through the productivity of resources to meet national objective for agricultural growth and resource sustainability given the pressure on natural resources.

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4.4 Impact of Exchange Rate and Interest Rate Policy Instruments on Agricultural Growth

The result of the impact of exchange rate and interest ratepolicy instruments on agricultural growth from finite distributed lag model is presented in Table 5. From the table, the intercept term has a coefficient of -32.0484 this implies that without the use of policy instruments, agricultural growth will be negative, -32.05% (P=0.049<0.05). The value of the R^2 was 0.8898. This means that 88.98% of the variation in agricultural growth is accounted for by exchange rate (*forex*), interest rate (*i_rate)* and inflation rate (*N_fla*). The F-statistics (P=0.000<0.01) was statistically significant at 1% indicating that all the variables included in the model jointly exert significant impact on agricultural growth. This further shows that monetary policy tools are indispensable tool of agricultural development. The coefficient of exchange rate (*forex*) policy instrument was 1.50 and (P=0.049<0.05) therefore statistically significant at 5%. This implies that the devaluation of exchange rate policy instrument resulted in 1.5% increase on agricultural growth on the average. This is rather surprising because it is expected that increase in exchange rate will increase the cost of inputs and hence decline in agricultural productivity and growth but the result has indicated otherwise. This is likely due to fact that the exchange rate in Nigeria has largely been fixed, relatively stable without a drastic increase except in 2015 when policy makers devalued the naira, N365 /1US$ from N197/1US$ as depicted in the graph of exchange rate. It is also an indication that exchange rate stimulated investment and hence growth.

Table 5 showing estimate of both monetary policy instruments from Finite Distributed Lag Model

Variables		B-Coefficient	Standard error	T-value	P-value
Lnforex		1.5001	0.72711	2.06	0.049**
i_rate		-1.8278	0.71398	-2.56	0.016**
i_ratesq		0.0431	0.01758	2.45	0.021**
N_nfla		-1.3623	4.40567	-3.08	0.005***
agrth_1		0.3833	0.14005	2.74	0.011**
_cons		-32.048	31.379	-1.02	0.016**
Number of obs	=		38		
F(10, 27)	=		21.79		
Prob > F	=		0.000		
R-squared	=		0.8898		
Adj R-squared	=		0.8489		
Root MSE	=		1.1647		

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

This result is in agreement with Agénor (1995) who opined that real exchange rate depreciation actually boosted output growth. Mireille (2007) argues that overvaluation of exchange rates have constituted a major setback in the recovery process of Nigeria and Benin Republic. In addition, the author suggests that devaluation accompanied with well-targeted measures alongside an upward adjustment in the domestic price of tradable goods, could restore exchange rate equilibrium and improve economic performance. The finding is also in agreement with Ajisafe and Folorunsho (2002) who posited that foreign exchange appreciation is negatively related to agricultural growth and depreciation of exchange rate can be beneficial in some instances. For example, India in the 1990s devaluated its currency and in 1994 countries such as Côte d'Ivoire, Senegal and Mali devaluated their currencies. For instance, in narrowing the gap between its official and parallel exchange rates, Ghana carried out a step-wise devaluation of its official nominal exchange rate concurrently with fiscal reforms in order to reduce the deficit. But Sierra Leone met with great difficulties in trying to close the gap between the official and parallel market exchange rates, they faced a major problem of fiscal imbalance (World Bank, 2007). Edwards (1989) found that long-term effect of

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a real devaluation was more mixed; but as a whole it was suggested that the initial contractionary effect was not reversed subsequently. In the long run however, it is not possible to achieve real growth by continuously devaluing the domestic currency (Cafiero, 2003).

The coefficient of interest rate (*i_rate*) was -1.828 withP=0.016<0.05 which is also statistically significant at 5%. This means that a proportionate increase in interest rate resulted in -1.83% average decreases in agricultural growth ceteris paribus. The implication is that raising interest rate will have negative impact on agricultural growth. According to Agosin and Meyer (2000) macroeconomic stability actually stimulates inflows hence, aggregate level of growth in agriculture. Therefore, interest rate may have affected the cost of borrowing; the funds used to finance investment expenditures for capital goods and consumption expenditures for durable goods and became a disincentive to borrowing for agricultural activities. Inflation rate (*N_fla*) as a control variable had coefficients of -1.362 (P=0.005<0.01) this means that a proportionate rise in inflation resulted in -1.83% average decrease in agricultural growth ceteris paribus. This was expected. Although the institutions including political, financial and administrative - could also be major determinants of agricultural growth, the finding showed that monetary policy instruments are major requirement for agricultural and economic growth.It should be noted however that the impact of the change in the monetary policy instruments on the agricultural growth may also depend on the total policy package.

Diagnostics Test

Ramsey (1969) regression specification-error test (RESET) for omitted variables, Table 6. *estat ovtest* performs two versions of the test. This test amounts to fitting y=xb+zt+u and then testing t=0. If option rhs is not specified, powers of the fitted values are used for z. If rhs is specified, powers of the individual elements of x are used.

Model Specification Error Test

Table 6: Ramsey RESET test using powers of the fitted values of agrth

F-value	Df	Prob >F	Decision
0.296	3	0.133	Not rejected

Ho: model has no omitted variables

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

From the result (P=0.133>0.1) so the null hypothesis is not rejected. Diagnostic tests carried out above indicate that estimated models have correct functional form, there is no omitted variable and no irrelevant variable is included. The implication is that the model for monetary policy instruments and agricultural growth is correctly specified and no serious error of misspecification. It should be noted however that this testis a limited tool to detect specification errors just as any other tools. This is because RESET loses statistical power rapidly as powers of estimated y are added.

Autocorrelation and Multicollinearity

Multicollinearity is not a problem among the variables because Stata does this automatically by removing perfect collinearity. The command *estat bgodfrey in STATA* performs three versions of the Breusch-Pagan (1979) and Cook-Weisberg (1983) test for autocorrelation. The result of Breusch-Godfrey LM test for Autocorrelation is shown in table 7.

Table 7: Breusch-Godfrey LM test for Autocorrelation

Lags(1)	Chi2	df	P>chi2	Decision
1.396	1.483	1	0.2233	Not rejected

H0: no serial correlation

The result from the table indicated (P=0.2233>0.1). The result showed that the model has no serial correlation since the null hypothesis of no-serial correlation is not rejected at all levels of significance.

Heteroscadasticity

The result of Breusch-Pagan / Cook-Weisberg test for heteroskedasticity is presented in table 8

Table 4.12. Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Variables:	Chi2	df	P>chi2	Decision
fitted values of agrth	1.65	1	0.3251	Not rejected

Ho: Constant variance

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

The result from the table indicated (P=0.3251>0.1) therefore the null hypothesis of constant variance is not rejected at all levels of significant. According to Adkins and Hill (2008) the least square estimator can be used to estimate linear model even when the errors are heteroscadastic because the estimates will still be unbiased

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and consistent especially with time series data. The only problem will be that the variance –covariance matrix is not precise. However the use of robust variance-covariance estimator (VCE) in stata corrected the problem.

V. CONCLUSION

The findings revealed that agricultural growth adjusted fairly to the dynamics of monetary policy instruments in Nigeria. The instantaneous growth rate for agricultural output was 5.9% while the compound rate of growth amounted to 6.08%. There was acceleration in growth exchange rate and interest rate policy instruments with instantaneous and compound growth rate of 17.5%, 18.55%; and 0.61%, 0.62% respectively. There exist a unidirectional relationship between exchange rate and interest rate with agricultural growth. Interest rate yielded a negative impact of -1.83% on agricultural growth while exchange rate produced positive impact of 1.5%. Therefore unfavorable macroeconomic policies driven by unstable interest rate among others impacted negatively on agricultural growth. It is recommended that interest rate as a policy instruments needs to be stabilized to sustain investors' interest for increased growth in agriculture. Additionally narrowing of the foreign exchange gap is essential since its relative price influences other prices and the devaluation of the naira led to higher domestic prices. These may help government of Nigeria to achieve the desired growth in agriculture with possible positive results in key economic indices such as real GDP growth, growth in foreign reserves, and downward trend in inflation and reduced unemployment rate.

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The Productive Parameters and cost benefit Analysis of growing Rabbits Fed cooked Bambara groundnut meal in the semi- arid zone of Nigeria

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***Abstract*— *A ten-weeks feeding trial was conducted to determine the effect of replacing groundnut cake (GNC) with cooked Bambara nut meal (CBNM) on the performance of growing rabbits. Thirty mixed breed (New Zealand White X Dutch) of rabbits six to seven weeks of age with average initial body weight of 604.50 g were caged individually and allotted to five (5) dietary treatments. Each treatment had six (6) replications. The rabbits were given diets and clean drinking water ad libitum throughout the period of experimentation. In diets 1(control), 2, 3, 4 and 5 CBNM replaced GNC at 0%, 25%, 50%, 75% and 100%, respectively. The productive parameters measured include; feed intake, weight gain, feed conversion ratio. All data collected in the course of the experiment were subjected to analysis of variance (ANOVA) using the completely randomized design (Steel and Torrie, 1980) and where applicable Duncan's multiple range test, was used for mean separation, while analysis of economics of production was carried out based on the prevailing market prices of feed ingredients at the time of study. The cost per kilogram of each test diet, the cost of feeding rabbits on the test diets throughout the period of the experiment and the cost per kilogram of weight gained by the rabbits were used in assessing the economics of replacing different levels of groundnut cake with cooked Bambara nut meal. Daily feed intake was significantly (P<0.05) different among treatment groups with the control (0% CBNM) consuming more feed than those on different levels of CBNM. Daily feed intakes were 69.07 g, 59.51 g, 61.51 g, 60.53 g and 62.99 g for rabbits on the 0%, 25%, 50%, 75% and 100% CBNM levels, respectively. There were no significant difference (P>0.05) among treatments groups in weight gain, feed conversion ratio (FCR) and Use of CBNM as replacement for GNC resulted into a savings of at least ₦46.00 when 100% CBNM and up to ₦72.00 when 50% CBNM was used instead of GNC in growing rabbits' diets. It was concluded that CBNM can replace up to 50% of the GNC in the diets of growing rabbits for optimum economic benefit.*
***Keywords*— Productive, Cost-benefit, Cooked Bambara Nut Meal and Growing Rabbits.**

I. INTRODUCTION

In order to overcome the problem of protein shortages, attention is now focused on the production of animals that are prolific and capable of using different sources of feeds that are less costly or which are underutilized (Balogun *et al*., 2003; Omoikhoje *et al*., 2005 and Igwebuike *et al*., 2005).Ahamefule *et al*. (2005) reported that in recent times a case has been made for rabbit production as a realistic approach to counter the animal protein deficit in the diet of Nigerians. According to Igwebuike *et al*. (2005) strategies advanced include the use of prolific animals and alternative non-conventional feed ingredients for feeding livestock. Rabbit production is one of such alternatives as the animal is highly prolific and is known to thrive on a variety of feed ingredients.

In the field of monogastric nutrition, protein sources such as groundnut cake and soyabean meal are costly. The Bambara groundnut (*Voandziea subterranea*) is being experimented as an alternative to the conventional leguminous protein sources which are vital in the feeding of monogastric animals (Omoikhoje *et al*., 2005). These authors reported that Bambara groundnut is an underutilized feed resource for livestock and it is indigenous to Africa. Therefore, it can be a useful alternative to groundnut cake and soyabean meal. This is because of its nutritional qualities which are comparable to other leguminous feed ingredients. Pfeffer *et al*. (2002) explained that Bambara groundnut contained 27% crude protein, 60% nitrogen-free extract, 9% ether extract and gross energy of 19 MJ/Kg DM. The crop is cultivated under a wide range of soil and climatic conditions. It is known to be cultivated in the semi-arid environment. Joseph *et al*. (1999) reported that Bambara groundnut seeds are virtually free from metabolic inhibitors and toxins, a common phenomenon in most legumes. However, Omoikhoje *et al*. (2005) have reported that it has trypsin inhibitors, which can be removed by heat treatment.

Therefore, with the recent advocacy for increased protein in the diet of people living in developing countries through integrated livestock and crop production, rabbit production using under-utilized crops such as Bambara will be a step towards improving the nutritional and economic status of most peasant farmers, especially in the semi- arid zone of Nigeria. The objective of this study was therefore to investigate the effects of using cooked Bambara groundnut meal (CBGM) as a replacement for groundnut cake (GNC) on the productive parameters and to undertake the cost-benefit analysis of using the varied levels of CBGM in the diet of growing rabbits, in Maiduguri

II. MATERIALS AND METHODS

The feeding trial was conducted at the Teaching and Research Farm, department of Agricultural Technology, Ramat Polytechnic Maiduguri. Maiduguri is located within latitude 11^0 5ʹ north and longitude 13^0 9ʹeast (Encarta, 2007). It has an altitude of 354m above sea level (Alaku, 1983). The vegetative zone falls within the sahelian region of West Africa. The annual rainfall varies from 500-600mm with short duration of 3-4 months rainy season; long dry season of 7-8 months is prevalent. According to Ugherughe and Ekedolum (1986), the mean relative humidity ranges from 30%-50% around February to March, while maximum record of 90% is observed around August. Ambient temperatures are higher during the months of April to May and may reach up to 40^0 C and above (Alaku, 1983). According to Aliyu (2007), ambient temperature could be as low as 20^0C during the cold season while during the hot period, which is between February to June, it can reach 44^0 C.

Method of Processing Bambara groundnut seeds The Bambara groundnut seeds were subjected to cooking at boiling point (100^0C) for a period of one hour in an aluminum cooking pot containing water sufficient enough to cover the seeds using firewood as a source of fuel. After cooking for the period of one hour, the seeds were separated from the water and sun-dried for five days. This is to ensure complete reduction of moisture for ease of milling as corroborated by Omoikhoje *et al*. (2005) and Omoikhoje *et al*. (2006). The sun-dried seeds were then milled and used for the preparation of the experimental diets.

Experimental stock and management Thirty (30) mixed breed (New Zealand white X Dutch) of rabbits 6-7 weeks of age, were used for the feeding trial that lasted for the duration of ten (10) weeks, excluding one (1) week of adjustment period. The rabbits were weighed and randomly assigned to five (5) different dietary treatments, each treatment containing six (6) replicates. The rabbits were kept in separate cages made from wire with dimensions of 42cm x 42cm x 43cm (LX W X H). Cages were raised above the ground level for ease of cleaning. Metallic feeding trough and plastic drinkers were provided in each cage. Water and feed were provided *ad libitum* throughout the period of experiment. Five (5) experimental diets were prepared in which cooked Bambara groundnut meal (CBGM) replaced groundnut cake (GNC) as a source of protein at 0%, 25%, 50%, 75% and 100% levels in diets 1,2,3,4 and 5 respectively, as shown in Table 1. The parameters measured were daily feed intake, daily weight gain, feed conversion ratio, nutrient digestibility, carcass components, haematological characteristics and cost-benefit analysis.

Daily feed intake A known quantity (100g) of the experimental diets was fed to the animals in each treatment daily, the leftover of the feed was subtracted from the quantity given to determine daily feed intake of each rabbit. Daily weight gain was determined by weighing the animals at the onset of the experiment and weekly thereafter. The difference in weight at the end of each week gives the weight gained for that week and this is divided by seven to obtain the daily weight gain in grams.

Body weight gain/loss = final weight (g) - initial weight (g).

Feed conversion ratio was obtained by dividing the daily feed intake by the daily weight gain both expressed in grams.

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Daily feed intake (g)}}{\text{Daily weight gain (g)}}$$

The proximate chemical analysis of the cooked Bambara groundnut meal, groundnut cake, experimental diets and faecal samples were determined using the AOAC (1980) methods of analysis.

Determination of trypsin inhibitors This involved the weighing of 0.2 g of the samples into a screw cap centrifuge tube, 1 ml of 0.1 M phosphate buffer was added and the contents shaken at room temperature for one hour on a UDY shaker. The suspension obtained was centrifuged at 5000 rpm for 5 minutes and filtered through Whatman No.42 filter paper. The volume of each was adjusted to 2 ml with phosphate buffer. The test tubes were placed in a water bath and maintained at 37º C. Six milliliters of 5% TCA solution was added to one of the tubes which serves as a blank. Two (2) ml of casein solution was added to all the tubes which were previously kept at 37º C. These were incubated for 20 minutes. The reaction was stopped after 20 minutes by adding 6 ml of TCA solution to the experimental tubes and the tubes were shaken. The reaction was then allowed to proceed for 1hour at room temperature. The mixture was filtered through Whatman No. 42 filter paper.

Absorbance of the filtrate from sample and trypsin standard solutions were read at 280 nm and the trypsin inhibitors in mg g^{-1} was calculated using the formula of Kakade *et al*. (1969)

$$T.I\ mg\ g^{-1} = \frac{\text{A standard} - \text{A sample x Dilution factor}}{\text{0.1 g x sample wt. in g 1000 x sample size}}$$

Economic analysis The economic analysis was carried out based on the prevailing market prices of feed ingredients at the time of study. The cost per kilogram of each test diet, the cost of feeding rabbits on the test diets throughout the period of experiment and the cost per kilogram of weight gained by the rabbits were used in assessing the economics of replacing different levels of groundnut cake with cooked Bambara groundnut meal.

Statistical analysis All data collected in the course of the experiment were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980) and where applicable, Duncan's multiple range test (Duncan, 1955) was used for mean separation

III. RESULTS AND DISCUSSION

The proximate chemical composition of the experimental diets, CBGM and GNC were presented on Table 2. The performance characteristics of rabbits fed varied levels of CBGM are shown in Table 8. The mean daily feed intake per rabbit was significantly different ($P < 0.05$) for the treatments. The control group (0% CBGM) consumed more feed than those on different levels of CBGM. There was no significant difference ($P > 0.05$) between treatments in weight gain and it is within the range of 10 to 20 g reported by Cheeke (1987) for growing rabbits in tropical environments. Similarly final weight gain also showed no significant difference ($P>0.05$) among treatment groups. The final weight in this study is above the 1267.00- 1295.00 g/rabbit reported by Igwebuike *et al*. (1995) for growing rabbits of similar age fed graded levels of sorghum waste. The feed conversion ratio (FCR) were not significantly ($P>0.05$) different among treatments. FCR obtained in this study was slightly inferior to the 4.13- 3.93 reported by Ehebha *et al*. (2008) who fed graded levels of cooked Bambara groundnut to growing rabbits. The performance of the rabbit in this experiment indicated that CBGM contains essential nutrients that can support adequate growth of rabbits at various levels of inclusion in their diets.

The cost-benefit analysis of the rabbits on the various treatment diets was presented in Table 4. The results indicated that at the end of this study final weight was obtained for the different treatment groups, with no significant difference ($P>0.05$) among the treatment groups. The control treatment (0%CBGM) consumed more feed and recorded the highest total feed cost of (₦50.33/kg feed) but gained weight similar to other groups on Bambara nut-based diets. That means more expenses was incurred in the control than in treatment groups. The cost/Kg weight gain was also highest in the control compared to other groups which implied that the control gain similar weight with other groups at a higher price/ Kg gain. Treatment T_2 (25%CBGM) diet consumed lowest feed and gain weight similar to other treatment groups. The cost/Kg weight gain for the study was lowest**.** Treatment T_3 (50%CBGM) has lowest value of ₦55.48 cost/Kg gain with a slightly higher total weight gain 799.20 g than other treatments while the control T_1 (0%CBGM) recorded highest cost/Kg gain of ₦65.36. At the end of the study it was observed that all treatments gained similar weight, but there was variation in quantity of feed consumed which was responsible for differences in cost/Kg gain. The percentage reduction in cost/Kg gain between treatment groups were as follows; T_1 and T_2 14.43%, T_1 and T_3 15.17%, T_1 and T_4 10.10% and T_1 and T_5 9.85%. Therefore, the use of CBGM as replacement for GNC resulted into a savings of at least ₦6.44 when 100% CBGM and up to ₦9.88 when 50% CBGM is used instead of GNC in feeding growing rabbits. Furthermore, the profit margin obtained ranged from ₦305.07 to ₦335.06 with treatment T_3 having highest profit margin compared to the control and other groups. The percentage profit margin ranged from 1.63 to 9.83 as shown in the Table 4.

IV. CONCLUSION AND RECOMMENDATIONS

In this study cooked Bambara groundnut meal was found to be suitable for the feeding of growing rabbits at different levels of inclusions, from 25% to 100% as a replacement for groundnut cake, a conventional plant protein source. Rabbits fed varied levels of CBGM have shown good performance in terms of weight gain, feed efficiency etc. From this experiment it can be concluded that cooked Bambara groundnut meal (CBGM) can replace groundnut cake (GNC) at different levels of inclusions but 50% CBGM diets should be used for optimum economic benefit.

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Table 1: Composition and calculated analysis of the experimental diets

Ingredients (%)	Levels of GNC replaced by CBGM				
	T_1 (0)	T_2 (25)	T_3 (50)	T_4(75)	T_5 (100)
Maize grains	45.00	45.00	45.00	45.00	45.00
Wheat offal	17.00	17.00	17.00	17.00	17.00
Groundnut cake (GNC)	18.35	13.76	9.18	4.59	0.00
Cooked Bambara groundnut meal (CBGM)	0.00	4.59	9.18	13.76	18.35
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Common salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix*	0.15	0.15	0.15	0.15	0.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Dry matter (DM)	95.66	95.61	95.68	95.64	95.63
Crude Protein (CP)	19.25	18.54	17.76	17.15	16.44
Crude Fibre (CF)	6.04	5.90	5.76	5.62	5.48
Ether Extract (EE)	5.19	5.88	6.56	7.24	7.93
Ash	4.59	4.51	4.42	4.33	4.24
Nitrogen free-extract (NFE)	64.93	65.17	65.50	65.66	65.91
Metabolizable energy (Kcal/Kg)	3437.66	3476.81	3513.73	3551.92	3590.42

*Premix: Bio-mix supplying the following vitamins/minerals per kg: vit. A 5,000 IU; vit.D_3 800,000 IU; vit E 12,000 mg; vit K 1,500mg; vit B_1 1,000mg; vit B_2 200mg; vit B_6 1,500mg; Niacin 12,000mg; pantothenic acid, 20.00mg; Biotin 10.00mg; vit B_{12} 300.00 mg, folic acid 15,000 mg; choline chloride 60,000 mg; manganese 10,000 mg; Iron 15,000 mg; Zinc 800 mg; Copper 400 mg; Iodine 80 mg; Cobalt 40 mg; and Selenium 8,000 mg.

Table2: Proximate composition of cooked Bambara groundnut meal (CBGM) groundnut cake (GNC) and the experimental diets

Nutrients (%)	Levels of GNC replaced by CBGM							
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	CBGM	GNC	RBG
Dry matter	90.56	90.57	90.60	90.63	90.61	93.80	95.90	92.70
Crude protein(CP)	16.79	15.53	14.37	13.37	12.31	22.14	47.60	21.31
Crude fibre (CF)	9.48	10.62	10.76	10.90	11.05	9.83	3.71	6.78
Ether extract (EE)	5.19	5.88	5.89	6.05	6.20	8.13	2.73	7.50
Ash	5.40	5.60	5.00	5.80	5.31	3.60	4.90	3.34
Nitrogen-free extract (NFE)	53.70	51.71	52.21	51.17	51.38	47.10	36.96	60.21
Trypsin inhibitor activity (TIA) %	-	0.14	0.29	0.43	0.58	3.14	-	7.15
Metabolizable energy* (Kcal/Kg)	2,947	2,886	2,862	2,801	2,771	3,149	3,294	3,533

*ME (Kcal/Kg) calculated according to the formula of Pauzenga (1985) ME = 37 X % CP + 81 X %EE + 35.5 X %NFE.

RBG= Raw Bambara groundnut.

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Table 3: Performance of rabbits fed varied levels of cooked Bambara groundnut meal (CBGM) as replacement for groundnut cake (GNC)

	Levels of GNC replaced by CBGM					
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM
Number of rabbits	6	6	6	6	6	-
Mean initial weight(g/rabbit)	606.67	602.50	600.00	606.67	606.67	81.112^{NS}
Mean final weight(g/rabbit)	1373.30	1385.00	1399.20	1354.20	1374.20	69.575^{NS}
Mean daily feed intake(g/rabbit)	69.07^{a}	59.51^{b}	61.51^{b}	60.53^{b}	62.99^{b}	1.3405*
Mean weight gain(g/rabbit)	10.66	11.18	11.41	10.68	10.96	0.7559^{NS}
Feed conversion ratio(FCR)	6.48	5.32	5.39	5.67	5.90	2.4011^{NS}
Mortality (%)	0	0	0	0	0	--

SEM = standard error of means
NS = not significant (P> 0.05)
* Significant difference (P< 0.05)
a, b = means in the same row bearing different superscript differ significantly (P<0.05).
GNC= groundnut cake
CBGM= cooked Bambara groundnut meal.

Table 4: Cost-benefit analysis of feeding varied levels of cooked Bambara groundnut meal (CBGM) to growing rabbits as replacement for groundnut cake (GNC)

	Levels of GNC replaced by CBGM				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Cost price/ rabbit (₦)*	540.00	540.00	540.00	540.00	540.00
Initial weight (g/rabbit)	606.67	602.50	600.00	606.67	606.67
Final weight(g/rabbit)	1373.00	1385.00	1399.20	1354.20	1374.20
Total weight gain(g/rabbit)	766.33	782.50	799.20	747.53	76.53
Total weight gain(Kg/rabbit)	0.77	0.78	0.81	0.75	0.77
Total feed intake(g/rabbit)	690.74	595.12	615.09	605.32	629.86
Total feed intake(Kg/rabbit)	0.69	0.60	0.62	0.61	0.63
Cost/kg feed (₦/Kg)	72.94	72.71	72.48	72.25	72.02
Total feed cost (₦)	50.33	43.63	44.94	44.07	45.37
Cost of Production (₦)	590.33	583.63	584.94	584.07	585.37
Selling price/rabbit (₦)	895.40	905.07	920.00	900.05	895.40
Profit margin/rabbit (₦)	305.07	321.44	335.06	513.98	310.03
Cost /Kg gain (₦/Kg)	65.36	55.93	55.48	58.76	58.92
Percent reduction in Cost /Kg gain (₦/Kg)	-	14.43	15.17	10.10	9.85
Percent marginal gain in relation to the control	-	5.10	9.83	3.58	1.63

Cost per kilogram of the various ingredients used in compounding the experimental diets; maize grains ₦73.55, GNC ₦100.00, CBGM ₦95.00, Wheat offal ₦46.00, Groundnut haulms ₦70.00, Fish meal ₦103.44, Bone meal ₦60.00, Premix ₦600.00 and Salt ₦30.00.(price of ingredients as at June 2009).
The percentages in parenthesis represent the levels of GNC replaced by CBGM in the diets.
* ₦1.00 ≡ $0.0067

Carcass and Nutrient Digestibility Trial of Growing Rabbits fed Cooked Bambara Nut Meal as Replacement for Groundnut Cake in a Semi-arid Zone of Nigeria

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***Abstract*— *A ten-weeks feeding trial was conducted to determine the effect of replacing groundnut cake (GNC) with cooked Bambara nut meal (CBNM) on the performance of growing rabbits. Thirty mixed breed (New Zealand White X Dutch) of rabbits six to seven weeks of age with initial body weight of 604.50 g were caged individually and allotted to five(5) dietary treatments. Each treatment had six (6) replications. The rabbits were given diets and clean drinking water ad libitum throughout the period of experiment. In diets 1(control), 2, 3, 4 and 5 CBNM replaced GNC at 0%, 25%, 50%, 75% and 100%, respectively. The parameters determined were nutrients digestibility and carcass components. All data collected in the course of the experiment were subjected to analysis of variance (ANOVA) using the completely randomized design (Steel and Torrie, 1980) and where applicable Duncan's multiple range test, was used for mean separation. There were no significant differences (P>0.05) among treatment groups in terms of nutrient digestibility except for Nitrogen-free extract (NFE). There were no significant difference (P>0.05) among treatment groups for all carcass parameters measured except for the dressed weight, dressing percentage; and racks expressed as percentage of slaughter weight. The retail cuts as percentage of slaughter weight differ significantly (P<0.05) for racks while the shoulder, loins and thighs did not differ (P>0.05) among treatment groups.*

***Keywords*—Carcass, Cooked Bambara nut, Growing Rabbits and Nutrient Digestibility.**

I. INTRODUCTION

There is inadequate protein supply in the diet of most people living in developing countries including Nigeria as indicated by reports from different sources (Uko *et al*., 1999; Alade *et al*., 2001; Balogun *et al*., 2003; Ahamefule *et al*., 2005 and Igwebuike *et al*., 2005). The protein consumption of people in these countries is below the Food and Agriculture Organisation's (FAO, 1987) recommendation of 28g of animal protein/person/day. FAO (2000) also estimated that about 200 million people in Africa are undernourished at the dawn of the millennium. The protein inadequacy is related to high cost of conventionalfeed ingredients especially the protein sources.The high cost of ingredients is basically attributed to competition between human and animals especially monogastrics which depend on cereal grains as their source of energy and pulses (legumes) such as groundnut and soyabeans as their protein sources. According to Alade *et al*. (2001) livestock feeds particularly for non-ruminants are costly in developing countries because of the competition between human and livestock for conventional ingredients.

In order to overcome the problem of protein shortages, attention is now focused on the production of animals that are prolific and capable of using different sources of feeds that are less costly or which are underutilized (Balogun *et al*., 2003; Omoikhoje *et al*., 2005 and Igwebuike *et al*., 2005).Ahamefule *et al*.(2005) reported that in recent times a case has been made for rabbit production as a realistic approach to counter the animal protein deficit in the diet of Nigerians. According to Igwebuike *et al*.(2005) strategies advanced include the use of prolific animals and alternative non-conventional feed ingredients for feeding livestock. Rabbit production is one of such alternatives as the animal is highly prolific and is known to thrive on a variety of feed ingredients.

In the field of monogastric nutrition, proteinsources such as groundnut cake and soyabean meal are costly. The bambara groundnut (*Voandziea subterranea*) is being experimented as an alternative to the conventional leguminous protein sources which are vital in the feeding of monogastric animals (Omoikhoje *et al*., 2005). These authors reported that bambara groundnut is an underutilized feed resource for livestock and it is indigenous to Africa. Therefore, it can be a useful alternative to groundnut cake and soyabean meal. This is because of its nutritional qualities which are comparable to other leguminous feed ingredients. Pfeffer *etal*. (2002) explained that bambara groundnut contained 27% crude protein, 60% nitrogen-free extract, 9% ether extract and gross energy of 19MJ/Kg DM. The crop is cultivated under a wide range of soil and climatic conditions. It is known to be cultivated in the semi-arid environment. Joseph *et al*. (1999) reported that bambara groundnut seeds are virtually free from metabolic inhibitors and toxins, a common phenomenon in most legumes. However, Omoikhoje *et al*. (2005) have reported that it has trypsin inhibitors, which can be removed by heat treatment.

Therefore, with the recent advocacy for increased protein in the diet of people living in developing countries through integrated livestock and crop production, rabbit production using under-utilized crops such as bambara will be a step towards improving the nutritional and economic status of most peasant farmers, especially in the semi-arid zone of Nigeria.The high cost of conventional feed ingredients as a result of competition between human and livestock brings about persistent shortfall of animal protein in the diets of most people living in developed countries, which invariably leads to undernourishment. The use of non-conventional feed such as bambara groundnut to feed fast-growing animals like rabbit should be given attention.The objective of this study is to evaluate the nutrient digestibility and carcass characteristics of growing rabbits fed varied levels of CBGM; anddetermine the proximate composition of Cooked Bambara Groundnut Meal (CBGM). The study will serve as a step towards improving the nutritional status and economic well-being of peasant farmers in Maiduguri. It will equallyprovide useful information about the effectiveness of using bambara groundnut (*Voandziea subterranea*) as an alternative to groundnut cake in the diets of growing rabbits.These information will be handy tools for students and researchers in the field of monogastric nutrition.The study evaluated the suitability of replacing GNC with CBGM as a protein source in the diets of growing rabbits. Parameters such as nutrient digestibility and carcass characteristics were evaluated.

II. MATERIALS AND METHODS

The feeding trial was conducted at the Ramat Polytechnic's Agricultural Science and Technology Animal Farm, in Maiduguri. Maiduguri is located within latitude 11^0 5'north and longitude 13^0 9'east (Encarta, 2007). It has an altitude of 354m above sea level (Alaku, 1983). The vegetative zone falls within the sahelian region of West Africa. The annual rainfall varies from 500-600mm with short duration of 3-4 months rainy season; long dry season of 7-8 months is prevalent. According to Ugherughe and Ekedolum (1986), the mean relative humidity ranges from 30%-50% around February to March, while maximum record of 90% is observed around August. Ambient temperatures are higher during the months of April to May and may reach up to 40^0 C and above (Alaku, 1983). According to Aliyu (2007), ambient temperature could be as low as 20^0C during the cold season while during the hot period, which is between February to June, it can reach 44^0 C.

Sources of ingredients

Bambara groundnut (*Voandzeiasubterranea*) seeds were purchased from the Maiduguri Monday market. Other sources were Gamboru market, Muna Garage, Baga motor Park Market and other markets in Maiduguri, Nigeria. Likewise other ingredients were purchased or sourced locally.

Method of processing bambara groundnut seeds

The bambara groundnut seeds were subjected to cooking at boiling point(100^0C) for a period of one hour in an aluminum cooking pot containing water sufficient enough to cover the seeds using firewood as a source of fuel. After cooking for the period of one hour, the seeds were separated from the water and sun-dried for five days. This is to ensure complete reduction of moisture for ease of milling as corroborated by Omoikhoje *et al*.(2005) and Omoikhoje *et al*. (2006). The sun-dried seeds were then milled and used for the preparation of the experimental diets.

Experimental stock and management

Thirty (30) mixed breed (New Zealand white X Dutch) of rabbits 6-7 weeks of age, were used for the feeding trial that lasted for the duration of ten (10) weeks, excluding one (1) week of adjustment period. The rabbits were weighed and

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randomly assigned to five (5) different dietary treatments, each treatment containing six (6) replicates. The rabbits were kept in separate cages made from wire with dimensions of 42cm x 42cm x 43cm (LX W X H). Cages were raised above the ground level for ease of cleaning. Metallic feeding trough and plastic drinkers were provided in each cage. Water and feed were provided *ad libitum* throughout the period of experiment.

Experimental diets

Five (5) experimental diets were prepared in which cooked Bambara groundnut meal (CBGM) replaced groundnut cake (GNC) as a source of protein at 0%, 25%, 50%, 75% and 100% levels in diets 1,2,3,4 and 5 respectively that produced is nitrogenous and is calorie diets formulated to contain 18% crude protein and 3437 metabolizable energy (kcal/kg).

The parameters measured

The parameters measured were nutrient digestibility and carcass characteristics.

Nutrient digestibility

The nutrient digestibility trial was conducted at the end of the 6th week of the experiment. Three (3) rabbits were randomly selected for total faecal collection. These animals were allowed two days adaptation period which was followed by five (5) days of faecal collection. Faeces were collected by placing fine wire mesh trays under the cage cells. The amount of faeces voided daily was weighed and then dried at room temperature for 2-3 days. The air dried faeces were then oven-dried at 105^0 C for 24 hours to achieve constant weight. The dried samples were stored for chemical analysis. The chemical composition of the faecal samples was determined using the Association of Official Analytical Chemists (AOAC, 1980) procedures. The apparent nutrient digestibility was calculated according to the formula proposed by McDonald (1991) as:

$$\frac{\%\text{ Nutrient in feed x feed intake} - \text{nutrient in faeces x faecal output}}{\%\text{ nutrient in feed x feed intake}} \times \frac{100}{1}$$

Carcass parameters /slaughter procedure

At the end of the experiment three (3) rabbits from each treatment were selected for slaughter. The rabbits were selected based on the average weight of each treatment group. The rabbits were fasted overnight (12 hours) before slaughtering; this was done to reduce the risk of contamination of the carcass during dressing. Before slaughtering, the rabbits were weighed in the morning. This measurement is important in determining the dressing percentage (Fielding, 1991). The rabbits were slaughtered by transverse cutting of the trachea, oesophagus, large carotid arteries and jugular veins to ensure maximum bleeding (Mann, 1960).The dressed carcass is the part of the rabbit left after the removal of the head, feet, skin, kidneys and visceral organs. The dressed carcass were later divided into retail cuts (shoulder/forelegs, hind legs, rack and loins) as described by Blasco *et al*. (1993). The head, feet, skin, heart, liver, kidneys and lungs were weighed and expressed as percentage of slaughter weight. The weight of dressed carcass was expressed as a percentage of the live weight to obtain the dressing percentage.

$$\text{Dressing percentage (\%)} = \frac{\text{carcass weight (g)}}{\text{Live weight (g)}} \times \frac{100}{1}$$

Chemical analysis

The proximate chemical analysis of the faecal samples were determined using the AOAC (1980) methods of analysis.

Statistical analysis

All data collected in the course of the experiment were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980) and where applicable, Duncan's multiple range test (Duncan, 1955) was used for mean separation.

III. RESULTS AND DISCUSSION

The nutrient digestibility of rabbits fed various levels of CBGM was presented in Table 9. The result of this study showed that there were significant differences (P<0.05) among treatments for digestibility ofdry matter and crude protein, crude fibre, ether extract, ash as well as that of nitrogen-free extract. The digestibility for CP has ranges of 80.27% to 85.33% with the control having highest value. The EE digestibility were 72.25% to 80.67% for different treatment groups with rabbits on 25%CBGM diet having highest value while lowest value was recorded in the group receiving 75%CBGM.The digestibility for ash ranges from 71.31% to 79.26%. Nitrogen free-extract digestibility ranges from 65.52% to 67.93% with significantdifference (P<0.05) among treatment groups. Despite the slightly higher digestibility of the control group (0%CBGM) the digestibility of nutrients recorded in this experiment showed that the nutrients in CBGM are highly digestible especially with heat treatment which was reported to bring about increased digestibility and protein utilization (Okah *etal*., 2006) and this could be responsible for the appreciable growth observed in the rabbits investigated since higher digestibility of nutrients makes them available for the animals to utilize.

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Carcass measurements

The carcass measurements are summarized in Table 2.Therewereno significant difference (P>0.05) among treatment groups for all carcass parameters measured except for the dressed weight, dressing percentage; and racks expressed as percentage of slaughter weight. The final live weight for the treatment groups ranged from 1375.00 g to 1456.66 g with the control having highest value, though not significantly different (P>0.05). The values obtained were higher than 960.10 g to 1041.60g reported by Joseph *et al*.(1999). Slaughter weights of 1243.33 g to 1390 g were obtained in this experiment and these were lower than 1695.00 g to 2050.00 g reported by Onifade and Tewe (1993) for growing rabbits. The dressed weight of 711.67 g to 756.67 g was recorded for the treatment groups with T_2group having significantly (P<0.05) higher dressed weight than other treatment groups. These values were higher than 288.70 g to 501.60 g reported by Joseph *et al*. (1999) since dressed weight is a reflection of the slaughter weight of the rabbits. The dressing percentage obtained were 53.10% to 56.79% with the control having significantly (P<0.05) lower value of 53.10%. This shows that inclusion of CBGM has positive influence on the carcass yield of the rabbits as reflected by the dressing percentage. Although the increase in dressing percentage did not followed a regular pattern, the treatment group T_2 (25%CBGM) has 56.79%, followed by T_5, T_3 and T_4 with 55.59%, 53.76% and 53.75% respectively. The dressing percentage obtained here compared favourably with the range (50-56%) reported by Fielding (1991) as normal for growing rabbits.

The weight of organs/body components expressed as percentage of slaughter weight indicated that there were no significant difference (P>0.05) among the various treatment groups. The values for head, skin, feet, heart, liver, lungs, stomach (with content), small intestine (with content), large intestine (with content), caecum, kidneys and kidney fats as percentage of slaughter weight were similar in all the treatments. The values for retail cuts expressed as percentage of slaughter weight shown in Table 12 indicated that there were no significant difference (P>0.05) among treatment groups in respect of theshoulder, loin and thigh. The weight of racks showed that there were significant differences (P>0.05) among treatment groups. The control group has lowest rack weight compared to other treatment groups. The range 5.54% to 6.36% was obtained for the rack which is slightly lower than 6.50% to 7.80% reported by Joseph *et al*. (1999) who fed toastedBambara nut to weaner rabbits. The low rack weight in the control group (0% CBGM and the 75% CBGM) may be linked to the low dressing percentage of the groups.

IV. CONCLUSION AND RECOMMENDATIONS

The continued increase in the demand for animal protein in the diet of people living in developing countries calls for an increase in production of fast-growing and prolific animals such as rabbit using non-conventional feed ingredients like bambara groundnut.

In this study cooked bambara groundnut meal was found to be suitable for the feeding of growing rabbits at different levels of inclusions, from 25% to 100% as a replacement for groundnut cake, a conventional plant protein source. Rabbits fed varied levels of CBGM have shown good performance in terms of weight gain, feed efficiency and nutrient digestibility. Although CBGM can replace 100% of the GNC in the rabbit's diets, the inclusion of up to 50% of CBGM in the diet of growing rabbits as replacement for GNC gave optimum economic benefits. The use of CBGM in the feeding of growing rabbits is a simple and cheaper method of overcoming the adverse effects of the anti-nutritional factors.

From this experiment it can be concluded that cooked bambara groundnut meal (CBGM) can replace groundnut cake (GNC) at different levels of inclusions but 50% CBGM diets should be used for optimum economic benefit. However, to obtain more information, it is recommended that investigations be extended to cover other age groups and classes of rabbits such as fattening, pregnant and lactating rabbits.

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Table 1: Nutrient digestibility of rabbits fed varied levels of cooked bambara nut meal(CBGM) as replacement for groundnut cake (GNC)

Levels of GNC replaced by CBGM	T_1(0%)	T_2(25%)	T_3(50%)	T_4(75%)	T_5(100%)	SEM
Number of rabbits	3	3	3	3	3	-
Dry matter (DM) %	63.32^{ab}	62.70^{ab}	61.49^{ab}	59.49^{c}	64.17^{a}	0.3652*
Crude protein (CP)%	85.33^{a}	80.27^{e}	81.33^{d}	81.71^{c}	85.18^{b}	0.5774*
Crude fibre (CF) %	47.79^{b}	47.41^{c}	46.44^{d}	42.38^{e}	49.69^{a}	0.3361*
Ether extract (EE) %	78.35^{abc}	80.67^{a}	78.91^{ab}	72.25^{e}	72.98^{d}	0.3665*
Ash %	79.26^{a}	76.16^{ab}	71.45^{c}	67.71^{e}	71.31^{d}	0.3661*
Nitrogen-free extract %	66.92^{ab}	67.46^{b}	67.93^{a}	65.52^{c}	66.12^{c}	0.3624*

SEM= standard error of means

NS= not significant (P> 0.05)

* Significant difference (P<0.05)

a, b, c. mean in the same row bearing different superscripts differ significantly.

Table 2: Carcass measurement of rabbits fed varied levels of cooked bambara groundnut meal(CBGM)

Levels of GNC replaced by CBGM	T_1(0%)	T_2(25%)	T_3(50%)	T_4(75%)	T_5(100%)	SEM
Number of rabbits	3	3	3	3	3	-
Final live weight (g)	1456.66	1425.00	1375.00	1346.00	1398.33	38.8350^{NS}
Slaughter weight (g)	1390.00	1333.33	1323.33	1243.33	1311.70	45.1680 ^{NS}
Dressed weight (g)	738.33^{b}	756.67^{a}	711.67^{ab}	668.00^{ab}	728.33^{b}	26.0830*
Dressing percentage (%)	53.10^{c}	56.79^{a}	53.76^{ab}	53.75^{ab}	55.59^{b}	1.0972 *
Weight of organs/body components as percentage of slaughter weight						
Head	9.45	9.89	9.31	9.20	10.25	0.4233 ^{NS}
Skin (wet)	8.77	8.35	8.55	8.77	9.23	0.5500 ^{NS}
Feet	2.33	2.67	2.16	2.35	1.63	0.2366^{NS}
Heart	0.26	0.29	0.32	0.27	0.75	0.2220 ^{NS}
Liver	2.77	2.28	2.76	2.54	2.63	0.1326 ^{NS}
Lungs	0.70	0.79	0.70	0.81	0.73	0.1211 ^{NS}
Stomach(with content)	3.89	3.63	3.20	3.77	3.38	0.4543 ^{NS}
Small intestine ,,	3.25	3.02	2.96	3.00	2.33	0.2575^{NS}
Large intestine ,,	1.66	1.49	2.12	1.70	1.12	0.3715 ^{NS}
Caecum ,,	7.05	4.29	5.81	6.55	5.11	0.7819 ^{NS}
Kidneys	0.63	0.59	0.71	0.64	0.63	0.1615 ^{NS}
Kidney fat	0.86	0.94	0.93	1.39	0.70	0.2723 ^{NS}
Retail cuts as percentage of slaughter weight						
Shoulder/forelegs	15.42	17.53	14.79	15.97	15.97	0.4465^{NS}
Racks	5.54^{b}	6.13^{ab}	6.55^{a}	5.49^{b}	6.36^{a}	0.2378*
Loins	10.73	9.80	10.34	10.85	8.62	0.6299^{NS}
Thighs/hind legs	21.30	23.06	21.39	21.75	22.81	0.8339^{NS}

SEM = standard error of means

NS= not significant (P>0.05)

* = significant difference (P<0.05)

a, b, c… means in the same row bearing different superscripts differ significantly (P<0.05).

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The Influence of Climate Variation on Abiotic Plant Stress: A Review

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***Abstract*— *The increase in the carbon-dioxide (CO_2) present in the atmosphere as a result of human activities affects the ambient temperature, and rainfall pattern in terms of season, duration, intensity of sunshine, increased drought periods, waterlogging, and increased evapotranspiration. This influence negatively the development, yield and quality of the plants grown under this condition. The quests to produce stress tolerant/resistant plants and increase crop productivity have led to the study of plant stresses, their response to different stress type and stress management procedures in plants. This paper has discussed in details the different abiotic stressors in plants and how they are being influenced by climate variation, the response of these plants to different abiotic stresses or a combination of stresses, and its management.*

***Keywords*— Abiotic Plant Stress, Climate variation, Plant Responses, Stress Management.**

I. INTRODUCTION

The effects of climate change on the general environment have been very significant over the years, most especially in agricultural plants grown in these environments. According to Intergovernmental Panel on Climate Change (IPCC), stresses are incurred on plants as a result of changes in the climatic conditions of the environment, which has been conclude to be the most influencing factor affecting agricultural production at low lowlands mostly occupied by developing countries[1].It increases the presence of carbon dioxide in the air and also the temperature of the environment[2]. These are major constraints to food supply and balanced environment which has lead most researchers into looking for good adaptation strategies for plantsunder this condition[3], by developing plant species and smart crops that are resilient to the effect of climate change[4]. Vulnerability to this kind of stress inhibited on plants due to climate change results to disruption in the plant metabolism processes, thereby incurring reduction in aptness and quality agricultural crop production[5]. The individual climate change inducing stressors are abiotic in nature [6] and they imposestress on different plant species: these includes drought, elevated CO_2, temperature (low and high)[7], waterlogging, rainfall and sunshine intensity, chemical factors (heavy metals and pH). The fight against these stress factors are however complex due to the interrelationship amongst them [8], with the major challenge being to understand how these react to different stressors, the diversity response pathways elicited by them and their genetic determination [1, 9, 10].This paper therefore aimed at reviewing the influence of climate variation on abiotic plant stress, responses and management.

1. Major Abiotic Stressors in Plants

1.1. Temperature

Development and growth of plants is hinged on the environmental temperature. This varies depending on the crop grown [11]. The effect of temperature on the potentials of plants growth are maximum and minimum daily temperature and variation in the day and night temperature with their respective average temperatures [12]. A significant rise in the temperature due to climate change will over time in reduced rainfall, wind speed and snow cover which will also lead to a reduced length of growing season for plants, and will affect negatively the quality of the crops and agricultural productivity[13]. Fluctuations in the environmental temperature occurs more speedily than

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changes in stress factors thus exasperating the effects of other stresses on plants [8]. The rise in temperature is a result of the global warming which varies regionally. Prospectively, the developing countries are more vulnerable and this may perhaps result in increasing food insecurity in such region. A recent study on the effects of frost and extreme temperatureson wheat production (*Triticum aestivum L*) showed that frost caused unfruitfulness and abortion of formed grains while excessive heat resulted in reduction in number of grains formed in filling period of the grain [14]. With the notable effects of these extreme weather events on crop production which results from climate change, the impending effect of climate variation will endanger the production trend of crops thereby giving room for food insecurity. The effect of high temperature stress on a pearl millet, identifying sensitive stages, with parameters like temperature thresholds, genetic variability and fertility of pollen germination being determined. It was found that exposure to high temperature stress reduces pollen germination and seed yield, and also affects the fertility of the pollen and pistil tissues[15, 16].

The response of plants to this class of stress depend the type of crop or plant as seen on Fig. 1. Broccoli (*Brassica oleracea var. Italica*) growth response to temperature started from 5 ^{0}C and retired at 25 ^{0}C while that of maize (*Zea mays L.*) started from approximately 10 ^{0}C and retired at approximately at 40 ^{0}C.

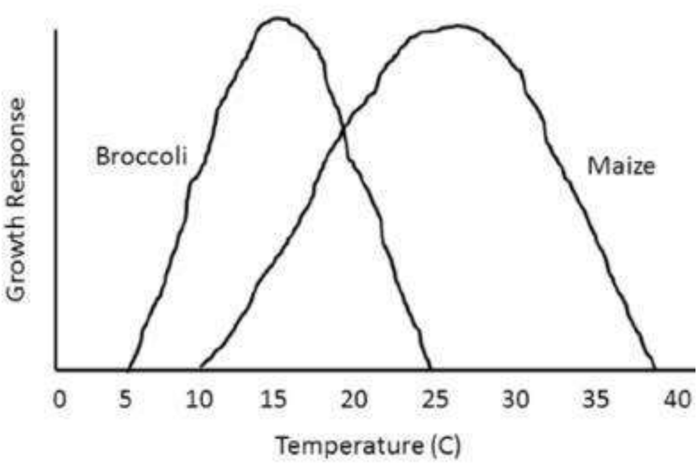

Fig.1: Minimum and Maximum temperature response for maize and broccoli [11]

1.2. Drought and Rainfall pattern

Drought is one of the major abiotic stressor of agricultural plants restraining crops' return globally [17]. It does not only affect the crops growth and yield, also affect the quality of the yield. In an experiment carried out on miscanthus for biofuel production, drought treatment was observed to have declined plant weight by 45% and the composition of the biomass and cell wall structural rigidity were severely altered due to stress incurred by the plant during the drought period[18]. According to Dhankher (2018), drought as an abiotic stress factor is being projected to hinder productivity in more than 50% of the arable lands in the world by the next 50 years. But the availability of saline water might lighten the world's water problem if plants that are salt tolerant are being developed[15, 19-22]. However, in response to this kind of plant stress, the need for drought tolerating plant is a necessity to boycott or reduce its negative impacts on food security. Fig. 2 shows an extreme case of drought on a land.

Fig.2: Xerohalophytes growing in soil impacted by severe Drought[15].

Also in terms of rainfall pattern and distribution, already in tropical countries, there is variability in the soil water content as a result of its distribution as reported by [23]. This is an indication that the soil water content is becoming scarce for plants use. In an investigation to know the effect of timing precipitation on grassland and rainforest in USA, the result showed that soil water content available for plant use depend on the amount of precipitation in the study area [24]. That is, when rainfall distribution uniformity is low, the available soil water content would reduce, hence will not uniformly meet the plant's soil-water-nutrient need, thus inducing stress on plants in those affected areas. This is often results from climate change. According to [25] and [26], climate change influences the timing of rainfall from one season or period to the other either resulting in smaller precipitation event or large one depending on the shift. This sudden shift in the precipitation affect plants growths and

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causes plant stress by disturbing plant metabolism, arresting photosynthesis, and may finally cause plants to die off.

Change in the soil water content and soil features results in having reasonable impact on the plant and soil processes as indicated on by Fig. 3. The response in Above-ground Net Primary Productivity (ANPP) depends on which season receives extra water and which one receives less. The findings here further showed that the soil water content determines the response of Above-ground net Primary Productivity [27]. Generally effects of drought stress on plants includes Reduction in seed germination and development, poor growth in vegetation, poor reproductive growth, reduction in leaf weight, reduced photosynthesis, reduced stomatal conductance andsignificant reduction in the total dry matter.

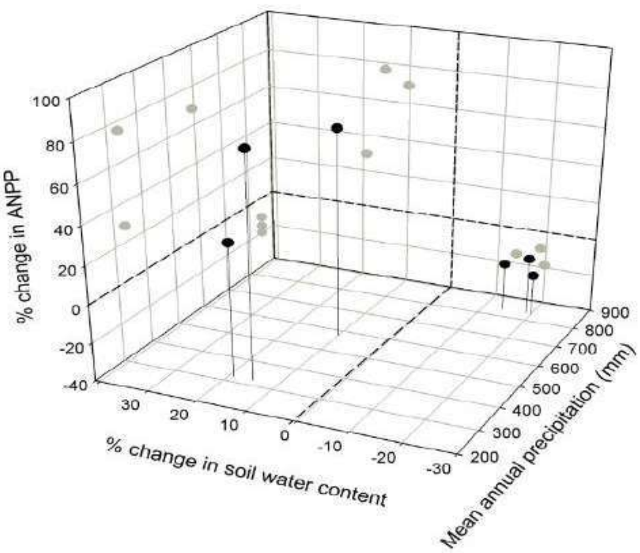

Fig.3: The of effect precipitation at extreme level on the Above-ground Net Primary Productivity through a rainfall slope[18]

1.3. Waterlogging/Flooding

Climate change has altered the hydrological cycle processes which have resulted to impairment or reduction in crop growth in so many areas around the world. Consequently, there is a large scale reduction in agricultural production especially on a flatland or places near the river due to waterlogging [28]. Waterlogging occur as result of leakage from irrigation canals or pure surface drainage but predominantly caused by heavy rainfall in such area [29]. As a result of the built water on the land and soil compaction, the available Oxygen (O_2) for plants cells are reduced because the diffusion process of O_2 is slow in ponding water [29, 30]. Due to the limited supply in O_2, anaerobic bacteria releases venomous amount of Iron ion, Manganese ion and sulphide [29].

Crops grown in a waterlogged condition undergo different physiological and morphological variations [29]. One of the major response of plant to waterlogging stress is stomatal cessation which impacts not only gas exchange, but also reduces the submissive absorption of H_2O, which is harmfully prejudiced by anaerobic conditions in the rhizosphere [28]. Transpiration is also reduced which eventually results to wilting of the leaf and early senescence; consequentially, foliar abscission will become the result [31]. In flood logged area, respiration of roots are not aerated in which gas diffusion are severely reserved, thereby resulting to it changing from aerobic to anaerobic conditions which is dangerous to plants development [31, 32]. Waterlogging also deters the nutrients intake of plants as presented in Table 1. [33] in an investigation to know the effect of waterlogging on growth nutrient concentrations observed that there was high sprout dry weight of wheat in the waterlogged treatments compared to the control. Both in barley and wheat there was an indication of reduction nutrient such as Nitrogen, Phosphorus, Potassium, Manganese, Copper, Zinc and Magnesium as shown on Table 1.

Table 1: Mineral concentrations of spring barley and spring wheat shoots as related to a 15 days period of waterlogging

	Wheat			Barley		
Nutrients	Control	Waterlogged	SC	Control	Waterlogged	SC
Mg/g dry matter						
N	47.1	38.1	30-45	49.9	34.8	20-40
P	6.2	4.9	3.5-6.0	5.1	3.9	3.5-6.0
K	57.4	48.6	33-45	63.2	45.1	30-55
Ca	6.3	5.8	4-10	8.3	6.9	5-10
Mg	1.9	1.4	2-3.5	2.3	1.9	1.5-3.0
Mg/kg dry matter						

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Mn	41.8	27.5	35-100	37.9	21.9	30-100
Cu	12.2	10.0	7-15	10.5	7.2	6-12
Fe	92.8	89.7	-	89.9	69.1	-
Zn	39.6	28.5	25-70	38.4	26.5	20-60
Mg/g dry matter						
N	49.1	29.0	30-45	48.9	34.5	20-40
P	4.6	3.3	3.5-6	4.4	3.6	3.5-6.0
K	50.5	28.0	33-45	54.5	28.1	30-55
Ca	4.9	6.2	4-10	8.1	12.2	5-10
Mg	3.2	2.0	2-3.5	3.0	2.8	1.5-3.0
Mg/kg dry matter						
Mn	53.9	35.1	35-100	63.9	47.7	30-100
Cu	10.7	7.9	7-15	10.1	9.4	6-12
Fe	72.1	70.0	-	69.5	71.0	-
Zn	38.6	21.4	25-70	40.5	34.1	20-60

Source: Adopted from [33]

1.4. Salinity

The effect of salinity on agricultural crop production and food supply according to [15] has been on the increase worldwide, with the cultivation of salt-sensitive crops such as rice and wheat being a worldwide practice [34], salinity stress needs to be promptly addressed. Rice according to [34] is one of the crops planted most around the world as it is a major source of food for almost all humanity. Thirty-nine (39) million hectares out of the 130 million hectares of land on which rice is cultivated worldwide contains a certain degree of salinity which varies with the rice cultivar [35, 36]. Salinity is a stressor common to arid and semi-arid regions of the world where evapotranspiration exceeds rainfall, and as a resultleads to inadequate rain to filter away the soluble salts from the root zone[37]. Lands with salinity stress problem covered at least 7 percent of the world land area four decades ago according to [37], and has been seen to double every two decades. Showing that the salinity stress problem is rapidly increasing every day majorly as a result of climate change[38, 39]. Approximately 1.6 Mha of land is being lost to salinity stress every year, with 60 percent salinization coming from natural sources (weathering of minerals, and soils developed from saline rocks) and 40 percent coming from secondary sources(irrigation, deforestation, overgrazing or intensive cropping). But ironically majority of the land loss as a result of secondary salinization is caused as an adverse effect of irrigation of the farmland[37] with both normal water and treated sewage effluents. This takes place in at least 20 percent of irrigated lands in agriculture [38]. The salinity stressor reduces drastically the ability of plants to take up water and other nutrients from the soil, leading to stunted growth; salt deposits find their way into the transpiration stream and damage the cells in leaves thereby causing leaf burn; it also affects the enzyme activity happening within the plant.The salinity of a soil is measured in terms of electrical conductivity (EC), and these soils have a mixture of salts of Sulfate, Sodium, Magnesium, Chlorine and Calcium.

But most often, it is the combination of two more stressor that sometimes affect growth of a plant, for example heat and salinity or drought and heat as indicated by the Venn diagram presented in Fig. 1 [6]. Several researches have investigated the combine effects of drought and heat stress on maize, sorghum and turf-grasses growth and productivity. The studies showed that the combine effects of the two stressors were higher compared to when the stresses were applied individually [40-42].

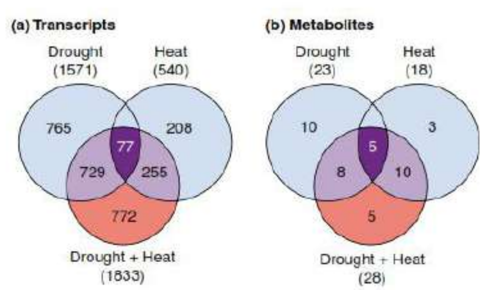

Fig.4: Unique molecular characteristics of drought and heat stress combination[6]

II. PLANT RESPONSES TO ABIOTIC STRESS

Having seen that abiotic stresses on plants like temperature, flooding, drought, and salinity affect crop production heavily, as they cause stunted growth in plants, affects plant metabolism and thus reducing crop yield by as much as 70%[43], it has also been seen that 50% of crop yield losses come as a result of abiotic stress in most crop plants [43]. Also with the constant changes in the climatic conditions of the world, most of these abiotic stresses on plants are made worse than how it was in previous years. For example the increased presence of CO_2, methane, Nitrous oxide and Chloro-flourocarbons in the atmosphere as a result of industrialization and other human activities have increased drastically the average ambient temperature which causes heat stress[43, 44]. This increase in the ambient temperature of the environment also increases the evaporation in water bodies, thereby causing an unexpected decrease in the available water for crop production which in extreme cases leads to drought[4, 34, 43]. Therefore a better understanding of plant responses to these abiotic stresses and their tolerance mechanism will help improve crop resistance and productivity[45, 46].

Plants response to Abiotic stresses depends heavily on their developmental stage. Their response to drought and flooding according to [43] is majorly ordered by genetic expression and biochemical metabolism via different physiological processes. Some of the morphological growth indices affected by drought stress is the leaf area of the plant, the plant height, dry matter and biomass production. The photosynthetic efficiency, gas exchange measurements, the stomatal conductance, the phytochemical and the non-phytochemical quenching, malondi-aldehyde (MDA) and relative water content are the physiological indices put in check during the evaluation of drought stress in plants[47]. Therefore plants undergoing this type of stress gradually losses water from the protoplasm, the plant cell will dehydrates and this affects the structure of the plant cell [43, 45, 48]. When all the free water in the protoplasm of the plant cell is lost, only plants that are dessication-tolerant (resurrection plants) will remain, and others will die off [43].

Plant's architecture is altered during flooding, although this is majorly dependent on the type of flood. When the plants are covered completely with floodwater, plant growth is stopped to conserve energy to be used once the level of water goes down. This strategy is important when the plant is completely flooded[43, 45]. In situations whereby the plantsare completely flooded for a long period of time, the plant dies off as a result of the food reserve being completely depleted. During this period, there is also low oxygen (O_2), and the plants resort to rearranging their anatomy and metabolism so they can be able to function. This rearrangement to create space and a continuous gas channel to facilitate an internal O_2 from the canopy to the root of the plant is known as aeranchyma [45]. Adjustment to the metabolic pattern of the plants during flood stress is driven by hormones like the abscisic acid, gibberlin, and ethylene.

In periods of high temperature, there is a very severe damage to the chlorophyll, as heat stress changes the structural arrangement of the thylakoids, thus affecting its functionality, and also reduces the chlorophyll content of the plant. The above adverse effects on the plant reduces the ability of the plant to photosynthesize because by reducing the chlorophyll content, the photosynthetic pigments are reduced, thereby leading to physiological impairment and reduced growth of the plant [49]. The leaf of the plant also loses water under high temperatures thus leading to stomatal closure due to reduced leaf water potential[43, 49]. According to [50] stomatal closure is the major factor affecting photosynthesis in plants. High temperatures according to [51] causes impaired pollen and ovary development which adversely leads to the bad reproductive health of plants. Plants also undergo denaturation of protein and enzymes under extreme temperature conditions which gives rise to the programmed death of the tissues and cells [43, 52].

III. ABIOTIC STRESS MANAGEMENT

Managing abiotic stresses in plants is a very is a challenging task because of its multifaceted nature. Comprehensive researches for the development of abiotic stress tolerance in plants are in progress, comprising genes from several pathways like the osmolyte synthesis, ion homeostasis, antioxidative pathways, and regulatory genes [53]. Several attempts have been made to substantiate the role of "single-function" gene(s) in the past ten (10) as well as transcription factor(s) for abiotic stress tolerance [53]. Because abiotic stress tolerance is multigenic in nature, the modern trend is moving towards genetic transformation of multiple genes or transcription factors. Generally, abiotic stresses can be managed by genetically improving the genes and transcription factors, or by employing cultural practices which includes modification and adjustment of planting time and crop density in the field so as to contain the effect of these abiotic stresses. Another method is to apply phytohormones, signaling and trace elements and also by applying osmo-protectants[44, 51].

Conventionally, some of the plants tolerant to these abiotic stresses discussed in the previous sections can be recognized when proper screening methods and criteria for selection are employed via cultural field breeding techniques, like modifying planting time and adjusting the compactness of plants cultivated to evade these stress situations [43, 52]. One major limitation in adopting the conventional field screening of these plants is that the screening and identification process of a plant for a particular type of stress-tolerant trait might be severely influenced by other stress factors. For instance, the quality of the screening process of a plant for cultivars tolerant to extreme temperature stresses, might be affected by other stresses either biotic (pests and pathogens) or abiotic (salinity). Therefore [44, 52] was of the opinion that glasshouses screening should be employed as an alternative to field screening [43]. Selection of some stress-tolerant plants for cultivation has been has notably been hindered by the polygenic nature of the trait, epistasis, genotype by environment and low heritability[43].These traits can be identified by carrying out Quality trait Loci (QTL) analysis. The Qualitative trait Loci (QTL) analysis according to [43, 44, 52]were carried out on rice, maize and wheat and heat stress tolerant traits were found. Although these traits were found to be associated with the reproductive stage of these plants[43, 54, 55]. Some other Loci, like the Loci for freezing tolerance at vegetative stage, chilling at seedling stage, submergence-tolerance Loci was also found in Arabidopsis model plants, maize and rice.

Biotechnological advancement has of recent given way to genetically modify the crop plants to be resistant or tolerant to some stress factors[56]. Advancement in biotechnology and genetic engineering brought out tools and methods of controlling the mechanism of abiotic stress resistance, and for developing crops tolerant to specific stress by introgression of the genes involved in stress response and putative tolerance [57]. This is important as it introduces the modified genes into genomes of elite breeding lines, and as such helps to improve crop varieties [16, 52, 54, 56, 57].

IV. CONCLUSION

It can be seen that climate change severely intensifies the effect of these abiotic stresses on plants. The stresses not properly managed makes it impossible to meet global food demand. The tolerance of plants to abiotic stress is as a result of activities ofdiverse stress-responsive genes that relate with other elements of stress-transducing pathways. A very good knowledge of the physiological processes in response to different abiotic stress will help design methods and mechanisms to transform in order to improve tolerance of different abiotic stress in plants. Thus, stress-tolerant gene resources from crop plants, model plants and microorganisms need to be identified and developed by making use of appropriate genetic transformation technologies.

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Adoption of Improved Cassava Varieties by the Women Farmers in Akinyele Local Government area of Oyo State

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Abstract— *The study investigates adoption of improved Cassava varieties by women in Akinleye Local Government area of Oyo State. 92 respondents were selected using multi stage sampling techniques. Data on sources of input used, adoption of cassava varieties and problem been faced in process of adoption of improved varieties were collected through structured interview schedule. The data was later analyzed using descriptive and inferential analysis. The findings revealed that most (29.3%)of the respondents were between age 30 to 40years, 27.3% of the respondents, had no formal education while 43.5% had 5 to 10 years' experience in cassava farming. The relationship between socio-economic characteristics such age, educational level, farm size, years of farming, labour and adoption level of respondent were determined using chi-square. Inferential statistics shows that there is no significant relationship between age, marital status, secondary occupation and adoption (P>0.05) while education, household size and adoption show significant relationship (P< 0.05). It was observed that most women farmers are late adopters of improved cassava varieties developed by the research institutes in the country. It is recommended that women should liaise with research institute for proper information on current improved cassava varieties in the country.*

Keywords— ***Level ,Adoption, Improved Cassava Varieties, Women Farmers, Akinleye LGA.***

I. INTRODUCTION

Cassava *(Manihot Esculenta*), also called yucca, Mogo, or manioc, is a woody shrub of the euphorbiaceous (spurge family) native to south America.(Akinwonmi and Andoh, 2013). It is extensively cultivated as an annual crop in tropical and sub-tropical regions. The oldest direct evidence of Cassava comes from a 1,400 years old Maya site Joya de cern, in Elsalvador (Stone, 2002). World population of Cassava root was estimated to 184 million tons in 2002, rising to 230 million tons in 2008 (FAO, 2008). The majority of the production in 2002 was in Africa where 99.1 million tons were grown, 51.5 million were given in Asia and 33.2 million tons in Latin America and Caribbean. Nigeria is world largest producer of Cassava. however, based on the statistics from the FAO of the United Nations, Thailand is the largest exporting country of dried Cassava, with a total of 77% of world export in 2005 (Berrin and museum 2007). Cassava plays a particular important role in agriculture in developing countries especially in sub-Sahara Africa because it does well on poor soils and with low rainfall, and because it is a perennial that can be harvested without allowing it to act as a famine reserve, and it also offers flexibility of resource-poor farmers because it serves as either a subsistence or a cash crop (Stone, 2002).

In Nigeria, Women farmers are into agriculture and most especially cassava farming starting from planting to harvesting, processing and production. Our women farmers are illiterate using crude tools for subsistence agriculture and old methods of planting, these are the prevailing conditions under which Cassava is planted in Nigeria, and processed as Garri (Berrin and museum, 2007). For success to be recorded in the area of cassava , there is need to carry women along in the adoption of improved cassava varieties, Although, Nigeria has released so many improved Cassava varieties that will boost production and keep the country in the lead of world's largest producer of the root crop. The varieties, which are products of about a decade old convectional breeding research include, NRO1/0004, CR41-10TMS01/0203 and TMS 00/0240 were bred by scientist

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working at Ibadan-based International Institution of Tropical Agriculture (IITA), while NR 01/0004 and CR 41-10 were bred by Umudike-based National Root Crops Research Institute (NRCRI) and the Columbian-based International Centered for Tropical Agriculture (CIAT) respectively (Akoroda and Teri, 2004).

The input and effort of women in Cassava production is the major reason for the improvement in the production of the crop in the country. The hard labour of women which contributed to the general acceptability of the crop in the area of domestic uses and industrialization usage are the main reason of our rating in the world as the one of the major producer of the crop in the world. Against this background, the study ascertained adoption of improved cassava varieties by the women farmers in Akinyele local Government of Oyo State.TMS01/0203 and TMS 00/0240 were bred by scientist working at Ibadan-based International Institution of Tropical Agriculture (IITA), while NR 01/0004 and CR 41-10 were bred by Umudike-based National Root Crops Research Institute (NRCRI) and the Columbian-based International Centered for Tropical Agriculture (CIAT) respectively (Akoroda and Teri, 2004).

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II. RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

The findings revealed that 10.9% of therespondents are less than 30 years and above 60years respectively. 29.3% of the respondents falls between the age of 31-40 years and 26.1% between 41-50 years and followed by 22.7% of respondents between 51-60- years. This implies that that the probability of women participating in farm work depreciates with age . Table 1, further shows that majority of the respondents were married (88%) while just 6.5% were single. This shows that majority are mature which confer responsibility. This is in line with Pratt (2004) finding who reported that married people tend to be responsible for the needs of their family at all times . It was further revealed that respondents with primary school certificate (42.4%) were much involved in cassava farming from the result obtained. 28.3% of them have no formal education while 7.6% added Adult literary school. Secondary or Modern school certificate recorded 12% while 9.8% of them had tertiary certificate. This implies that the level of education of the respondents can be attributed to lackadaisical altitude of the women to adoption of improved cassava varieties in the study area. Also, It was revealed that 62% of the respondents were using between 1-5 hectares of land for cassava activities, 8.7% of the respondents used between 10-15 hectares of the land while 12.0% of the respondents are using 15-20 hectares of the land for their farming activities. This implies that level of adoption will be low as a result of fewer people with large hectares of land , with small land these set of farmers will adopt innovations earlier.

It was also revealed that 34.8% of the respondents hired labourer to assist them of their farm while 25.0% used family as sources of labour. Most (38.0%) of respondents make use of family member combined with hired labourer on their farm. This implies that respondents practice hire and family labour in order to reduce their cost of input in other to maximized profit in Cassava planting.

Table 1: Socio-Economic Characteristics

Variable	Frequency	Percentage (%)
Age		
Less 30	10	10.9
31-40	27	29.3
41-50	21	26.1
51-60	24	22.8
Above 60	10	10.9
Total	92	100.0
Marital Status		
Single	6	6.5
Divorced	2	2.2
Married	81	88.0
Widow	3	3.3
Total	92	100.0
Educational Level		
No Formal Education	26	28.3
Adult Literary School	7	7.6
Primary School Certificate	39	42.4
Secondary School	11	12.0
Tertiary School	9	9.8

Total	92	100.0
Primary Occupation		
Farming	63	68.5
Petty Trading	22	23.9
Others	7	7.6
Total	92	100.0
Farm Size		
1-5	57	62.0
5-10	16	17.4
10-15	8	8.9
15-20	11	12.0
Total	92	100.0
Sources Of Labour		
Hired	32	34.8
Family	23	25.0
Hired And Family	35	38.0
Others	2	2.2
Total	92	100.0

Field Survey, 2017

From the Table 2, it was revealed that 35.9% of the respondent got their cuttings from relatives, 33.7% from market, and 9.8% of the respondents alsogot their cuttings from extension agent, while 20.7% of the respondent got their cuttings from research institutes. This implies that most (35.7%) of the respondent got their cuttings from relatives because they can easily approach them at any time. This is in line with Food and Agricultural study on rural area which stated that dependence people on resources of relatives on their farm is their way of life. (F.A.O, 1995). Table 2 also revealed that 18.5% of the farmers harvested their Cassava within 8 months, 22.8% of them Cassava within 9-12 months old, 15.2% of the farmers harvested their Cassava between 13-17 months old, 40.2% of the respondent harvested theirs within 18.22 months old while 3.3% of the farmers harvested their Cassava above months old. It can be denote that respondents are not into planting improved cassava varieties based on the outcome which are not encouraging. According to the Table 2, 30.4% of the respondents got their credit from relatives and friends, 12.0% of them got it from cooperatives while 29.3% of the respondents got their credit from personal savings, 27.2% of them got there from bank of personal saving this implies that most of the respondents finance their farm because they cannot afford to borrow. The result shows that 42.4% of the respondents got their fertilizer from extension agent, 45.7% of the respondents got theirs from Research Institute, and 7.6% of the respondents got their fertilizer from ADP service center, while 4.3% of the respondent got their fertilizer from farm's group. This implies that majority of the respondents got their fertilizer from Research Institute properly to ensure that fertilizers gotten are of good quality. Also, 55.4% of the respondents acquired their herbicides from extension agents, 23.9% got theirs from Research Institute and 7.6% also got their herbicides from ADP service centerwhile 13.0% of the respondents got their herbicides from farm's group

Table 2: Sources of Input for Cassava Activities

Variable	Frequency	Percentage
Sources of Stock		
Friends/Relatives	33	35.9
Market	31	33.7
Extension Agent	9	9.8
Research Institute	19	20.7
Total	92	100.0
Sources Of Credit		
Relatives/Friends	28	30.4
Cooperatives	11	12.0
Personal Saving	27	39.3
Loan from bank	25	27.2
Bank loan and personnel savings	1	1.1
Total	92	100.0
Sources Of Fertilizer		
Extension Agent	39	42.4
Research Institute	42	45.7
ADP Service Center	7	7.6
Farm's Group	4	4.3
Total	92	100.0
Sources Of Herbicides		
Extension Agent	51	55.4
Research Institute	22	23.9
ADP Service Center	7	7.6
Farm's Group	12	13.0
Total	92	100.0
Sources Of Insecticides		
Extension Agent	35	38.0
Research Institute	13	14.1

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ADP Service Center	20	21.7
Farm's Group	24	26.1
Total	92	100.0

Field Survey, 2017

Level of Adoption by the Respondents

Table 3 revealed that majority (37.5%) of the respondents were late adopters. This implies that the majority of the respondents adopted improved varieties of cassava after outcome and feedback from early adopters.Laggers with23% followed the majority, the lagggers are the set of respondents who wait for a certain innovation to completely outdated. They adopted the improved varieties that are not been used by the majority in the study areas. It was observed from the Table that only 6.5% are innovators. This implies that that they accounted for lager farm land and are ready to take risk at any time. Also from the study it was revealed that the innovators are the educated farmers in the study area.

Table 3: Level of Adoption

Level of Adoption Percentages	Frequency	
Innovators	6	6.5
Early majority	12	13.0
Early Adopters	17	18.5
Later Adopters	34	37.5
Laggers	23	12.0
Total		92 100.0

Source: field survey, 2017

Problems of Cassava Farmers in Adopting Improved Varieties .

The Table 4 shows the problems of cassava farmers in cultivating new improved Cassava varieties. From the Table 4 it is deduced that the respondents were indifference that new cassava varieties has extremely short live, 50% accept while 50 % reject. Also, it was accepted by majority (100%) thatthe roots deteriorate within hours of harvesting while majority !00% made it clear that information on improved cassava varieties are not been spread enough to the farmer. It was also revealed that 100% of the respondent accepts that there is insufficient land for cassava cultivation in commercial quantity. Also from the result of the analysis, 100.0% of the respondents accept that there is limited funding sources and epileptic power supply. 50.0% of the respondents accepts that there were no plans to absorb the excess quantity produced while 50.0% of the respondent reject. Respondent also encounter indebtedness to financial institution from which they obtained loans to engage in large scale Cassava farming 0.00% of the respondent face this problem while 100.0% of the respondent did not encounter this problem.

Table 4: Problems of cassava farmers

Variable	Accept	Reject
New Cassava varieties has its extremely short live, the root deteriorate 34-72hrs of harvest	46(50.0)	46(50.0)
The root deteriorate 34-72 hours of harvesting	92(100.0)	0(0.0)
Lack of information of current improved varieties	92(100.0)	0(0.0)
Insufficient land for Cassava cultivation in commercial quantity	92(100.0)	0(0.0)
There were no plans to absorb the excess quantity produced	46(50.0)	46(50.0)
Farmers were indebted to financial institutions form which they obtained loans to engage in large scale Cassava farming	0(0.00)	92(100)

Source: Field Survey, 2017

Hypotheses Test

There is no significant relationship between some selected socio- economic characteristics and adoption of improved cassava varieties.

The test of relationship between selected personal characteristics of respondents and level of Adoption in Table reveals that household size ($\chi 2$=0.863, p=0.040) and education had significant relationships with level of adoption. It implies that household size assist the respondents to get information on improved cassava varieties. Also, education helped the respondents to use acquired knowledge, skills and attitude to perform effectively in the cassava production.

Table 5: Chi-Square Test of Socio-Economic Characteristics and Level of Adoption

VARIABLE	X^2	DF	PVALUE	DECISION
Gender	0.379	1	0.538	NS
Age	2.389	4	0.659	NS
Marital	5.842	3	0.120	NS
Household	0.863	2	0.040	S
Education	6.312	2	0.000	S
Secondary occupation	0.72	2	0.965	NS

Source: Field Survey, 2017

III. CONCLUSION AND RECOMMENDATION

From the Foregoing, It can be deduced that cassava farming unlike other food crops are mainly activity of married women who are most in their active age. Most of the farmers were into small scale farming which made up to be late adopters of cassava varieties. The Adoption of Improved cassava varieties was influenced by lack of agricultural input, inadequate information on improved varieties and glut issues Finally , education plays important role in adoption of improved cassava varieties, Majority of the educated farmers are into adoption of improved cassava varieties more than uneducated ones in the study area.

Recommendation

1. More women should be encouraged to get involved in cassava production
2. State and local Government should fully utilize the provisions of land use decree of 1978 for equitable allocation of land among progressive, for land – starved farmers.
3 .Effective supply of agricultural inputs, such as cassava or cultivars, fertlilizers, insectidides, through ADP at affordable prices, should be encouraged.

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Impact of Liberalization on Indonesian Food Security: An Error Correction Model Approach

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***Abstract*— *This study aims to examine the impact of trade liberalization in South East Asia on Indonesia's food security and to analyze the factor that determines food security in Indonesia. Error Correction Model (ECM) approach was used to analyze time-series data from 1980 to 2016. The result is trade liberalization that marked by the implementation of the AEC (ASEAN Economic Community), trade barriers elimination among ASEAN member countries, and trade openness affected food security in Indonesia in the short-run and long run. In the short run, food security was significantly influenced by rice availability, consumption growth, openness, rainfall, and AEC implementation. While, rice availability, rainfall, and AEC implementation was influenced by food security in Indonesia in the long run.*

Keywords*— *Liberalization, Rice, Food Security, Error Correction Model

I. INTRODUCTION

Trade liberalization in Southeast Asia has a significant impact on the goods and services trades in the region, especially in Indonesia. The impact of the liberalization of trade in goods and services arises from declining trade barriers and reducing import tariffs, reducing customs procedures, and increasing logistics (Itakura, 2014). The increase in trade cooperation in goods and services in the ASEAN region affected the ease of trade flows between countries. The ease of trade flows will facilitate the flow of food from food surplus countries to the food insecure countries. International trade was connecting food production and consumption and plays an important role in improving food security. It allows global production to take place in the most suitable areas and allows food to flow from the country with abundant food supplies to food-insecure countries (Runge, 2003).

Food security will be achieved if all people, at all times, have physical and economic access to safe and quality food according to their nutritional needs and preferences for active and healthy lives (FAO, 2006). International trade contribution to food security is explained in the Rome Declaration on World Food Security and the World Food Summit Plan of Action. The declaration provides a foundation for food security at the individual, household, state, regional and global levels. International trade has an impact on the dimensions of access to food security through its influence on prices, availability of production factors, economic growth, household income, and labor. Farmers sell excess crop yields in the local or export markets to obtain other food products. The amount of food that can be obtained is influenced by trade policies that influence the price of food that can be purchased with household income. Manufacturers indirectly benefit from an increase in demand for the goods they sell (Winters et al., 2004; Alesandro et al., 2017).

Numerous studies focused on the impact of liberalization on food security have investigated using several methods, such as qualitative methods was used in Mozambique(Laweki, 2016) in India and China (Gandhi et al, 2014) in developing countries (Boratynska, 2016; Gingrich et al, 2014; Anderson et al, 2014), and in Asia (Reardon et al, 2014). Computable general Equilibrium technique was used in Nepal (Pyakuryal, 2010), in Japan (Tanaka et al, 2011), in the Philippine (Mariano, 2014) others (Hosoe, 2014). Cointegration methods (Dorosh et al, 2016). Generalized Method of Moments (GMM) (Abdulai et al, 2017). Binary logistic regression methods in Pakistan (Abdullah et al, 2017). Time series analysis in the Philippines(Ebo, 2017).

The purpose of this study is to examine the impact of trade liberalization implemented in South East Asia on Indonesia food security and to explore factor determine food security in Indonesia in the long run and short run. This study is analyzed using the error correction model approach, and food security is measured by food energy consumption.

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II. MATERIAL AND METHODS

2.1 Data

Analyzing time-series data from 1980 to 2016, the data was obtained from the Indonesia Central Statistics Agency, Indonesia Ministry of Trade, Indonesia Ministry of Agriculture, Indonesia Meteorology Climatology and Geophysical Agency, Food and Agriculture of the United Nations (FAO), United Nations Conference and Trade Development (UNCTAD), World Integrated Trade Solution (WITS) World Bank, and ASEAN Secretariat.

2.2 Research Methods

To examine the relationship between food security and AEC, rice prices, consumption growth, availability, GDP per capita growth, openness, rice production growth, rainfall, the econometric analysis using error correction models were used.

First step the stationary or integration degree of the variables in the model using the Augmented Dickey-Fuller test (unit root test) were analyzed. The second step is to examine the long-run relationship between the dependent variable and the independent variable, where Johansen Cointegration Test is used. In the third step, the cointegrated data using the Error Correction Model (ECM) was analyzed.

The relationship between food security as a dependent variable with food prices, consumption growth, availability, GDP growth per capita, openness, production growth, rainfall, and AEC (dummy variable) as the independent variable is formulated in the basic research model below

$$FS = \beta_0 + \beta_1 PRODGt + \beta_2 CONSGt + \beta_3 LnAV_t + \beta_4 LnRF_t + \beta_5 LnOpen_t + \beta_6 GDPCG_t + \beta_7 LnPRCt + \beta_8 AEC_{ij} + e_t \ldots (1)$$

Where FS is Food Security (kcal / capita) ; PRODG is growth of rice production in the year i (percent); CONSG is growth of rice consumption in year i (percent); AV is the availability of rice (tons) calculated by summing production and imports minus exports (tons); RF is Rainfall (mmHg); Open is openness, which calculated by export volume minus import volume divided by GDP value, GDPCG is GDP per capita growth (percent); PRC is the rice price in year t (Rp); Dummy AEC (ASEAN Economic Community), which 1 after AEC was implemented and 0 before AEC was implemented.

The Indicator of food security used is energy consumption from rice expressed in kilocalories (kcal), for each individual in a population. The formula for calorie consumption per capita according to FAO (2003) is the total calories available from rice divided by the population. This measurement is the most applied quantitative indicator of food security and has been used in several previous studies as a measure of calorie consumption and national food security (Smith and Haddad, 2000, 2001, Abdulai, 2017). Increased per capita calorie availability means a decrease in the prevalence of malnutrition and reduced malnutrition in children which are used as indicators of improved nutrition (Smith and Haddad, 2000, 2001; FAO, 2005, 2013; Dawson and Sanjuán, 2011, Abdulai, 2017). The rainfall data used in this study is a proxy of climate change which is considered to have an effect on rice production in Indonesia and national food security (Abdulai, 2017).

2.2.1 Stationary Test

The stationary test aims to ensure that all variables in the equation are stationary. Stationary data are important in time series analyses because non-stationary data can create spurious regression (Gujarati, 2003). Stationary tests are carried out using the unit root test with the Augmented Dickey-Fuller Test (ADF) method (Dickey and Fuller, 1984).

Using the ADF test model, the null hypothesis and other decision-making bases used in this test are based on the critical value of MacKinnon instead of the t-test. Furthermore, the t-ratio is compared with the critical statistical value at the ADF table to find out whether there are unit-roots. If the hypothesis null is accepted it means the variable is not stationary, it is necessary to test the degree of integration at the first difference. Unit root test hypothesis:

o: $\beta = 0$, the data set is not stationary

H1: $\beta \neq 0$, the data set is stationary

With test criteria if:

Probability of DF> 0.05 then H0 is accepted

Probability of DF <0.05 then H0 is rejected

If the data is not stationary at first degree, then the test must continue until each variable is stationary.

2.2.2 Co integration Test

In order to test the cointegration among variables, the Johansen (1988) maximum likelihood ratio test is employed. Johansen's maximum likelihood cointegration test is applied to examine the long-run relationship between the dependent variable and the explanatory variable in the model. Johansen test using the trace and Max-Eigen statistics test is to show a long-run relationship among the variables. If two or more variables have different degrees of integration, then the two variables cannot be cointegrated. If the statistical critical value is above the probability value at the level of 0.05

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(5%) then there is cointegration between the independent variable and the non-independent variable.

The cointegration test hypothesis is Ho: $\beta = 0$, the data series are not cointegrated, H1: $\beta \neq 0$, cointegrated data series.

2.2.3 Error Correction Model

The Error correction model for impact of liberalization on food security can be written as follows

ΔFS = β0+ β1PRODGt+ β2CONSGt+ β3LnAVt + β4LnRFt +β5LnOpent+ β6GDPCGt+ β7LnPRCt+ β8AEC+ ΔECt .... (2)

III. RESULT AND DISCUSSION

3.1 Stationary test

The stationary test is used to test whether the time series data is stationary or not. Unit root test at zero levels indicates that the consumption growth variable (CONSG), rainfall (RF) and per capita GDP growth (GDPCG) are significant at $\alpha = 0.05$, it means the data is stationary at level, while, food security variable (ln FS), rice price (ln PRC), availability (ln AV), openness (ln OPEN), and production growth (PRODG) are not significant at α = 0.05, the null hypothesis is accepted, it means that the variable contains the unit root and not stationary at zero levels, therefore it is necessary to test stationary in a higher degree (first difference). See Table 1.

Stationary test in first differences shows that food security (ln FS), rice price (lnPRC), availability (ln AV), consumption growth (CONSG), per capita GDP growth (GDPCG), openness (ln OPEN), production growth (PRODG), and rainfall (ln RF) are significant at α = 0.05. Because all data has been stationary, the co-integration test is then carried out.

3.2 Co Integration test

Co integration test results show that the value of the trace statistic is above the 5% critical value; the null hypothesis is rejected at the 5% level of significance. These result Indicates that there is co integration between food security and the independent variable, in other words, there is a long-run relationship between food security variable (ln FS) as dependent variable with consumption growth variable (CONSG), rainfall (RF), per capita GDP growth (GDPCG), rice price (lnPRC), availability (lnAV), openness (ln OPEN) , and production growth (PRODG), see table 2.

3.3 Error Correction Model

Error Correction Model is conducted to determine the effect in the short run. The ECT coefficient value is -0.04 or less than one, negative and statistically significant at the 5% level, indicating that error correction slowly adjusts to the long-run balance. The adjustment process towards long-run balance is 4.84 percent while the remaining adjustments occur in the following year. see table 3

3.4 Short Run Estimation

The Result shows that the determination coefficient is 0.713327, implies that 71.33% of food security in Indonesia can be explained by the variables of price, availability, consumption growth, per capita GDP growth, openness, rainfall, production growth, and AEC

Table. 1: Unit Root Test Augmented Dickey Fuller Result

Variable	Level	outcome	First Difference	Outcome
Ln Food Security	0.9945	unit root	0.0001	stationary
Ln Price	0.6586	unit root	0.0003	stationary
Ln Availability	0.1561	unit root	0.0000	stationary
Consumption growth	0.0001	stationary	0.0000	stationary
GDP per capita growth	0.0000	stationary	0.0000	stationary
Ln Openness	0.6097	unit root	0.0000	stationary
Production growth	0.2222	unit root	0.0000	stationary
Ln Rain Fall	0.0192	stationary	0.0001	stationary

Table. 2:The Result of Johannsen cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability
None *	0.853715	243.5500	197.3709	0.0000
At most 1 *	0.785960	176.2731	159.5297	0.0044
At most 2*	0.571714	125.3173	122.6154	0.0082
At most 3*	0.562633	95.63856	92.75366	0.0083
At most 4	0.444680	39.03607	47.85613	0.2588
At most 5	0.246195	18.44872	29.79707	0.5331
At most 6	0.212081	8.556956	15.49471	0.4079
At most 7	0.006106	0.214368	3.841466	0.6434

Table.3: The Result of Error Correction Model estimation

Variable	Coefficient	t-Statistic	Prob.
C	1511.709	8.606460	0.0000
Ln price	0.116507	1.659680	0.1126
Consumption Growth	-8.17E-06**	-2.199421	0.0398
Ln Availability	5.690280**	2.100145	0.0486
GDP per capita Growth	-0.801000	-1.467380	0.1578
Ln Openness	10371.50**	2.419009	0.0252
Production Growth	2.635774	0.823442	0.4200
Ln Rain Fall	0.044473**	2.321382	0.0309
ASEAN Economic Community (dummy)	280.8668***	5.642744	0.0000
ECT	-0.048352	-0.231170	0.0089

Note: *** represent significance at 1% levels, ** represent significance at 5% levels, * represent significance at 10% levels respectively

implementation, while 28.67% variation in food security is determined by other variables outside the model. F-probability value is less than 0.05 means that all explanatory variables together have a statistically significant effect on food security in the short run. Consumption growth, rice availability, openness, rainfall, and AEC (dummy) variable have statistically significantly affected food security in the short run. While Price, production growth, and per capita GDP growth, don't have a statistically significant effect on food security in Indonesia in short-run, see table 4

National rice availability, openness, and rainfall will increase energy consumption by 5.69%, 10371%, and 0.04%, respectively. After AEC implementation energy consumption will increase by 280%, while the increasing of rice consumption growth and GDP per capita growth will reduce energy consumption by 8.17% and 0.80%. As the main staple food, the changes in rice prices do not affect rice consumption. Openness positively implies that the existence of openness (trade liberalization) will increase trade volume and have the potential to improve the status of the country's food security (Abdulai, 2017).

Table. 4: Variable Coefficient for Short Run and Long Run

Variabel	Short Run	Long Run
Price	0.116507 (0.1126)	0.011401 (0.8473)
Consumption growth	-8.17E-06** (0.0398)	-3.76E-07 (0.8404)

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Availability	5.690280**	6.415423**
	(0.0486)	(0.0159)
GDP per capita growth	-0.801000	-0.662420
	(0.1578)	(0.2523)
Openness	10371.50**	7046.244
	(0.0252)	(0.1040)
Production growth	2.635774	-1.820522
	(0.4200)	(0.4899)
Rainfall	0.044473**	0.048421**
	(0.0309)	(0.0226)
AEC	280.8668***	289.8999***
	(0.0000)	(0.0000)
Adjusted R-squared	0.713327	0.660614

Note: *** represent significance at 1% levels, ** represent significance at 5% levels, * represent significance at 10% Levels respectively

Per capita GDP (Gross Domestic Product) describes the access of the population's economy, including access to food. GDP per capita is one indicator of the purchasing power of the population. The higher GDP per capita shows the higher purchasing power of the population and the lower level of poverty. Bennet (1954) Trade openness encourages exports for abundant products in a country, including low-skilled workers (in some developing countries) that will create employment opportunities and increase workers' incomes. This kind of process can play an important role in reducing poverty and increasing food security. (Jaffe et al, 2011). Several previous studies such as Grossman and Helman (1992), Frankel and Romer (1999), Wacziarg and Welch (2003), Sohn and Lee (2006), Chen and Gupta (2006), and Chang et al. (2009) concluded that foreign trade has an important role in spurring economic growth in most countries in the world.

Setiawan (2015) examined the effect of rainfall on food productivity in East Java showed that the relationship of annual rainfall in Bojonegoro Indonesia with rice production has a positive correlation of 0.59, which means that the higher rainfall in this region the greater the production of rice in the region. Agriculture is highly depending on rainfall and climate change, especially changes in the hydrological cycle is a threat to production and food security (Nelson et al., 2014)
%.
states that if people's income increases, they will want to consume various types of food due to lifestyle changes.

3.5 Long Run Estimation

The determination coefficient in the long run estimation is 0.6606. It implies that 66.06% of the variation in food security in Indonesia can be explained by variations of price, availability, consumption growth, per capita GDP growth, openness, rainfall, production growth, and AEC implementation while 33.94% variation in food security is determined by other variables outside the model.

The coefficient in the long run estimation is 0.660614. It implies that 66.06% of the variation in food security in Indonesia could be explained by the variations of price, rice availability, consumption growth, per capita GDP growth, openness, rainfall, production growth, and AEC implementation. 33.94% variation in food security is determined by other variables outside the model.

Rice availability, rainfall, and AEC implementation have statistically significantly affected food security in the long run, while price, consumption growth, Per capita GDP growth, openness, and production growth has no significant effect in long run.

The Increasing of national rice availability and rainfall will increase energy consumption per capita 6.41% and 0.05%, furthermore after AEC implementation energy consumption will increase by 289%. While the increasing in consumption growth, per capita GDP and productivity growth, will reduce energy consumption by 3.76%, 0.66%, and 1.82%.

IV. CONCLUSION

This study concludes that trade liberalization marked by the implementation of the AEC (ASEAN Economic Community), the elimination of trade barriers between ASEAN member countries, and trade openness, affecting food security in Indonesia in the short and long term. The growth of rice production does not have a significant impact on food security both in the short and long term. It shows Indonesia's high dependence on rice imports. The results of this study indicate that there has been a shift in consumption patterns from rice as the main source of carbohydrates and energy sources into non-rice products such as tubers, fruits, etc. as alternative energy sources. Climate change especially changes in rainfall affect rice production and food security in Indonesia. In the short term, the factors that affect food security in Indonesia are the availability of rice, consumption growth, openness, rainfall, and AEC implementation. Whereas in the long run it is influenced by the availability of rice, consumption growth, openness, rainfall, and MEA implementation. There are several recommendations that can be taken to improve food security in Indonesia through increasing factors that have a significant influence on food security. Policymakers can choose long-term or short-term policies or joint policies. Therefore, in the short term, the Indonesian government needs to pay attention to and increase rice supply to meet food energy needs through increasing national rice production and imports. Regulate policy instruments in increasing rice productivity and trade policies to improve national food security. Likewise in long-term policies, the government needs to pay attention to the availability of national rice, consumption growth, and trade openness.

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Modelling of Orthometric heights from Multi-Networks of GNSS/Precise Levelling in FCT, Abuja

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***Abstract*— *The geoid is used as a transformation linkage between ellipsoidal heights (h) determined from DGPS observations and orthometric heights (H). Widespread acceptability and adoption of GPS in local geospatial data acquisitions require the development of a local geoid model (N) for use to obtain orthometric heights in the absence of a national geoid model. Geoid model can be developed by gravimetric approach; global geopotential model (GGM); geometric technique among others. The conventional approach to GPS measurements is the use of one base reference station for field measurements. It has several drawbacks e.g. in signal range/coverage, accuracy degradation of results, etc. Based on Grashof's law of stability of triangles, this study was therefore based on dual reference base stations to improve on DGPS signal range and stability of results. Pro-online matrix solver was applied to the least squares observation equations of the two modelled FCT surfaces (multi - quadratic and bicubic) to determine polynomial coefficients. The geoid undulation was computed and orthometric height generated for production of a topographical plan at 1m contour interval for elevation data in surveying, engineering and environmental applications. Skill =1 and bias = 0 were computed to confirm the predictive capability of the models and that no bias/errors were introduced into the respective modelling exercise. Diagnostic test also confirmed the viability and feasibility of providing vertical datum surface for FCT by this approach. Standard deviation (σ) as accuracy indicator was computed and the multi-quadratic model with σ =11cm was the better geoid surface for modelling of orthometric height in the FCT by the geometric method.*

Keywords—***Geoid undulation, Multiquadratic, Bicubic, Grashof's law, Orthometric height.***

I. INTRODUCTION

The use of GNSS in orthometric height (H) determination requires a geoid model (N) to transform the observed ellipsoidal height (h). For global applications, global geoid models (EGM2008) have been developed to provide the geoid undulation. For small to medium-sized areas, global geoid model, according to Odera and Fukuda (2015) is too generalized and will lead to error in orthometric height if applied. Merry (2009) gave a value of 3m in Central Mozambique when compared with EGM2008 values due to the use of generated gravity anomalies. Hence, this requires the development of local geoid models for the needs of GNSS user community in geospatial data acquisitions and applications.

Al-kragy *et al.* (2015) observed that a geoid model is a three dimensional (3D) geospatial model that defines the relationship between the ellipsoid and the geoid surfaces at a specific area. Eteje *et al.* (2018) defined geoid as the surface which coincides with that surface to which the oceans will conform over the entire earth if free to adjust to the combined effects of earth's mass attraction and the centrifugal force of earth's rotation. Methods of geoid undulation determination are namely:

(a). Gravity measurements for gravimetric geoid by solving general Stoke's integral formula by spherical harmonic expansion as given by Heiskanen and Moritz (1967):

$$N = K\frac{K\delta m}{RG} - \frac{\delta W}{G} + \frac{R}{4\pi G}\iint \Delta g S(\varphi) d\sigma \tag{1}$$

$$S(\varphi) = 1 + \frac{1}{\sin\frac{\varphi}{2}} - 6\sin\frac{\varphi}{2} - 5\cos\varphi - 3\cos\varphi \ln(\sin\frac{\varphi}{2} + \sin^2\frac{\varphi}{2}) \tag{2}$$

where the various parameters are as given in the literature.

Assuming that the mass of real earth is equal to the mass of the normal earth and the potential generated by two masses to be equal, the first two terms in equation (1) become zero i.e.

$$N = \frac{R}{4\pi G}\iint \Delta g S(\varphi)d\sigma \quad (3)$$

The difficulty with Stoke's formula is that solution requires gravity data all over the earth which is impossible to achieve arising from the double integral in the formula. To overcome this, global geopotential models (GGM) were developed. These global models are inadequate for local applications and Odera *et al.* (2015) stated that they are too generalized to be useful for local applications and hence, for areas of limited sizes, a local geometric geoid model could be developed for orthometric data acquisitions.

(b) Geometric Geoid Model

This is developed for areas ranging from small to medium and computed directly from GPS based ellipsoidal height (h) and collocated with points of known orthometric heights (H). From the relationship given by Kotsakis and Sideris (1999), Jekeli (2006), a linear relationship between h, H and N where ξ is deviation of the vertical and curvature of plumb line is

$$h = N + H + \xi \quad (4)$$

Seker and Yildirin (2002) observed that at $\xi = 1''$, the error incurred is 0.08mm which is negligible, insignificant and of no practical consequence. Also, Nordin (2009) computed the effect of $\xi = 1''$ as less than 1mm. Figure 1 shows the linear relationship between the heights. The combined interpretation and implication of the above values is that we can write with confidence that:

$$N = h - H \quad (5)$$

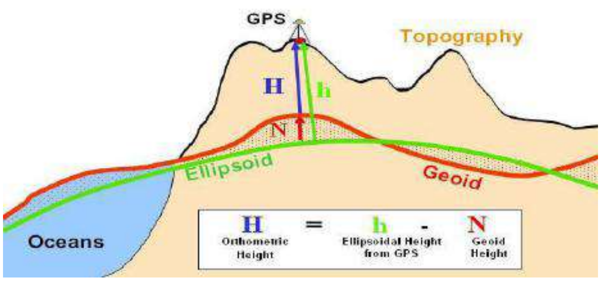

Fig. 1: Relationship between Orthometric, Geoid and Ellipsoidal Heights

Source: Ono (2013) and Eteje et al. (2018)

1.2 Datum Ambiguity/Bias

The vertical datum may be inconsistent due to measurement error and is evident in all three height components of *h, H* and *N*. Let *δh, δN* and *δH* be the biases in each of the components, we can, therefore, write from equation (6)

$$h = N + H \quad (6)$$

that

$$h + \delta h = (H + \delta H) + (N + \delta N) \quad (7)$$

$$h = H + N + (\delta H + \delta N - \delta h) \quad (8)$$

$$h = H + N + S \quad (9)$$

where,

$$S = (\delta H + \delta N - \delta h)$$

By comparing $h = N + H + \xi$ with $h = H + N + S$, it can be shown that $S = \xi$. Hence $\xi = (\delta H + \delta N - \delta h)$ is insignificant. From the various values of ξ computed by the above authors, the datum bias can therefore be taken as insignificant and hence negligible for low order survey and engineering applications and adequate for geometric geoid modelling (from $N = h - H$) and hence orthometric height determination from $H = h - N$. Milbert and Smith (1996) observed that the very small values of *S* compared to *N* support the direct conversion between ellipsoid and orthometric vertical datum even if they are not defined on a common reference. Geometric geoid model hence is adopted for modelling orthometric height in the provision of vertical datum for elevation data acquisition.

Kamaludin *et al.* (2005) observed that differential heighting method can be used to eliminate datum inconsistencies for topographical and engineering/environmental studies and applications. From $N = h - H$, interpolation of geoidal heights (*N*) becomes feasible over interested points with an available GPS ellipsoidal and existing orthometric heights.

1.3 Justification of Adopted Field Procedure

Generally, in DGPS campaigns only one base reference station is adopted for observations in the relative approach. This method has limitations in coverage and accuracy is spatially degraded after certain distances beyond, for example, 10km or over large areas. Martensson (2002) recommended the use of network that resembles a triangulation network in GPS campaigns where the aim is to obtain surface cover for geometric geoid modelling to ensure that no deterioration of results are experienced and hence it can be stated that the results from this study are highly stable and consistent since the FCT triangulation network was used for all measurements. Chang and Lin (1999) reported from studies using one and multiple base reference stations, that results obtained from the latter are more reliable and consistent achieving over 60% improvement in values both in horizontal and vertical components using DGPS.

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1.4 Stability of Shapes

A triangle is the simplest of closed figures in two dimensions and described as the strongest geometrical shape and most stable too because of its inherent structural characteristics. For example, a square is capable of becoming a parallelogram whereas a triangle is only capable of being a triangle. The explanation given to why the triangle is more stable than other shapes is that it only takes three points to define a plane. By adding any point to the plane will make it harder and harder for it to be stable. Also, no matter where the vertices of the triangle lie, they will always define a plane and hence triangles are both stable and rigid. Grashof's relationship can be used to compute geometrical stability of figure from Quora http:// www.quora.com as:

$$n = 3(L-1) - 2J - h \tag{10}$$

where,

n = degree of freedom

L is number of links; J is number of joints ; h is number of higher points. If $n = 0$, there is geometrical stability of results for a triangular geometry formed with two base reference receivers and one rover station as shown in Figure 2

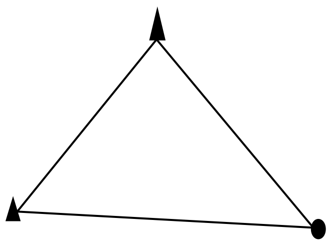

Fig. 2: Base Reference/Receiver (P)

From Figure 2, for a triangle, L = 3, J = 3, h = 0; n = 3(3-1)-2×3-0 = 0. This (n = 0) implies the adopting of triangular geometry for GPS observations, geometrical stability of results is achieved. For a line used as the conventional method of GPS relative technique of one base reference station and one rover position as shown in Figure 3, i.e. computed to be n = -4 to show that line used for field observation may not produce stable results.

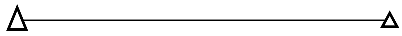

Fig. 3: A line

For a pentagonal geometry, L = 5, J = 5, h = 0, therefore n = 2 to indicate and imply that a deformed and in stable shape that may affect the data.

II. METHOOLOGY

2.1 GPS Field Observations

Dual base reference stations were used to determine the ellipsoidal heights of the observed controls used as rover positions with DGPS receivers and accessories. Three online post processing software was used to process for the ellipsoidal height and the arithmetic means of the ellipsoidal heights were computed. The average ellipsoidal heights of each point was used with the existing orthometric height to determine the geoid undulation of each control point, equation (5). See the results in Table 1

Table 1: Average Ellipsoidal Heights, Existing Orthometric Heights and Computed Geoid Undulations

	COORDINATE REGISTER VALUE			POST PROCESSED AVERAGE h (m)	UNDULATION, N=h-H (m)
CONTROL POINTS	EASTINGS (m) (e)X	NORTHINGS (m) (n)Y	EXISTING ORTHO. HEIGHTS H (m)		
FCC11S	331888.114	998442.043	485.447	509.396	23.949
FCT260P	255881.175	993666.807	201.944	224.74	22.787
FCT103P	340639.766	998375.578	532.558	556.836	24.278
FCT12P	333743.992	1008308.730	735.707	760.192	24.485
FCT19P	337452.408	996344.691	635.644	659.824	24.18
FCT2168S	310554.927	1009739.930	431.087	455.274	24.187
FCT24P	322719.776	1001884.850	453.804	477.987	24.183
FCT276P	351983.716	1025998.314	625.572	649.848	24.276
FCT4154S	329953.882	1003831.280	476.981	501.232	24.251
FCT4159S	326124.422	1003742.860	452.230	476.553	24.323
FCT66P	299148.035	998114.283	297.111	321.115	24.004
FCT9P	329821.512	1007612.091	497.253	521.693	24.440
FCT35P	322183.380	992926.363	427.171	451.299	24.128
FCT57P	303234.270	992916.402	323.844	347.795	23.951
FCT4028S	330164.634	1001388.240	449.592	473.942	24.35
FCT53P	308943.361	993406.773	351.943	375.955	24.012
FCT4652S	329441.767	997474.808	462.711	487.113	24.402

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FCT162P	270791.291	934625.533	189.696	215.091	25.395
FCT130P	330982.584	952889.869	695.608	719.383	23.775
FCT2327S	282526.612	973821.470	183.287	207.482	24.195
FCT2652S	271370.273	945385.429	138.952	163.741	24.789
FCT2656S	272644.591	941062.460	204.724	229.229	24.505
FCT83P	332954.205	987231.606	568.752	592.819	24.067
XP382	284074.729	983364.863	274.586	298.390	23.804

2.2 Polynomial Surfaces

The two polynomial surfaces considered to represent/model the FCT continuous vertical reference surface are: i) multiquadratic and ii) bicubic.

1. Multi – quadratic model (nine parameters) from Sanlioglu *et al.* (2009)

$$N = a_0 + a_1X + a_2Y + a_3X^2 + a_4Y^2 + a_5XY + a_6X^2Y + a_7XY^2 + a_8X^2Y^2 \tag{11}$$

Multi-quadratic interpolation according to Yanalak and Baykal (2001) is an analytical method of representing irregular surfaces that involve the summation of quadratic surfaces. Kirici and Sisman (2017) stated that even if the reference points are not homogeneously distributed, the results of surface modelling are barely affected. This is particularly applicable to the present studies with reference to the lopsided distribution of controls selected (after reconnaissance surveys) for use in geometric geoid development.

2. Bi- cubic model (third-order polynomial)

$$N = a_{00} + a_{10}X + a_{01}Y + a_{20}X^2 + a_{11}XY + a_{02}Y^2 + a_{30}X^3 + a_{21}X^2Y + a_{12}XY^2 + a_{03}Y^3 \tag{12}$$

Where,

$Y = ABS(y - y_o)$

$X = ABS(x - x_o)$

y = Northing coordinate of observed station

x = Easting coordinate of observed station

y_o = Northing coordinate of the origin (average of the northing coordinates)

x_o = Easting coordinate of the origin (average of the easting coordinates)

2.3 Least Squares Equation and Solutions

Observation equation was formed for each point and solved to determine the polynomial coefficients X from the observation equation generally as given by Ono *et al.* (2004):

$$V = AX - L \tag{13}$$

where,

A = coefficient matrix

X = vector of unknown parameters/coefficients

L = geoid undulations

Applying least squares principles, the solution is given by

$$X = (A^T A)^{-1}(A^T L) \text{ for unit weight} \tag{14}$$

Unit weight (W = 1) is assumed due to equal reliability of observations.

The geoidal undulation of at least six points must be known within the study area to enable redundancies for the robustness of least squares solution. In this study, twenty-four (24) points with both ellipsoidal and orthometric heights are known. The model parameters determined from least squares solutions are:

Multi – Quadratic Model Parameters

$$X = \begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \end{pmatrix} = \begin{pmatrix} 24.2248901210000000000 \\ -0.0000240934058058717 9 \\ -0.00008013620770038382 \\ 0.00000000009699046795 \\ 0.00000000370280953876 \\ 0.00000001166702184889 \\ -0.00000000000021600943 \\ -0.00000000000045716237 \\ 0.00000000000000000886 \end{pmatrix}$$

Bicubic Model Parameters

$$X = \begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \end{pmatrix} = \begin{pmatrix} 23.50081592604167925515 \\ 0.00004395285221636346 \\ 0.00009105227330487502 \\ -0.00000000156204910634 \\ -0.00000000352164634358 \\ -0.00000000178532065159 \\ 0.00000000000004116279 \\ 0.00000000000002433215 \\ 0.00000000000000729517 \\ 0.00000000000002928003 \end{pmatrix}$$

Standard deviation of observations (σ) was computed using (15):

$$\sigma = \sqrt{\frac{\sum v^2}{(n-1)}} \tag{15}$$

where,

v = residual = difference between model and known geoid height.

n = number of points.

2.4 Interpolation of Geoid and Orthometric Height Modelling

Microsoft Excel program was developed to interpolate the geoid undulation and hence model the orthometric height for each point within the study area. The *x*, *y* and h are input into the Microsoft Excel program developed to interpolate both geoid and orthometric heights. The modelled orthometric heights were then compared with their corresponding existing orthometric heights of the controls and the standard deviation was computed from equation (15) as $\sigma_{\text{multi}} = 11\text{cm}$ and $\sigma_{\text{Bicubic}} = 14\text{cm}$.

2.5 Hypothesis Testing for Comparison of Orthometric Height

The null hypothesis is given by H_0 while the alternative is H_1 and is formulated as follows:

$H_o : \mathrm{R} = 0$, no relationship between $H_{\text{Multiquadratic}}$ and H_{MSL} (16)

$H_1 : \mathrm{R} \neq 0$, there is a relationship between $H_{\text{Multiquadratic}}$ and H_{MSL} (17)

Significance level α = 0.05 i.e. 95% confidence level.

Decision rule: reject H_o if $|\text{computed } t| > t_{20,0.05}$ from *t*- distribution table.

Scenario: $H_{\text{Multiquadratic}}$ and H_{MSL}

The statistical significance of the relationship was computed by *t*-test statistics formula given in janda.org/c/10/lectures/topic/L as:

$$t = R\sqrt{(n-2)/(1-R^2)} \tag{18}$$

In the case of $H_{\text{Multiquadratic}}$ and H_{MSL}, the computed t = 0 while table t =1.717. From the decision rule above, we reject H_o i.e. the existing heights do not have any correlation with the modelled heights. Hence H_1 is accepted and further, it may be an indication of coincidence of the two surfaces but referenced to different reference datum, the geoid and the mean sea level. Height values based on the geoid (multi-quadratic or bi-cubic models) are the desired orthometric heights and is the primary goal of this study in FCT for height modernization according to Nwilo (2013).

2.6 Evaluation of Surface Fitting Techniques

Alevzakou and Lambrou (2011) stressed the need to determine if a surface of higher degree is necessary in geometric geoid modelling by using the relationship given as:

$$(r_1\sigma_2 / r_2\sigma_1) \leq F_1 r_2 \tag{19}$$

Where,

r_1, r_2 = degrees of freedom of the smaller degree surface and the greater surface respectively.

σ_1, σ_2 = standard deviation of the two surfaces respectively.

F_1, r_2 = F distribution for one degree difference between the tested surfaces σ_1 = 0.109959231m σ_2 = 0.135719119m r_1 = 15 (multi-quadratic surface), r_2 = 14(bi-cubic surface) .

The decision rule is if $(r_1\sigma_2 / r_2\sigma_1) \leq F_1 r_2$, then no higher surface is needed for geometric geoid modelling of FCT. The Computed value of $(r_1\sigma_2 / r_2\sigma_1)$ = 1.32242959925

F_1, r_2 from F Tables = 4.531 (http://www.stat.ucla.edu/-dinov).

From the relationship $(r_1\sigma_2 / r_2\sigma_1)$ and *F* distribution F_1, r_2, since 1.32242959925<4.531, no higher degree surface is needed for geometric geoid model in the FCT. This is an indication that either multi-quadratic or bi-cubic model can be used to model orthometric height although the multi-quadratic model performed better and could be taken as the optimum.

2.7 Skill and Bias Estimates

The skill parameter can be used as a measure of the model predictive capacity in relation to the observations. This skill parameter ranges from negative values to one with the corresponding value of one implying a total agreement between observations and the model results. The bias values computed as zero simply imply that the data used, equipment used and personal error did not show any bias whatsoever in this study. Bias and skill were calculated by the relationship given by Sutherland *et al.* (2004)

This also suggested that the selection and combination of equipment, personnel, field techniques and processing methods adopted yielded high quality data to produce the FCT geoid surface information as much as possible. Orthometric heights from the surface are hence based on geoid and compatible with GNSS technique and the adopted dual base reference stations technique.

2.8 Diagnostic Test for Multiquadratic and Bicubic Models

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To carry out a diagnostic test for the predictive ability of the models in orthometric height modelling as stated in Sinha and Prasad (1979), the computation was carried out using $1.98/\sqrt{N}$ where N is the number of stations = 24 in this study to compare with chi-squares table values. The decision rule is if $1.98/\sqrt{N} < \chi^2$, then models are satisfactory at 95% confidence level. In this study, $1.98/\sqrt{N} = 0.404$. Using the Chi squares (χ^2) test at the 95% degrees of freedom (d.o.f), we have for multiquadratic model, degree of freedom = 15, at 95%, χ^2 = 24.996; bicubic model, degree of freedom = 14 at 95% χ^2 = 23.685. Since 0.404 < 24.996 or 23.685, the models proved satisfactory at 95% confidence limits for modelling orthometric heights from GNSS techniques as confirmed by the diagnostic tests.

2.9 Application Areas and Importance of the Geoid Model

Applications of geoid are:

1. For transforming GPS ellipsoidal heights (h) to orthometric height for practical surveying and engineering applications.
2. An important part of a National Geodetic Data Infrastructure (NGDI).
3. The geoidal map can also be used to interpolate for geoid heights at any point of interest in FCT.
4. This is useful where the conventional method of spirit levelling is costly, tedious, time-consuming and costly especially in highly urbanized areas.

The importance of the determined geoid models in orthometric height derivation are:-

1. Consistency and compatibility with GNSS technique is achieved with these models for orthometric height determination.
2. Orthometric heights can be interpolated for all points of interest within the FCT.

III. DISCUSSION OF RESULTS

3.1 Plot of Geoid Undulation Against Controls

Figure 5 presents the plots of multi-quadratic and bicubic geoid heights against control stations. This was done to show graphically the differences between the multi-quadratic and the bi-cubic models' geoid undulations. It can be seen that the two surfaces are nearly coincident and identical from a visual inspection of Figure 5. This implies and confirms the interchangeability and acceptability of the two models for orthometric height determination within the FCT but attaching more weight to the multi-quadratic model. However, visual observations/interpretations are generally subjective.

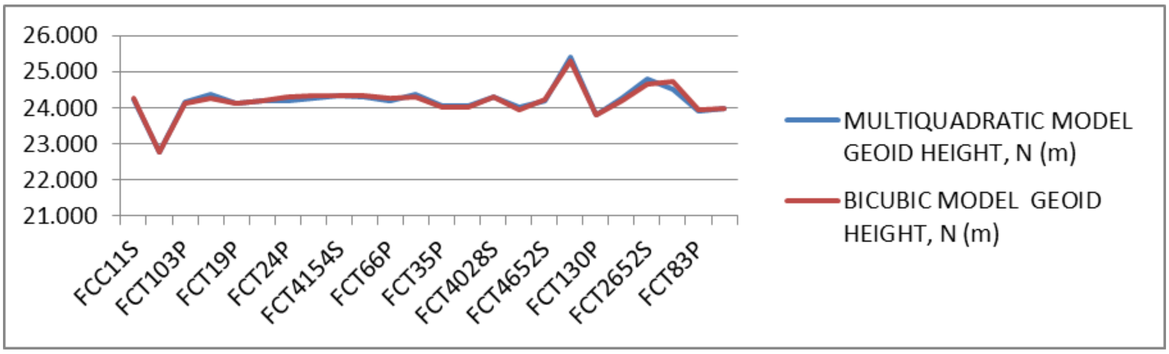

Fig. 5: Geoid Undulation Models from both Multi-Quadratic and Bi-Cubic Models.

3.2 Similarity of Surfaces

Figure 6 shows the plots of the multi-quadratic model, bicubic model and existing orthometric heights. This was also done to show graphically the similarity of the three surfaces. From Figure 6, it can be confirmed that the multi-quadratic model is more suitable and adequate as it is smoother for the modelling of orthometric heights in FCT by GNSS technique.

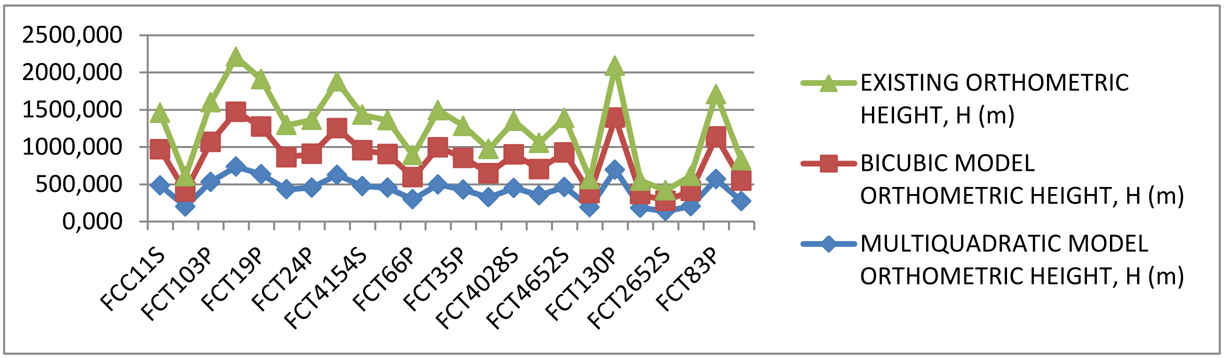

Fig. 6: Similarity Plots of the Three Surfaces

IV. CONCLUSIONS

From the study, the following conclusions can be made:

1. Multiquadratic model takes good care of the lack of homogeneous distribution of selected controls in geoid modelling.
2. Coefficient of correlation (R) and coefficient of determination (R^2) values of $R =$ 0.995m and $(R^2) =$ 99% respectively indicate the multi-quadratic model has a high predictive ability at 95% confidence limits.
3. Dual base reference stations were adopted for data acquisition instead of conventional single base reference station. This enabled the stability of results by exploiting Grashof's law of stability of triangles.
4. The feasibility of developing a geoid model for GPS user community by GNSS/Levelling in FCT has been demonstrated as an alternative approach to conventional spirit levelling in orthometric height determination

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Relationship between Polynomial Geometric Surfaces Terms and Observation Points Numbers and Effect in the Accuracy of Geometric Geoid Models

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Abstract—*The application of the geometric method of local geoid model determination which requires the fitting of geometric surfaces to known geoid heights to enable geoid heights of new points to be interpolated involves the use of least squares technique for computation of the models' parameters. The selection of polynomial geometric surfaces depends on the size of the study area, the variation of the geoid heights and the number of measurement points. The accuracy of the geometric geoid model increases as the number of observation points approximates the number of geometric surface terms. But in most cases, the number of observation points is not considered. To this effect, this paper presents the relationship between geometric surfaces terms and observation points numbers and effect in the accuracy of geometric geoid models. A total of 23 points of known local gravimetric geoid heights were used. Two polynomial geometric (third and fifth degrees) surfaces were fitted to the geoid heights at various observation point numbers and compared to determine the relationship between the number of model terms and that of observation points and effect in the accuracy of the models. Least squares adjustment technique was applied to obtain the model parameters. The differences between the models and the known geoid heights of the points were computed and used to obtain the RMSEs as well as the accuracy of the models. The obtained results showed that the accuracy of the polynomial geometric geoid models tends to the highest as the number of measurement points approximates the number of the model terms and in a unique solution where the number of observation points is equal to the number of the polynomial geometric model terms, the model accuracy is highest. The paper recommends that the geometric method of local geoid model determination should be strictly applied in small areas. Where the method will be applied in considerable large areas, higher degrees polynomial geometric surfaces with a larger number of terms approximating the number of observation points should be applied. This will enable a proper fit of the polynomial surface to the known geoid heights, as well as high accuracy to be obtained.*
Keywords— ***accuracy, geometric geoid, model terms, points number, polynomial surfaces.***

I. INTRODUCTION

The transformation of GNSS ellipsoidal heights to practical, orthometric heights in local areas has necessitated the determination of local geoid models of various areas. Local geoid model is determined using several methods such as gravimetric, gravimetric-geometric, astro-geodetic and geometric methods. The gravimetric method involves the use of either free air or Bouguer gravity anomalies computed from absolute gravity values of selected points obtained with a gravimeter within the study area and theoretical gravity obtained on the local ellipsoid adopted for geodetic computation in the study area as given by Eteje *et al.* (2019). The gravimetric-geometric method uses the geoid heights of points obtained from gravity observation and a geometric surface fitted to the gravimetric geoid heights to enable geoid heights of new points to be interpolated within the study area. The astro-geodetic method has to do with the use of astronomically and geodetically obtained data. The geometric method is applied in a small area and requires the use of levelling and GNSS acquired data such as orthometric and ellipsoidal heights of points accurately obtained with respect to reliable benchmarks and geodetic controls. Using the orthometric and ellipsoidal heights of the points, the geoid heights of the

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points are computed (see figure 1) with (Oluyori *et al.* 2018)

$$N = h - H \quad (1)$$

Where,

N = Geoid height
h = Ellipsoidal height
H = Orthometric height

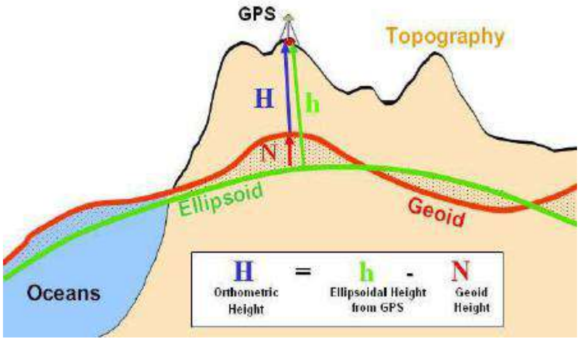

Fig. 1: Relationship between Orthometric, Geoid and Ellipsoidal Heights
Source: Eteje et al. (2018)

The geometric method has been applied by various researchers in different parts of the world. Such researchers include Erol and Celik (2004) which applied the fifth-degree geometric surface in an area of $50 \times 45\text{km}^2$ in Turkey and Oluyori *et al.* (2018) that also applied the second-degree and the third-degree surfaces in the Federal Capital Territory, FCT, Abuja, Nigeria among others.

Applying the geometric method for the determination of a local geoid model of an area, the geoid heights of selected points are normally computed from the orthometric and ellipsoidal heights of the points and a geometric geoid surface is fitted to the obtained geoid heights of the points to enable geoid heights of new points to be interpolated using the model. The selection of a method simply depends on the size of the study area, the variation of the geoid heights and the total number of points. Usually, two or more geometric surfaces are fitted to the geoid heights and their accuracy are computed and compared. The model with the highest accuracy, best fit the points as well as the study area and it is recommended for application in the study area.

The fitting of the geometric surface to the geoid heights of chosen points in the study area requires the computation of the model parameters which in turn requires the application of least squares technique. In most cases, the lager the study area, the larger the number of points to be used for the determination of the geoid model. This enables proper depicting of the shape of the geoid model.

It is assumed that the computed geoid heights have been adjusted. The application of the least-squares technique here is to obtain the model parameters. It is to be noted here that the reliability of the model depends on its ability to reproduce accurately the known geoid heights of the points.

The accuracy with which geoid heights are obtained using the determined geoid model is computed by finding the differences between the known geoid heights of the points and their respective geoid heights from the model (model geoid heights). The differences are used to compute the Root Mean Square Error, RMSE as well as the reliability of the model. The accuracy of the model is usually highest when applying the least squares technique for the computation of the model parameters as well as fitting the geometric surface to the geoid heights of the points when the number of the chosen points is equal to the number of the model terms. In other words, in a unique solution where the number of observations is equal to the number of unknown parameters. Using the least squares technique, the differences between the estimates (most probable values) and observations is the residual and this is equal to the differences between the model and the known geoid heights of the points.

Considering the fact that the highest accuracy of the geometric geoid model is obtained when the number of points is equal to the number of geometric surface terms, then when applying the method in a very large area which in turn requires large number of points, a geometric surface with a large number of terms should be applied. It is also to be noted here that, the higher the degree of the model, the larger the number of the model terms. But often time, the geometric surfaces are chosen considering the size of the study area and the variation of the geoid heights only. To this effect, this paper presents the relationship between geometric surfaces terms and observation points numbers and effect in the accuracy of geometric geoid models.

1.2 Geometric Geoid Surfaces

Geometric geoid surfaces are mathematical interpolation surfaces fitted to geoid heights to enable geoid heights of new points to be interpolated using variables such as geographic or rectangular coordinates of the points. These surfaces include plane surface, bi-linear surface, second-degree surface, third-degree polynomial and fifth-degree polynomial (Eteje *et al.*, 2018). The surface to be adopted as well as the degree and order of the polynomial depending on the size of the study area, the variation of the geoid heights and the number of observation points.

1.2.1 Polynomial Surface

The polynomial surface used when determining geoid model is given by Erol and Celik (2004) and Kirici and Sisman (2017) as

$$N_{(x,y)} = \sum_{i=0}^{m} \sum_{\substack{j=k-i \\ i=0}}^{k} a_{ij} x^i y^j \tag{2}$$

Where,

a_{ij} = polynomial coefficients

m = degree of polynomial

x, y = plan coordinates of point

In applying the polynomial, the degree should be chosen and the polynomial should be formed for the chosen degree. Kirici and Sisman (2017) gave the third-degree polynomial surface with 10 terms as

$$\begin{aligned} N = a_0 + a_1 X + a_2 Y + a_3 XY + a_4 X^2 + \\ a_5 Y^2 + a_6 X^2 Y + a_7 XY^2 + a_8 X^3 + \\ a_9 Y^3 \end{aligned} \tag{3}$$

The fifth-degree polynomial geometric geoid surface with 21 terms is also given as

$$\begin{aligned} N = a_0 + a_1 X + a_2 Y + a_3 XY + a_4 X^2 + \\ a_5 Y^2 + a_6 X^2 Y^2 + a_7 X^2 Y + a_8 XY^2 + \\ a_9 X^3 + a_{10} Y^3 + a_{11} X^3 Y + a_{12} X^3 Y^2 + \\ a_{13} X^2 Y^3 + a_{14} XY^3 + a_{15} X^4 + a_{16} Y^4 + \\ a_{17} X^4 Y + a_{18} XY^4 + a_{19} X^5 + a_{20} Y^5 \end{aligned} \tag{4}$$

Where,

$Y = ABS(y - y_o)$

$X = ABS(x - x_o)$

y = Northing coordinate of observed station

x = Easting coordinate of observed station

y_o = Northing coordinate of the origin (average of the northing coordinates)

x_o = Easting coordinate of the origin (average of the easting coordinates)

1.3 Observation Equation Method of Least Squares Adjustment

The fitting of geometric geoid surface to a set of geoid heights requires the model parameters to be computed. The computation of these parameters is done by observation equation method of least squares adjustment technique. The functional relationship between adjusted observations and the adjusted parameters as given by Ono *et al.* (2014) is:

$$L_a = F(X_a) \tag{5}$$

Where, L_a = adjusted observations and X_a = adjusted parameters. Equation (5) is a linear function and the general observation equation model was obtained. The system of observation equations is presented by matrix notation as (Mishima and Endo, 2002 and Ono *et al.*, 2018):

$$V = AX - L \tag{6}$$

where,

A = Design/Coefficient Matrix,

X = Vector of Unknowns

L = Observation Matrix.

V = Residual

The residual, V which is the difference between the estimate and the observation is usually useful when applying least squares adjustment technique for determination of local geometric geoid model parameters. Since it is equal to the difference between the model geoid heights and the known geoid heights of the points. So, it can be used as a check.

The unknown parameter is computed as

$$X = (A^T A)^{-1} A^T L \tag{7}$$

where,

$(A^T A)^{-1}$ = Inverse of the normal matrix

The step by step procedures for the computation of geometric geoid model parameters are detailed in Eteje and Oduyebo (2018).

1.3.1 Accuracy of Geometric Geoid Model

The accuracy of a local geometric geoid model is obtained using the Root Mean Square Error, RMSE index. To evaluate the local geometric geoid model accuracy, the geoid heights of the points from the model are compared with their corresponding known geoid heights (geoid heights of the points to which the geometric surface was fitted) to obtain the residuals. The residual and the total number of selected points are used for the computation of the RMSE, as well as the accuracy of the geometric geoid model. The Root Mean Square Error, RMSE index for the computation of the geometric geoid model accuracy as given by Kao *et al.* (2017), and Eteje and Oduyebo (2018) is

$$RMSE = \pm\sqrt{\frac{V^T V}{n}} \tag{8}$$

Where,

$V = N_{Model} - N_{Known}$ (Residual)

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N_{Model} = Model Geoid Height of Point

N_{Known} = Known Geoid Height of Point

n = Number of Points

II. METHODOLOGY

The adopted methodology was divided into different stages such as data acquisition, data processing, and results presentation and analysis. Figure 2 shows the adopted methodology flow chart.

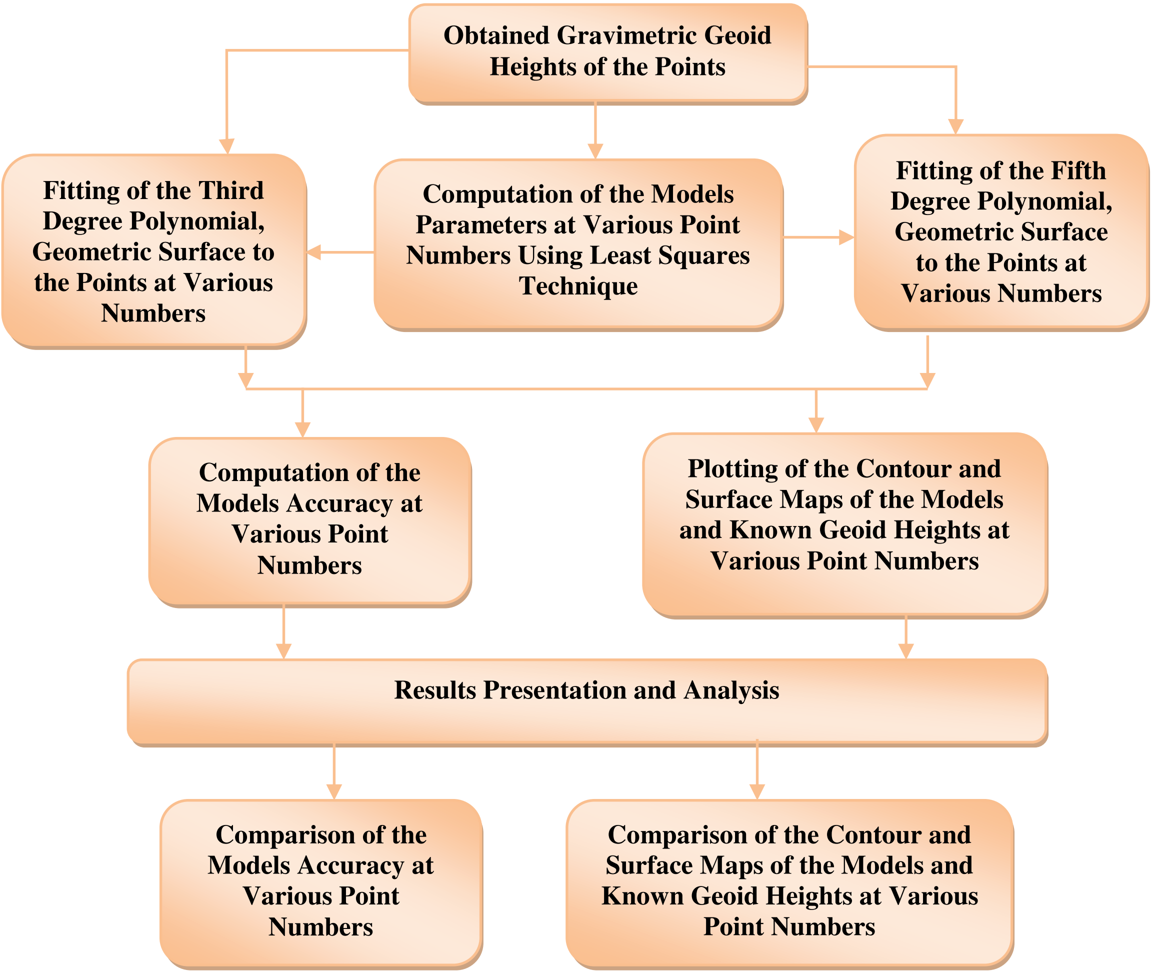

Fig. 2: Adopted Methodology Flow Chart

The geoid heights used in this study were obtained by gravimetric means. They were part of the local gravimetric geoid heights obtained for the determination of the local geoid model of Benin City. The geoid heights were computed using the integration of modified Stokes' integral given by Featherstone and Olliver (1997). They were also corrected for combined topographic effect. A total of 23 local gravimetric geoid heights were used. Table 1 shows the 23 local gravimetric geoid heights used in this study.

Table 1: Local Gravimetric Geoid Heights of the Points

STASTION	Northing	Easting	Free Air Geoid Height, N Corrected for Combined Topographic Effect
XSU92	257998.9800	357763.3720	2.086
RR01	257885.3227	355124.0166	2.420
SR02	253034.8393	356093.6672	1.978
SR05	245976.7564	356615.1406	2.802
SR06	244918.0916	356628.3396	3.266
UU02	265145.3515	353468.5482	3.498

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UU03	262403.8368	354173.5295	1.981
UU05	259407.1043	355613.0973	1.346
UU08	256422.9868	355521.4167	1.263
AD01	260514.8753	359958.1194	2.986
AD03	261867.2294	361745.9231	4.420
AK02	259528.7811	356853.3277	1.473
AK05	259332.1257	362604.6963	3.954
MR02	260751.5081	356528.1658	1.488
MR04	262930.8267	360077.3193	4.037
MR05	262428.2213	361076.8116	4.313
SK02	255516.1557	357459.1723	2.035
SK03	254396.4836	358439.3812	2.379
SLK01	259894.0672	352909.3470	0.781
SLK03	261813.3387	350594.2641	1.736
SLK05	264774.9356	348869.1903	3.357
EK02	257209.3523	350068.7731	0.983
EK05	252877.2407	345740.0760	2.516

2.1 Data Processing

The two polynomial geometric surfaces were fitted to the geoid heights at various point numbers. Considering the third-degree with 10 terms polynomial surface given in equation (3), 23 points, 22 points except for point SLK01, 21 points except for points SLK01 and UU03, and 11 points (XSU92, RR01, SR06, UU02, UU08, AD03, AK05, MR05, SK03, SLK05 and EK05) given in table 1 were used. The model parameters of the various point numbers using the third-degree polynomial surface were computed with least squares technique as well as equation (6). The computed model parameters for 23, 22, 21 and 11 points using the third-degree polynomial surface are respectively

Degree 3 with 10 terms (23 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \end{pmatrix} = \begin{pmatrix} 3.11075532680599771371 \\ -0.00120394557065107907 \\ -0.00108658105231516264 \\ 0.00000016658414901717 \\ 0.00000056608595962784 \\ 0.00000017705155729573 \\ -0.00000000000104326161 \\ -0.00000000004438844605 \\ -0.00000000003086059461 \\ -0.00000000000746460180 \end{pmatrix}$$

Degree 3 with 10 terms (22 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \end{pmatrix} = \begin{pmatrix} 2.73155471732261526491 \\ -0.00073663742886719859 \\ -0.00087436281264190545 \\ 0.00000010662872093383 \\ 0.00000043891915441287 \\ 0.00000015019093414260 \\ -0.00000000000221968508 \\ -0.00000000002875142096 \\ -0.00000000002809420215 \\ -0.00000000000626966800 \end{pmatrix}$$

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Degree 3 with 10 terms (21 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \end{pmatrix} = \begin{pmatrix} 2.43847691383301074294 \\ -0.00047806506299681554 \\ -0.00068328373815848417 \\ 0.00000007082027279844 \\ 0.00000036320471120925 \\ 0.00000012614935986116 \\ -0.00000000000277662777 \\ -0.00000000001995171264 \\ -0.00000000002572534018 \\ -0.00000000000536407133 \end{pmatrix}$$

Degree 3 with 10 terms (11 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \end{pmatrix} = \begin{pmatrix} 2.84134210525036567641 \\ -0.00039174295957339386 \\ -0.00122024751385652224 \\ -0.00000005315852447551 \\ 0.00000085679211426198 \\ -0.00000004681893390540 \\ 0.00000000001798607866 \\ -0.00000000008091676863 \\ -0.00000000001947174558 \\ 0.00000000000923505057 \end{pmatrix}$$

Applying the fifth-degree with 23 terms polynomial surface given in equation (4), 23 points, 22 points except for point SLK01 and 21 points except for points SLK01 and UU03 given in table 1 were also used. The model parameters of the various point numbers using the fifth-degree polynomial surface were as well computed with least squares technique as well as equation (6). The computed model parameters for 23, 22 and 21 points using the fifth degree polynomial surface are respectively:

Degree 5 with 10 terms (23 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \\ a_{10} \\ a_{11} \\ a_{12} \\ a_{13} \\ a_{14} \\ a_{15} \\ a_{16} \\ a_{17} \\ a_{18} \\ a_{19} \\ a_{20} \end{pmatrix} = \begin{pmatrix} 5.21254998397845812746 \\ -0.00360955700267510031 \\ -0.00565293996309406920 \\ 0.00000374631209072872 \\ 0.00000136757128228173 \\ 0.00000268293923752297 \\ 0.00000000000015298970 \\ -0.00000000128629548938 \\ -0.00000000098018688082 \\ -0.00000000012478321152 \\ -0.00000000052917832359 \\ 0.00000000000021748849 \\ -0.00000000000000003740 \\ 0.00000000000000001552 \\ 0.00000000000011102756 \\ -0.00000000000002536577 \\ 0.00000000000004442516 \\ -0.00000000000000000077 \\ -0.00000000000000000934 \\ 0.00000000000000000220 \\ -0.00000000000000000108 \end{pmatrix}$$

Degree 5 with 10 terms (22 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \\ a_{10} \\ a_{11} \\ a_{12} \\ a_{13} \\ a_{14} \\ a_{15} \\ a_{16} \\ a_{17} \\ a_{18} \\ a_{19} \\ a_{20} \end{pmatrix} = \begin{pmatrix} 7.30603629707767289898 \\ -0.01241421010635155914 \\ -0.00921069831052644470 \\ 0.00000770915077418606 \\ 0.00001178307394182408 \\ 0.00000686623538125153 \\ -0.00000000000001862531 \\ 0.00000000247293704077 \\ -0.00000000782726899965 \\ -0.00000000496385593976 \\ -0.00000000150183843005 \\ -0.00000000000043701290 \\ 0.00000000000000007432 \\ -0.00000000000000007645 \\ 0.00000000000176869774 \\ 0.00000000000077479601 \\ 0.00000000000009718472 \\ 0.00000000000000000336 \\ -0.00000000000000010210 \\ -0.00000000000000003909 \\ -0.00000000000000000077 \end{pmatrix}$$

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Degree 5 with 10 terms (22 Points)

$$\begin{pmatrix} a_o \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \\ a_8 \\ a_9 \\ a_{10} \\ a_{11} \\ a_{12} \\ a_{13} \\ a_{14} \\ a_{15} \\ a_{16} \\ a_{17} \\ a_{18} \\ a_{19} \\ a_{20} \end{pmatrix} = \begin{pmatrix} 4.08962429231355884825 \\ -0.00657653579427171073 \\ -0.00603156890006715885 \\ 0.00000564857097738800 \\ 0.00000971366697831134 \\ 0.00000637583787244764 \\ -0.00000000000097728351 \\ 0.00000000888273254851 \\ -0.00000001233708878443 \\ -0.00000000619639899917 \\ -0.00000000140699968469 \\ -0.00000000000127814393 \\ 0.00000000000000024780 \\ -0.00000000000000014322 \\ 0.00000000000324539422 \\ 0.00000000000111113695 \\ 0.00000000000005833078 \\ -0.00000000000000000360 \\ -0.00000000000000018917 \\ -0.00000000000000005661 \\ 0.00000000000000000193 \end{pmatrix}$$

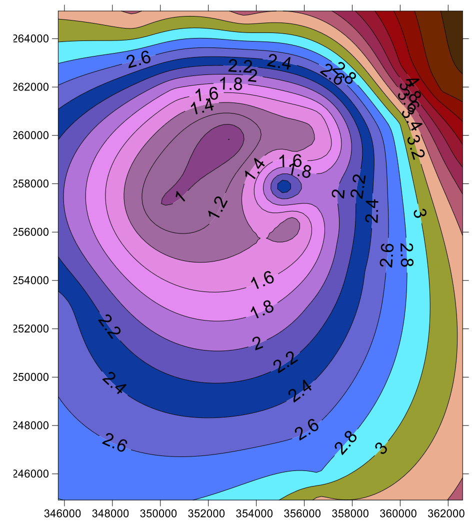

Fig. 3: Contour Map of Known Geoid Heights Using 23 Points

The reliability, as well as the accuracy of the two polynomial geometric surfaces using the various point numbers, were computed by finding the differences between the models' geoid heights of the points and their corresponding known (gravimetric) geoid heights. The computed differences and the total number of points for each case were used to compute the Root Mean Square Error, RMSE of the model using equation (8).

The contour and surface maps of the models and the known, as well as the gravimetric geoid heights of the points at various measurement point numbers, were plotted with surfer 11 to present their shape graphically.

III. RESULTS PRESENTATION AND ANALYSIS

Figures 3 and 4 respectively present the contour and surface maps of the third-degree model using 23 observation points. Also, figures 5 and 6 respectively show the contour and surface maps of the known geoid heights of the 23 points. This was done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the variations between the model and the known geoid heights of the points. It can be respectively seen from figures 3 and 5 and figures 4 and 6 that the contour and the surface maps of the third-degree model and the known geoid heights of the points are not identical which implies that the variations between the third degree model geoid heights and the known geoid heights of the points are considerably large. Thus, using 23 points which is far larger than the third-degree surface 10 terms, the accuracy of the model is very low.

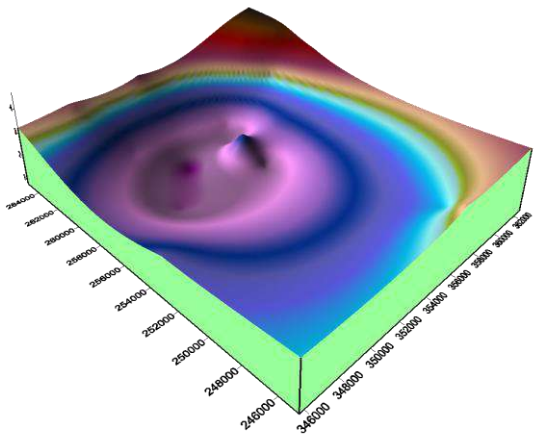

Fig. 4: Surface Map of Known Geoid Heights Using 23 Points

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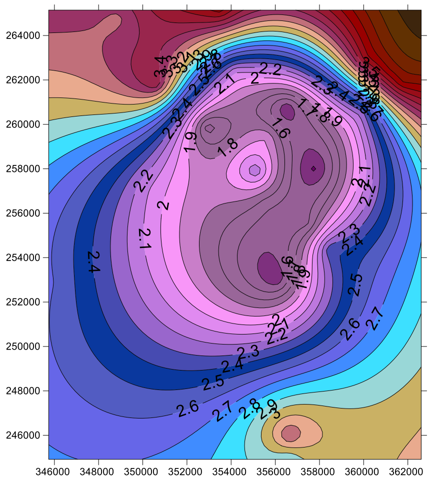

Fig. 5: Contour Map of Third Degree Surface at 23 Points

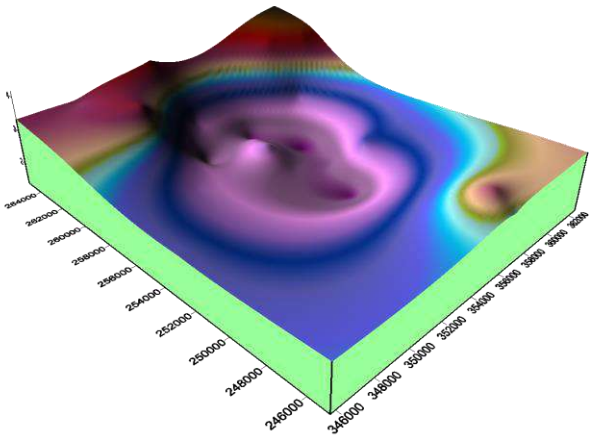

Fig. 6: Surface Map of Third Degree Model at 23 Point

Figures 7 and 8 respectively present the contour and surface maps of the third-degree model using 22 observation points. Also, figures 9 and 10 respectively show the contour and surface maps of the known geoid heights of the 22 points. This was also done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the variations between the model and the known geoid heights of the points. It can be respectively seen from figures 7 and 9 and figures 8 and 10 that the contour and the surface maps of the third-degree model and the known geoid heights of the points are not identical which also implies that the variations between the third degree model geoid heights and the known geoid heights of the points are very much large. Thus, using 22 points which is also far larger than the third-degree surface 10 terms, the accuracy of the model is also very low.

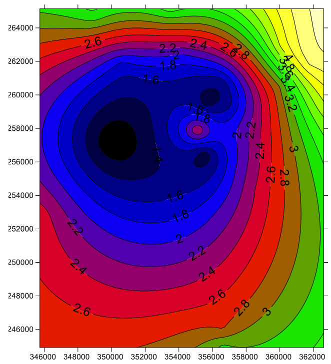

Fig. 7: Contour Map of Known Geoid Heights Using 22 Points

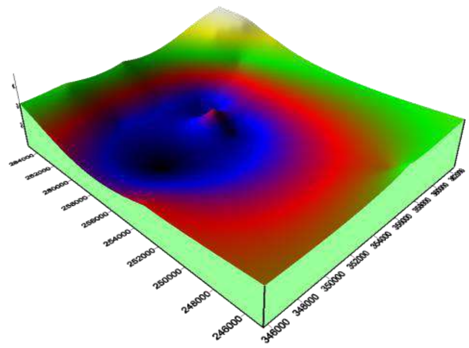

Fig. 8: Surface Map of Known Geoid Heights Using 22 Points

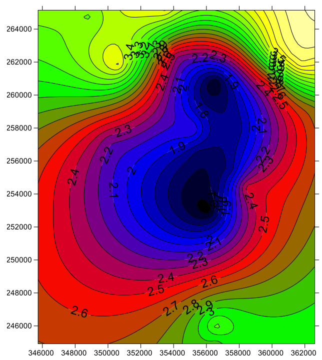

Fig. 9: Contour Map of Third Degree Surface at 22 Points

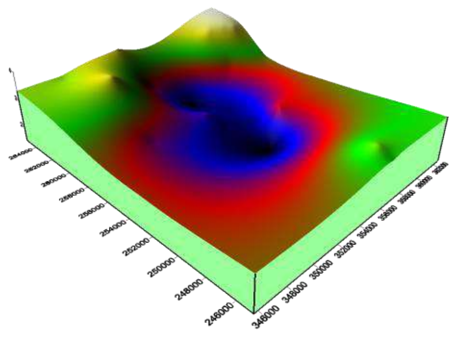

Fig. 10: Surface Map of Third Degree Model at 22 Points

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Again, figures 11 and 12 respectively show the contour and surface maps of the third-degree model using 21 observation points. Also, figures 13 and 14 respectively present the contour and surface maps of the known geoid heights of the 21 points. This was as well done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the differences between the model and the known geoid heights of the points. It can be respectively seen from figures 11 and 13 and figures 12 and 14 that the contour and the surface maps of the third-degree model and the known geoid heights of the points are not identical which implies that the differences between the third degree model geoid heights and the known geoid heights of the points are greatly large. Thus, using 21 points which are as well larger than the third-degree surface 10 terms, the accuracy of the model is well very low.

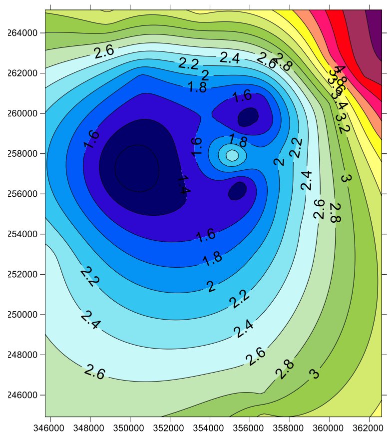

Fig. 11: Contour Map of Known Geoid Heights Using 21 Points

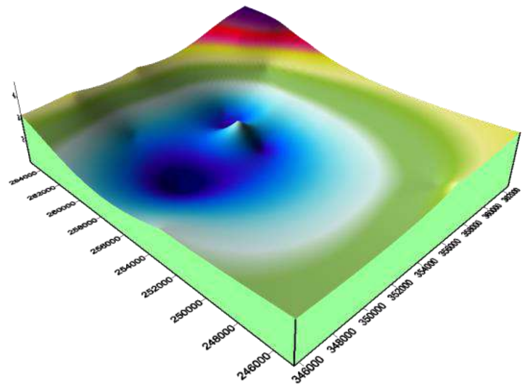
Fig. 12: Surface Map of Known Geoid Heights Using 21 Points

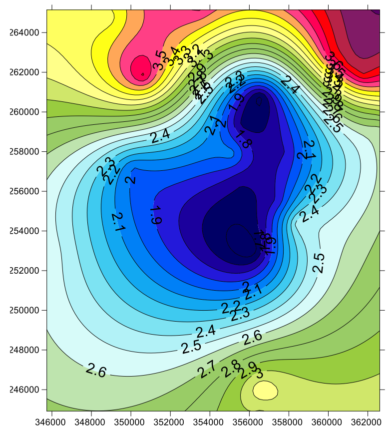

Fig. 13: Contour Map of Third Degree Surface at 21 Points

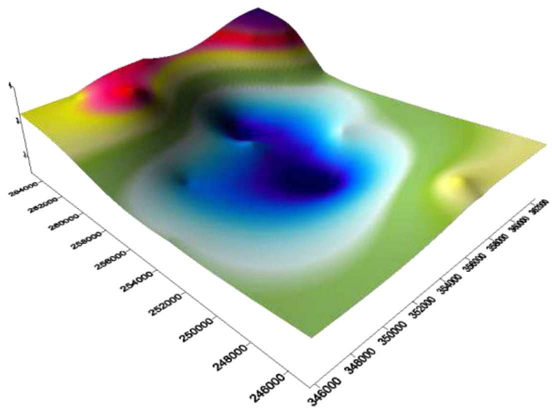
Fig. 14: Surface Map of Third Degree Model at 21 Points

Figures 15 and 16 respectively present the contour and surface maps of the third-degree model using 11 observation points. Also, figures 17 and 18 respectively show the contour and surface maps of the known geoid heights of the 11 points. This was as also done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the variations between the model and the known geoid heights of the points. It can as well be respectively seen from figures 15 and 17 and figures 16 and 18 that the contour and the surface maps of the third-degree model and the known geoid heights of the points are identical which implies that the variations between the third degree model geoid heights and the known geoid heights of the points are very small. Thus, using 11 points which is very close to the third-degree surface 10 terms, the accuracy of the model is very high. This also implies that the accuracy of the local geometric geoid model is highest when the number of points used is either almost or equal to the number of polynomial geometric model terms.

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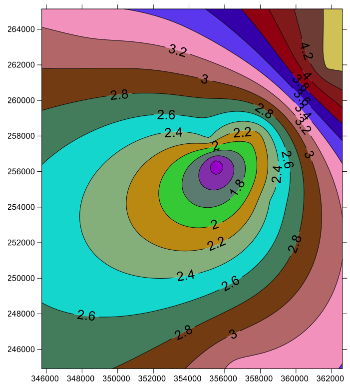

Fig. 15: Contour Map of Known Geoid Heights Using 11 Points

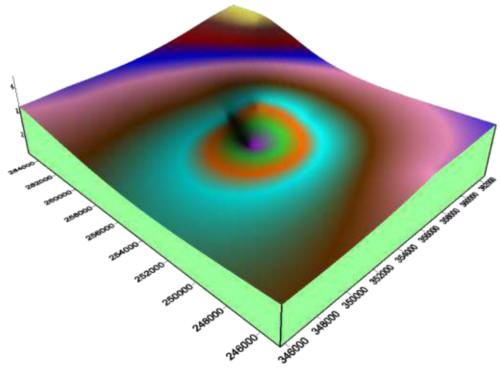

Fig. 16: Surface Map of Known Geoid Heights Using 11 Points

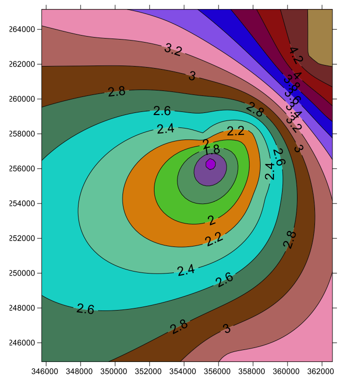

Fig. 17: Contour Map of Third Degree Surface at 11 Points

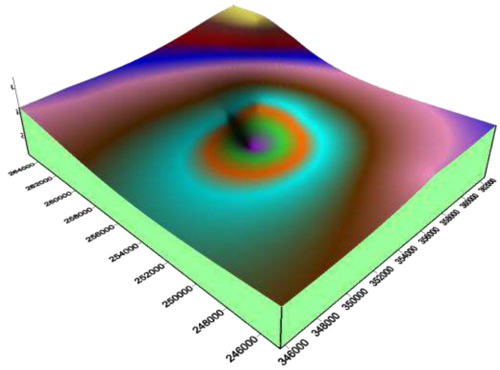

Fig. 18: Surface Map of Third Degree Model at 11 Points

Also, figures 19 and 20 respectively present the contour and surface maps of the fifth-degree model using 23 observation points. Again, figures 21 and 22 respectively show the contour and surface maps of the known geoid heights of the 23 points. This was as well done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the variations between the model and the known geoid heights of the points. It can also be respectively seen from figures 19 and 21 and figures 20 and 22 that the contour and the surface maps of the fifth-degree model and the known geoid heights of the points are approximately identical which implies that the variations between the fifth-degree model geoid heights and the known geoid heights of the points are small. That is, using 23 points which is close to the fifth-degree surface 21 terms, the accuracy of the model is slightly higher. This also means that the accuracy of the local geometric geoid model increases as the number of measurement points approximates the number of geometric model terms.

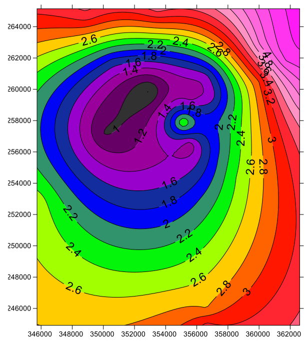

Fig. 19: Contour Map of Known Geoid Heights Using 23 Points

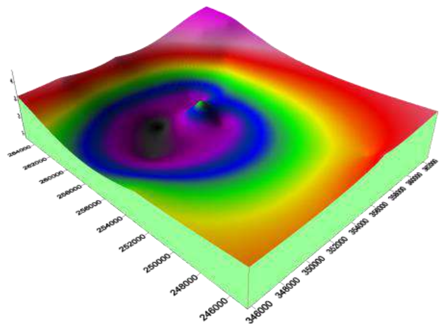

Fig. 20: Surface Map of Known Geoid Heights Using 23 Points

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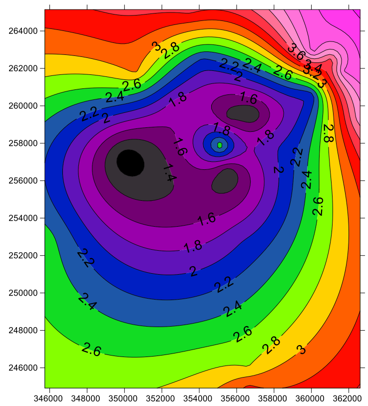

Fig. 21: Contour Map of Fifth Degree Surface at 23 Points

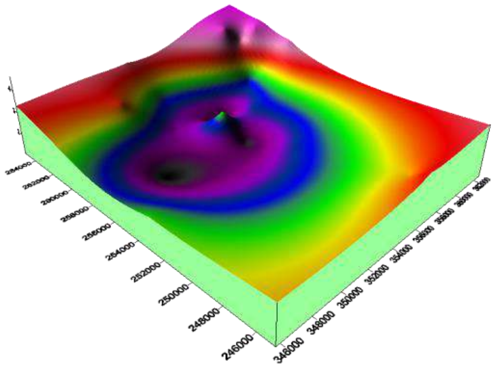

Fig. 22: Surface Map of Fifth Degree Model at 23 Points

Besides, figures 23 and 24 respectively present the contour and surface maps of the fifth-degree model using 22 observation points. Also, figures 25 and 26 respectively show the contour and surface maps of the known geoid heights of the 22 points. This was also done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the differences between the model and the known geoid heights of the points. It can also be correspondingly seen from figures 23 and 25 and figures 24 and 26 that the contour and the surface maps of the fifth-degree model and the known geoid heights of the points are very much identical which implies that the variations between the fifth degree model geoid heights and the known geoid heights of the points are truly small. That is to say, using 22 points which is very close to the fifth-degree surface 21 terms, the accuracy of the model is very high. This also implies that the accuracy of the local geometric geoid model tends to the highest as the number of measurement points is closest to the number of geometric model terms.

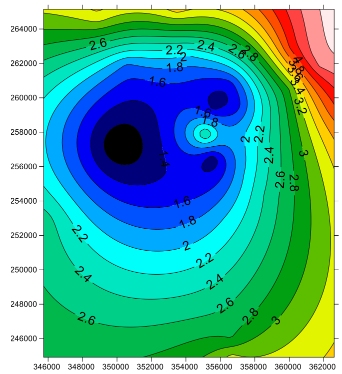

Fig. 23: Contour Map of Known Geoid Heights Using 22 Points

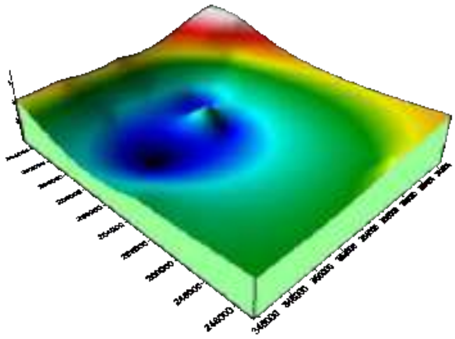

Fig. 24: Surface Map of Known Geoid Heights Using 22 Points

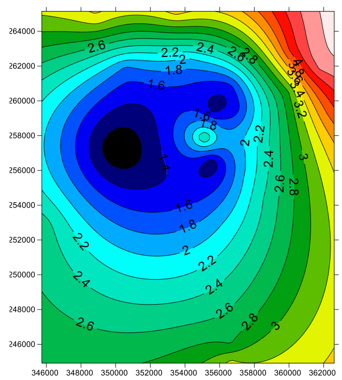

Fig. 25: Contour Map of Fifth Degree Surface at 22 Points

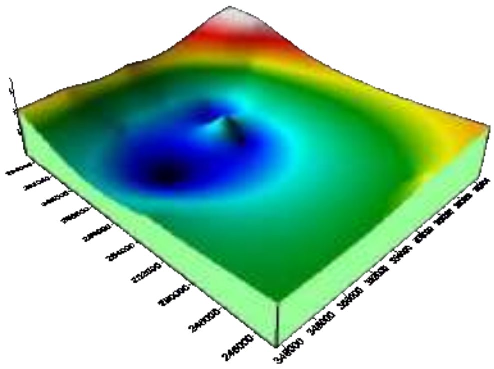

Fig. 26: Surface Map of Fifth Degree Model at 22 Points

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As well, figures 27 and 28 respectively present the contour and surface maps of the fifth-degree model using 21 observation points. Also, figures 29 and 30 respectively show the contour and surface maps of the known geoid heights of the 21 points. This was over again done to present graphically and compare the shapes of the model and the known geoid heights of the points to determine the resemblance as well as the variations between the model and the known geoid heights of the points. It can again be respectively seen from figures 27 and 29 and figures 28 and 30 that the contour and the surface maps of the fifth-degree model and the known geoid heights of the points are extremely identical which implies that the variations between the fifth-degree model geoid heights and the known geoid heights of the points are extremely small. Therefore, using 21 points which is equal to the fifth-degree geometric model 21 terms, the accuracy of the model is highest. This also shows that the accuracy of the local geometric geoid model is highest when the number of measurement points is equal to the number of geometric geoid model terms.

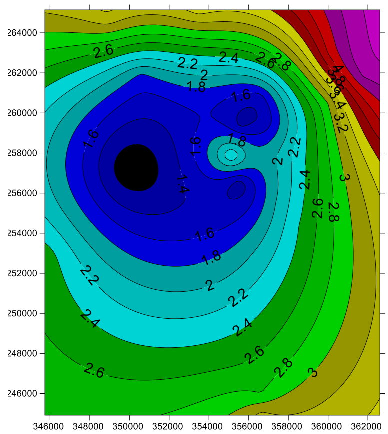

Fig. 27: Contour Map of Known Geoid Heights Using 21 Points

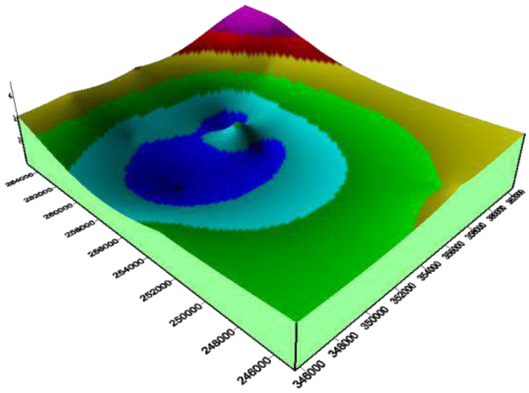
Fig. 28: Surface Map of Known Geoid Heights Using 21 Points

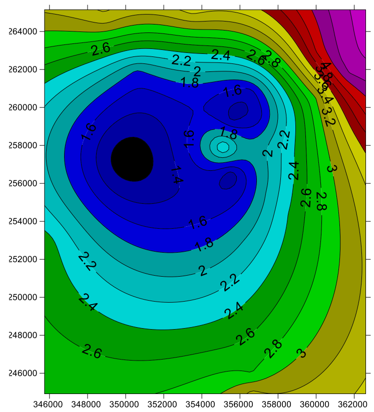

Fig. 29: Contour Map of Fifth Degree Surface at 21 Points

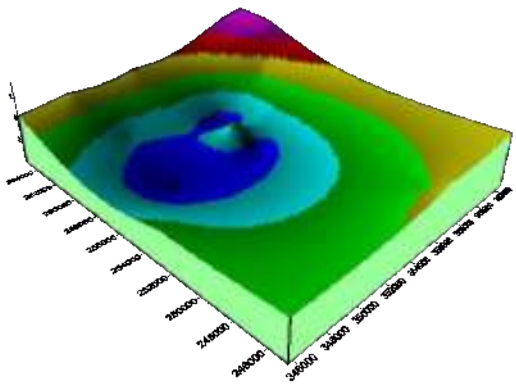
Fig. 30: Surface Map of Fifth Degree Model at 21 Points

Table 2 and figure 31 present the accuracy of the third-degree model at various measurement point numbers. This was done to compare the computed accuracy of the third-degree polynomial surface at various measurement point numbers. The smaller the computed Root Mean Square Error, RMSE, the better the accuracy of the model. It can be seen from table 2 and figure 31 that the accuracy of the third-degree geometric model at 23, 22, 21 and 11 measurement points are correspondingly 0.632m, 0.6358m, 0.6358m and 0.034m. This means that the accuracy of the model is highest at 11 measurement points. This is as the number of points used (11) is very close to the number of the third-degree geometric model terms (10). This again, implies that the accuracy of the geometric geoid model tends to the highest as the number of measurement points approximates the number of the model terms.

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Table 2: Accuracy of the Third Degree Model at Various Measurement Point Numbers

3rd Degres-10 Terms Geoid Surface				
	23 Points	22 Points	21 Points	11 Points
RMSE (m)	0.632	0.6358	0.6358	0.034

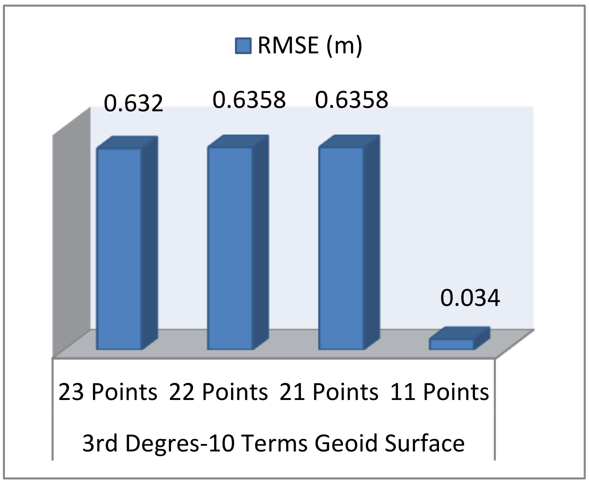

Fig. 31:Plot of Accuracy of the Third Degree Model at Various Measurement Point Numbers

Again, table 3 and figure 32 present the accuracy of the fifth-degree model at various measurement point numbers. This was as well done to compare the obtained accuracy of the fifth-degree polynomial geoid model at various measurement point numbers. The smaller the computed RMSE, the better the accuracy of the model. It can be seen from table 3 and figure 32 that the accuracy of the fifth-degree geometric model at 23, 22 and 21 measurement points are respectively 0.4333m, 0.0046m and 0.0003m. This means that the accuracy of the model is highest, less than 1mm at 21 measurement points. Also, at 22 observation points, the accuracy of the model is within 5mm. This once more implies that the accuracy of the polynomial geometric geoid model tends to the highest as the number of measurement points approximates the number of the model terms and in a unique solution, when the number of observation points is equal to the number of the polynomial geometric model terms, the model accuracy is highest.

Table 3: Accuracy of the Fifth Degree Model at Various Measurement Point Numbers

5th Degres-21 Terms Geoid Surface			
	23 Points	22 Points	21 Points
RMSE (m)	0.4333	0.0046	0.0003

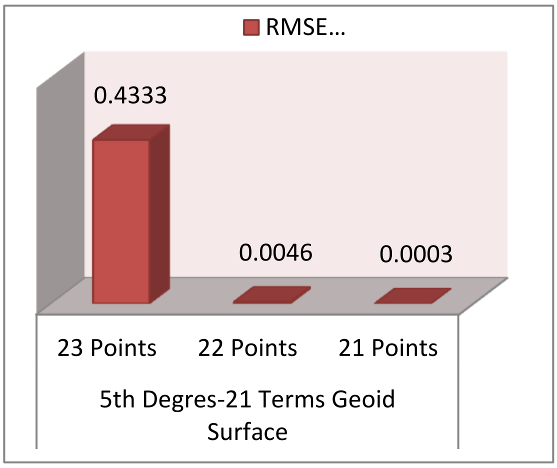

Fig. 32: Plot of Accuracy of the Third Degree Model at Various Measurement Point Numbers

IV. CONCLUSION AND RECOMMENDATIONS

1. This paper has determined the relationship between polynomial geometric geoid surface terms and observation points number and effect in the accuracy of geometric geoid models.
2. The paper has presented that the accuracy of the geometric geoid model tends to the highest as the number of measurement points approximates the number of the model terms.
3. The paper has also presented that the accuracy of the polynomial geometric geoid model is highest when the number of observation points is equal to the number of the polynomial geometric model terms
4. The obtained results have shown that the least squares model for fitting polynomial geometric surfaces to geoid heights should not just be the observation equal to the estimate but the residual should be considered as it can be used as a check. This is for the reason that the residual obtained from the difference between the estimate and the observation is equal to the difference between the model geoid height and its corresponding known geoid height.
5. The paper has also recommended that the geometric method of local geoid model determination should be strictly applied in small areas. Where the method will be applied in considerable large areas, having considered the variation of the geoid heights, higher degrees polynomial geometric surfaces with larger numbers of terms approximating the number of observation points should be applied. This will enable the proper fit of the polynomial surface to the known geoid heights, as well as high accuracy to be obtained.

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Effect of different media on mycelium growth of *Sclerotium rolfsii* Sacc. *invitro* condition

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***Abstract*— *An invitro experiment was conducted to study the effect of different culture media on mycelial growth of Sclerotium rolfsii Sacc. in Plant pathology Laboratory of Agriculture and Forestry University, Nepal. The pathogenic isolate of S. rolfsii was isolated from symptomatic tomato and maintained in PDA. Seven different culture media viz. Potato Dextrose Agar (PDA), Chickpea Dextrose Agar (ChDA), Bean Dextrose Agar (BDA), Carrot Dextrose Agar (CDA), Papaya Dextrose Agar (PpDA), Czapek Dox Agar (CzDA) and Sabouraud's Dextrose Agar (SDA) were prepared and 5-mm diameter mycelial plugs from the margins of 3-days old S. rolfsiiculture was transfer in the middle of each media plate. The radial mycelial growth was measured at 2 days interval for 14 days. Chickpea Dextrose Agar (ChDA) had significantly higher mycelia growth, which was superior than Potato dextrose agar (PDA). Papaya fruit, carrot root, chickpea grain and bean grain can be the common cheap source of carbon in industrial development of culture media.*

Keywords*— *Media, S. rolfsii, Mycelium, Carbon, isolate.

I. INTRODUCTION

*Sclerotium rolfsii*Sacc. is a necrotrophic soilborne plant pathogen forming sclerotia as a survival structure distributed worldwide. It causes various symptoms like seedling damping-off, root rot, collar rot, and stem rot in more than 500 plant species commonly legumes, crucifers, and cucurbits (Barnett and Hunter, 1972). Because of prolific growth of *S. rolfsii* and ability to produce persistent sclerotia, it is contributing in high degree of economic losses (Mahen et al., 1995).Under conducive conditions it can causes 55-95% mortality of the crop at seedling stage (Gurha and Dubey, 1982). Infection on plants by the pathogen is governed and triggered by the initial recognition phenomenon. Establishment of the pathogen in host depends upon some kind of similarity between two interacting partners (De Vay & Adler, 1976).

The capacity of fungi to utilize the available nutrients, of which carbohydrates are the major ones determine the ability of fungi to grow in different media. So it was observed that the growth rate varies with different carbon sources. Fungal media containing high carbohydrate source, nitrogen source is required for the growth of fungi at pH range of 5 to 6, and a temperature range from 15 to 37˚C. Fungal culture media are natural and synthetic. Natural media are composed of natural substrates like potato dextrose agar, V-8 juice agaretc whereas synthetic media contain defined amounts of carbohydrates, nitrogen, and vitamin sources (eg: Czapek-Dox medium).

Potato dextrose agar (PDA) is most commonly used natural media for the culture of fungi. Most lab used media are not cost effective at a large-scale, so industrialists have started to use several common cheap sources of carbon. So, the objective of this research was to identify alternative natural fungal media using substrate with cheap source of carbon.

II. MATERIALS AND METHODS

Media preparation

Five natural media: Potato Dextrose Agar(PDA), Chickpea Dextrose Agar(ChDA), Carrot Dextrose Agar(CDA), Bean Dextrose Agar(BDA), Papaya Dextrose Agar(PpDA) and two synthetic media: Saubourds Dextrose Agar(SDA),Czepadox Dextrose Agar(CzDA) were prepared. 200 g of potato pieces, chickpeagrains, carrot pieces, bean grains, papaya fruit pieceswere weighed individually for their respective media viz. PDA, ChDA, CDA, BDA, PpDArespectively and boiled in 500 ml of water for 10 minutes and filtered with muslin cloths. We added 20 g of dextrose and 20g of agar in each media and added distilled water to make the final volume of 1000 ml.

The synthetic media were prepared as manufactural instruction. SDA was prepared by mixing 40 g of dextrose, 10 g of Peptone and 15 g of Agar in 1000 ml of distilled water and CzDA by 30 g of Sucrose, 2 g of sodium nitrate, 1 g of Dipotassium phosphate, 0.5 g of Magnesium sulphate, 0.5 g of Potassium chloride, 0.01 g of Ferrous nitrate, 15 g of agar in 1000 ml of distilled water. The media were autoclaved for 121°C for 20 minutes at 15 psi pressure.

Table 1: Composition of different natural culture media

Ingredients	PDA	ChDA	PpDA	BDA	CDA
Pieces/grain	200 g	200 g	200 g	200 g	200 g
Dextrose	20 g	20 g	20 g	20 g	20 g
Agar	20 g	20 g	20 g	20 g	20 g
Distilled water	1000 ml	1000 ml	1000 ml	1000 ml	1000 ml

Isolation of *S. rolfsii*

The pathogen, *S. rolfsii* was isolated from the stems of infected tomato plants grown in Chitwan, Nepal by tissue segment method (Rangaswami and Mahadevan, 1999) onPDA. Small pieces of tissue of about 1 cm from infected collar region with some healthy tissue were cut with sterile blade. The pieces were surface sterilized with 1% sodium hypochlorite solution for 1 minute followed by three subsequent wash with sterilized distilled water. These pieces were kept onto PDA medium in Petri dishes. Plates were incubated at 27 ± 2°C for 2 day. The pathogen was identified as *S. rolfsii* based on its mycelial and sclerotial characteristics (Barnett and Hunter, 1972).

Experimental setup

The experiment was conducted in Plant Pathology laboratory of Agriculture and Forestry University (AFU), Chitwan, Nepal. Approximately 20-ml of autoclaved media was poured in each petri plate (9-cm diameter). Each plate was inoculated with a 5-mm diameter mycelial plugs from the margins of 3-days old culture grown on PDA. Plates were then incubated at 27±2^{0}C with 12-hour photoperiod for two weeks. The radial mycelial growth was measured in every 2 days interval for 14 days. The experiment was replicated four times.

Data analysis

Analysis of variance (ANOVA) was conducted using R version 3.6.0. Significant differences between treatments were determined using a Duncan multiple range test (DMRT) at p=0.05.

III. RESULTS AND DISCUSSION

Mycelial growth

Although the mycelial growth of *S. rolfsii*in papaya dextrose agar was significantly lower than potato dextrose agar up to 6 days of incubation, the mycelial growth was at par in both growth media after 8-DAI (Table 2). In chickpea dextrose agar medium, the mycelial growth was consistently superior over the 14-DAI (Table 2). This result showed that chickpea dextrose agar, papaya dextrose agar and bean dextrose agar can be used as alternative nutrient source for the growth of *S. rolfsii*.

Since sugars are the principle constituents of papaya with total content of 48.3% sucrose, 29.8% glucose and 2% fructose (Chan and Kwok, 1975; Gomez et al., 2006) and it also contains sodium, potassium, Magnesium, Calcium, Iron and other vitamins which encourages the growth of pathogen.

Chickpea contains on an average 23% of protein, 64% carbohydrate, 6% crude fibre and 3% ash. It also has high mineral content like phosphorous, calcium, magnesium, iron and zinc etc. these nutrients are capable of supporting fungal growth (Junakali AK et al., 2009).

Kan A et al. (2010) reported that chickpea has natural antibacterial activity against gram negative bacteria like *Staphylococcus aureus, Bacillus substilis* and *Enterococcus faecalis*. Hence the natural antibacterial property in Chickpea dextrose agar has additional benefits as media more selective for fungi and less prone to bacterial contamination.

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Table 2: Effect of different growth media on the mycelial growth of the pathogen S. rolfsiiSacc.

Treatments	2 DAI	4 DAI	6 DAI	8 DAI	10 DAI	12 DAI	14 DAI
Papaya dextrose agar	1.25[cd]	1.70[d]	2.47[cd]	3.22[bcd]	6.10[b]	8.10[a]	9.00[a]
Chickpea dextrose agar	2.45[a]	3.35[a]	4.50[a]	5.37[a]	7.30[a]	7.95[a]	8.77[ab]
Potato dextrose agar	2.17[ab]	3.02[ab]	3.50[b]	3.97[b]	5.52[b]	7.35[ab]	7.87[abc]
Bean dextrose agar	1.75[bc]	2.65[bc]	3.32[b]	3.80[bc]	5.87[b]	6.97[ab]	7.57[bcd]
Sabouraud dextrose agar	1.05[d]	1.62[d]	2.10[d]	2.65[d]	4.45[c]	6.12[bc]	6.90[cd]
Carrot dextrose agar	0.92[d]	1.07[e]	1.30[e]	1.55[e]	3.85[c]	5.05[cd]	6.47[d]
Czapek Dox Agar	1.97[ab]	2.32[c]	2.95[bc]	3.05[cd]	3.82c	4.20[d]	4.55[e]
F test	***	***	***	***	***	***	***
SEM	0.119	0.139	0.237	0.239	0.529	0.821	0.613
$LSD_{0.001}$	0.025	0.027	0.035	0.035	0.053	0.066	0.052
CV (%)	20.8	16.6	16.9	14.5	13.7	13.8	10.7

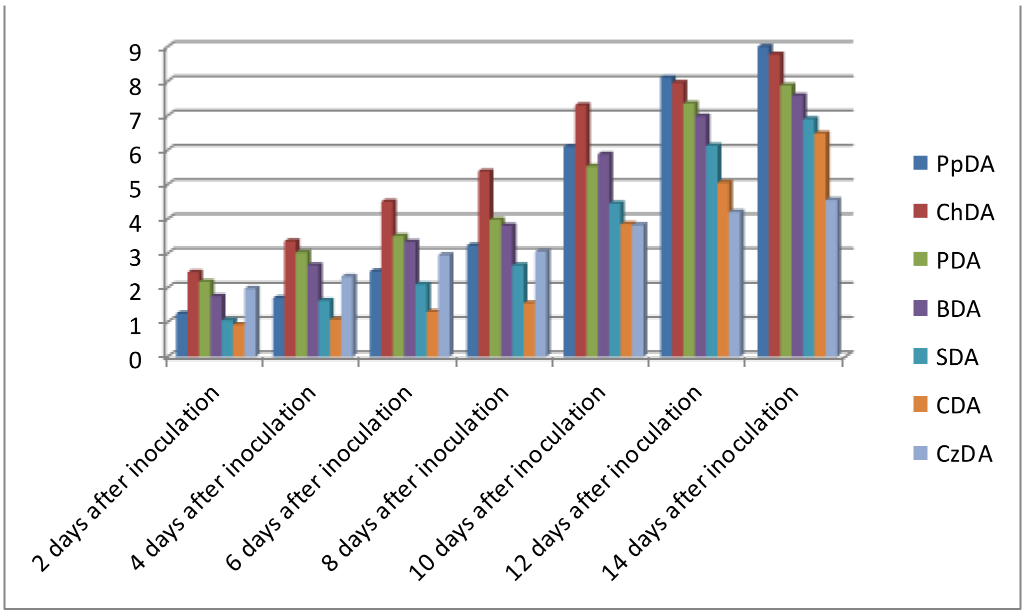

Fig.1: Mycelial growth of S. rolfsii in different culture media at various days after incubation

Mycelium characteristics on different media

The mycelium grown in chickpea dextrose agar (ChDA) had bright white color and Papaya Dextrose Agar (PpDA) had dull white color. Chickpea dextrose agar (ChDA), Bean Dextrose Agar (BDA) had condensed mycelium whereas uncondensed in Carrot Dextrose Agar (CDA).

Table 3: Comparison of mycelium characters of S.rolfsii on different growth media

SN	Media	Growth	Colony color	Appearance
1	PpDA	Initially slowand very fast in later	dull white	Cottony dull white
2	ChDA	Moderate	Bright white	Dense cottony white
3	PDA	Moderate	Cottony white	Medium Cottony white
4	BDA	Moderate	Light white	Condensed cottony
5	SDA	Slow to moderate	Bright white	Moderately condensed
6	CDA	Slow to fast	Bright white	Uncondensed cottony
7	CzDA	Slow	Extra white	Wavy like, condensed at margins, aggregated

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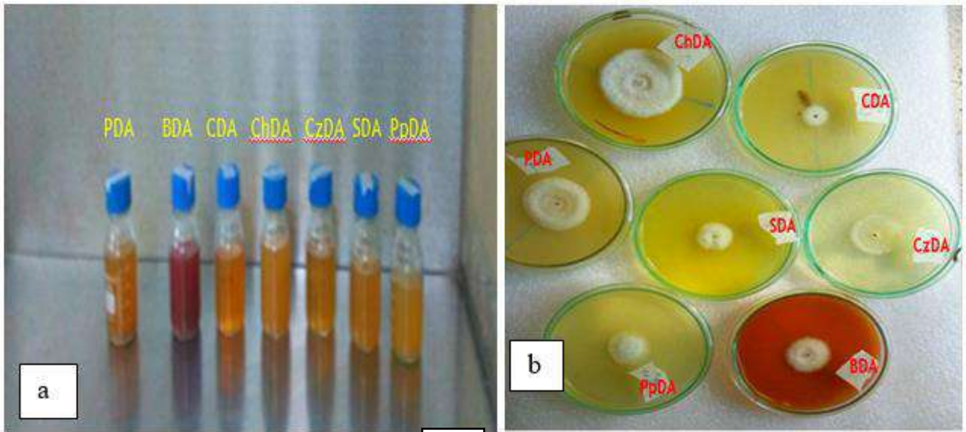

Fig.2: Preparation of culture media (a) and my b *growth of S. rolfsiiin different culture media at 6 DAI*

IV. CONCLUSION

Potato dextrose agar (PDA) is most commonly used fungal media. As an alternative to PDA, Papaya dextrose agar (PpDA), Chickpea dextrose agar (ChDA) and Bean dextrose agar (BDA) can use for the culture of sterile fungi like *S. rolfsii*, Papaya, chickpea and bean can be the cheap source of carbon for manufacturing the fungal culture media. Further study should be done to know the sporulation of fungi in these natural media.

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Population Dynamics of *Mackerel Scad* (*Decapterus macarellus*) in the Banda Sea

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***Abstract*— *Mackerel scad is a one of small pelagic fish that has important economic value in the waters around Ambon Island. This study aims to determine population dynamics including the length distribution, growth, gonad maturity, mortality and the rate of exploitation of mackerel scad in the waters around Ambon Island. This research was conducted during the period of September 2016 to July 2017. Total fish samples analyzed were 2534 individuals. The total length (TL) of fish caught during the eleven months of the research ranged from 9.0 - 31.9 cm with an average length of fish caught of 20.11 cm. Growth curve formed with the equation: L_t = 33.35 [1-exp$^{0.560}$ (t + 0.2799]. Gonad I maturity level was 8.13-10 16%, TKG II (gonad II maturity level) was 46.49-49.11% , TKG III (gonad III maturity level) was 16.54-18.93%, TKG IV (gonad IV maturity level) 24.34-26.02%, and TKG V (gonad V maturity level) was 0.07-0.21%, F value was 1.36/year with the rate of exploitation (E) of 0.53/year, the total mortality rate (Z) = 2.58/year and the natural mortality rate (M) = 1.23/year.*

Keywords*— *Decapterus macarellus, growth, gonad maturity level, mortality, exploitation rate, Banda Sea.

I. INTRODUCTION

Decapterus sp is one of the potential fisheries resources and has important economic value in the Banda Sea. The fish is pelagic scall species are generally caught by purse seine. There are four species of Decapterus found in the Banda Sea, and one of them is mackerel scad (*Decapterus macarellus*). Mackerel scad belongs to one of the dominant species of pelagic fish caught throughout the year. It is an offshore fish because it has a vast distribution and can be caught at depths of 40–200 meters (Silooy et al., 2019; and Smith-Vaniz, W.F., 1999).

Atmadja et al., (2003) revealed that the catching of Decapterus using purse seine which was carried out without following the rules of fisheries resource management resulted in the fishing of small-sized young fish with immature gonad. In an effort to manage fisheries resources, especially mackerel scad, up-to-date information about these resources is needed. Information on the potential and level of utilization, population dynamics and biological aspects are needed so that the resources of small pelagic fish can be well managed and utilized sustainably.

This research was conducted to examine several aspects of population dynamics including size distribution and growth, gonad maturity level (TKG), mortality and exploitation rate of mackerel scad (D. macarellus) in the waters around Ambon Island. The results of this study are expected to be able to add and enrich existing information so that it can be used as a reference for consideration in the sustainable management of mackerel scad, especially in the waters around the island of Ambon and in Maluku waters in general.

II. MATERIALS AND METHODS

This research was carried out around the Banda Sea (**Figure 1**) for eleven (11) months (September 2016-July 2017) representing four fishing seasons, namely transition season 2, west season, transition season 1 and east season. *D macarellus* fish samples were obtained from purse seine catches operating in the Banda Sea. Each sample was taken randomly at the fish-landing site and fishing port Ambon. The length of the entire fish samples was measured using a measuring board with a precision of 0.1 cm. The type of measurement performed was the total body length, which is the length from the front end of the

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head or the tip of the mouth to the end of the tail. Body Weight was measured using a digital scale with an accuracy of 0.1 gram.

Growth

Estimation of growth parameters using the Von Bertalanffy growth formula (Sparre et al., 1999) was as follows:

$$Lt = L\infty (1 - e\text{-}K (t\text{-}to))$$

Explanation:

Lt	= length of fish at the age of t (mm)
$L\infty$	= Fish Asymptote Length (mm)
K	= Growth rate coefficient
t_0	= The theoretical age of the fish when the length is zero (years old)
t	= age (years old)

Gonad Maturity Level

Gonad Maturity Level was determined macroscopically and performed morphologically by observing the color, shape and size of the gonad according to Cassie in Effendie (1997).

Mortality

Natural mortality was estimated by using Pauly's empirical formula (1984) as follows:

Log (M) = -0.0066 - 0.279 log ($L\infty$) + 0.6543 log (K) + 0.4634 log (T)

Explanation:

$L\infty$	= Fish asymptote length (mm)
k	= Growth Rate Coefficient
T	= Average surface water temperature (0C)

Total mortality was assumed using the formula proposed by Beverton and Holt (1956) in Sparre et al., (1999), namely:

$$Z = K\ L\ \infty - L\ L - L'$$

Explanation:

Z	= Total mortality rate (years)
K	= Growth rate coefficient
$L\infty$	= Fish asymptote length (mm)
L	= Average length of fish caught intact (mm)
L '	= The smallest size limit of length class of fish caught intact

Fishing mortality was predicted using the following equation:

$$Z = F + M$$

So that:

$$F = Z - M$$

The exploitation rate (E) was determined by comparing the fishing mortality rate (F) with the total mortality rate (Z) (Pauly, 1984):

$$E = F / (F + M)$$

If: E > 0,5 : Over Fishing

E = 0,5 : Maximum Sustainable Yield

E < 0,5 : Under Fishing

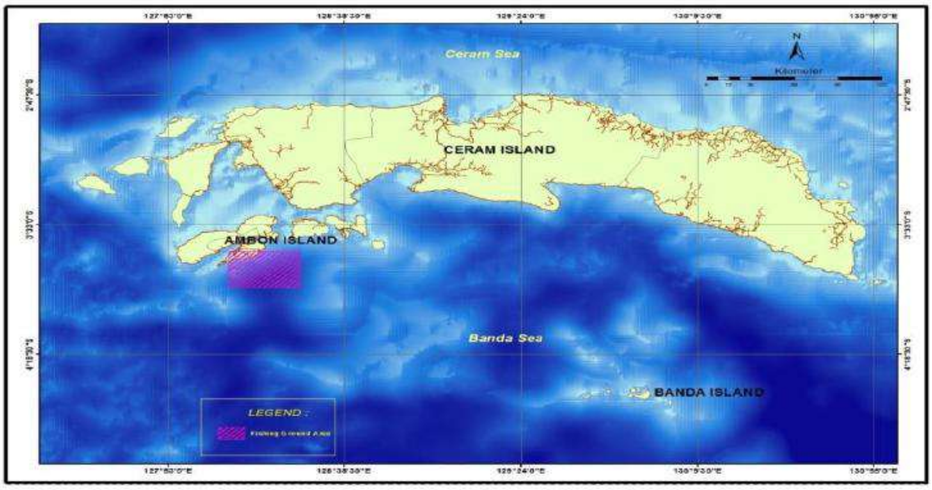

Fig. 1. Map of Mackerel scad (Decapterus macarellus) fishing operations in the Banda Sea

III. RESULTS AND DISCUSSION

3.1. Distribution of the Length of the Fish

This research was conducted during the period of September 2016 to July 2017. The total sample of fish analyzed was 2534 individuals (**Table 1**). The total length (TL) of fish caught during eleven (11) months of the study ranged from 9.0 cm to 31.9 cm with an average length of 20.11 cm. Each month, the size of the fish caught varied. This was presumably because the mackerel scad population around the waters of the island of Ambon consists of several groups. This can be seen by the

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shifting of the length of the fish throughout the fishing period.

The length range of the mackerel scad obtained in this study was almost the same as the size range of fish caught in Banda Aceh waters ranging from 16 cm to 32 cm, in the waters west of Sumatra ranging from 16 - 26 cm, in the waters of the Tomini bay ranging from 16 - 27 cm, in North Maluku waters ranging from 21 - 31.5 cm (Hariati 2004; Kusdi et al 2009; Widodo et al., 1999). According to Widodo (1988), Decapterus in the Java Sea mature at a size of 13.9 cm with a minimum decent size for fishing of 14.8 cm. Prihatini (2006) stated that Decapterus with a size of 14.0 cm has been considered mature because it has reached TKG III. Based on the size of the fish caught in this study, it can be classified in adult fish group that is feasible for fishing.

Table 1. Distribution of the total length of mackerel scad in the waters around Ambon Island

Period (month)	Quantity (individual)	Class Interval (cm)	Mid Length (cm)	Minimum (cm)	Maximum (cm)	Mode (cm)
Sep-16	354	23.0-29.5	26.25	23.0	29.4	27.5
Oct-16	339	18.0-21.9	19.95	18.0	21.9	20.5
Nov-16	410	9.0-31.9	20.45	9.0	31.8	16.5
Dec-2016	215	12.0-21.9	16.95	12.1	23.9	18.5
Jan-17	205	16.0-26.9	21.45	16.0	26.9	20.5
Feb-17	231	12.0-28.9	20.45	12.0	28.7	20.4
Mar-17	119	16.0-25.9	20.95	16.2	25.8	20.5
Apr-17	112	15.0-25.9	20.45	15.1	25.9	23.4
May-17	327	12.0-30.9	21.45	12.2	30.8	18.3
June-17	120	14.0-29.9	21.95	14.2	29.9	20.4
July-17	102	17.0-31.9	31.9	17.1	31.8	24.5
Total/average	**2534**		**20.11**	**14.99**	**27.89**	

3.2. Growth

Based on the growth parameter formulas by Von Bertalanffy which was allegedly using the ELEFAN-I method, the growth rate coefficient (K) value of the fish in the waters around Ambon Island tends to be slightly faster, namely 0.560 per year, with a longer asymptote length (L∞) of 33.35 cm, theoretical age of fish when the length is equal to zero (to) = -0.2799, and the Response Surface Rn (Goodness of fit index) = 0.227, thus the growth curve obtained with an equation of Lt = 33.35 [1-exp 0.56 (t + 0.27991]. The estimated value of growth that expresses the relationship between growth patterns and the maximum age of the population is depicted in the form of a growth curve as shown in **Figure 2**.

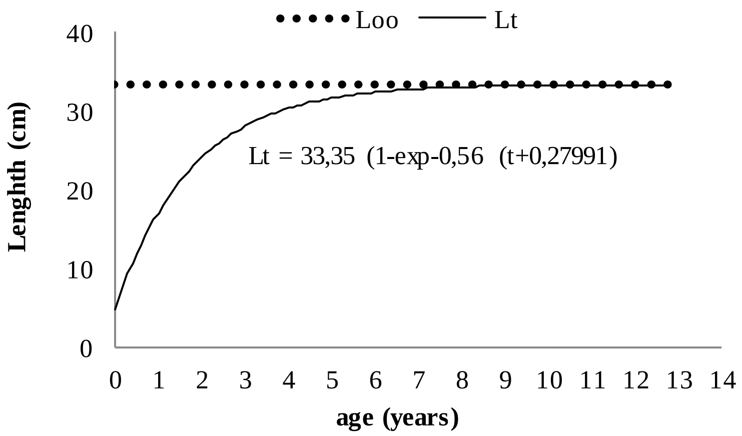

Fig 2. Estimated Growth Rate of Decapterus macarellus using von Bertalanffy formula in the Banda Sea

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The growth curve of this fish expressed the relationship between growth patterns and maximum age in the waters around Ambon Island. The growth rate of Decapterus population caught was relatively slightly faster (K> 0.5 per year). This growth curve showed that mackerel reached a maximum length of 33.35 cm at 23.7 months old or 2.6 years old. At this age, there is no growth or addition of fish length or size. The results found that the growth was slightly faster than some previous studies, in which the maximum age of Decapterus in the Java Sea waters was around 5 years old (Widodo, 1998), and the maximum age of mackerel scad in North Maluku waters was around 4 years old (Iksan and Irham, 2009).

The growth parameters of *D.macarellus* species in several locations in Indonesia ranged from 25.6 - 33.57 cm for L∞ parameter and ranged from 0.31 - 0.56 per year for K parameter. The difference in growth parameter values (L∞ and K) of the same species at different locations was greatly influenced by environmental factors, such as food availability, water temperature, dissolved oxygen, fish size, gonad maturity (Merta, 1992; Effendie, 1997; Widodo, 1988; Kaymaraman et al, 2014), the narrow range of sample sizes, the low length of asymptotes, and the limiting individual sampling results (Haruna et al., 2018).

3.3. Gonad Maturity Level

The results of observation on male and female gonad samples of Decapterus macarellus included the TKG I-V which were distributed in the range of class median of 17.5-31.5 cm. The gonad maturity levels consist of the young phase (TKG I) of 8.13-10.16%, the initial maturity phase (TKG II) of 46.49-49.11%, the mature phase (TKG III) of 16.54- 18.93%, the spawning phase (TKG IV) of 24.34-26.02%, and the saline phase (TKG V) of 0.07-0.21%, can be seen in **Figure 3**.

Distribution of the total percentage of the number of individuals at each level of gonad maturity in each month for both male and female fish showed that the young and initial maturity phases were found almost throughout the year with the highest percentage respectively in October and December (around 93-100%), the mature and spawning phases were found throughout the month except in October and December, where the highest average percentage was spread almost evenly in May to September in the range of 30-60%, while the saline phase in this study was barely found, the percentage found in March was 1-3%. The distribution of monthly gonadal development showed that the peak period when the mature gonads found was from May to September (**Figure 4 and Figure 5**).

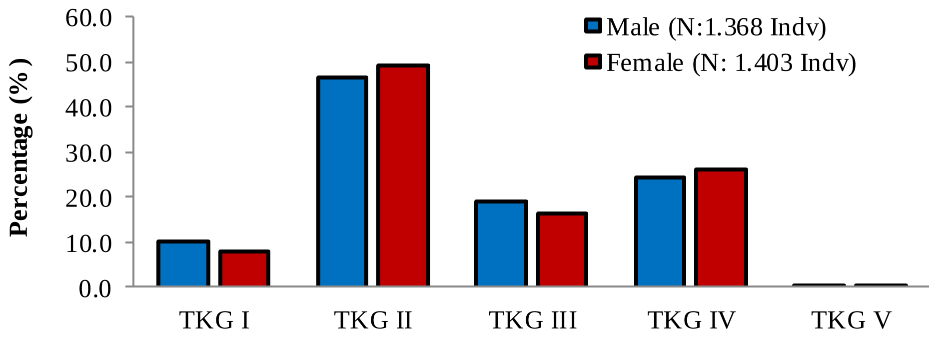

Fig 3. TKG percentage of Decapterus macarellus in the Banda Sea

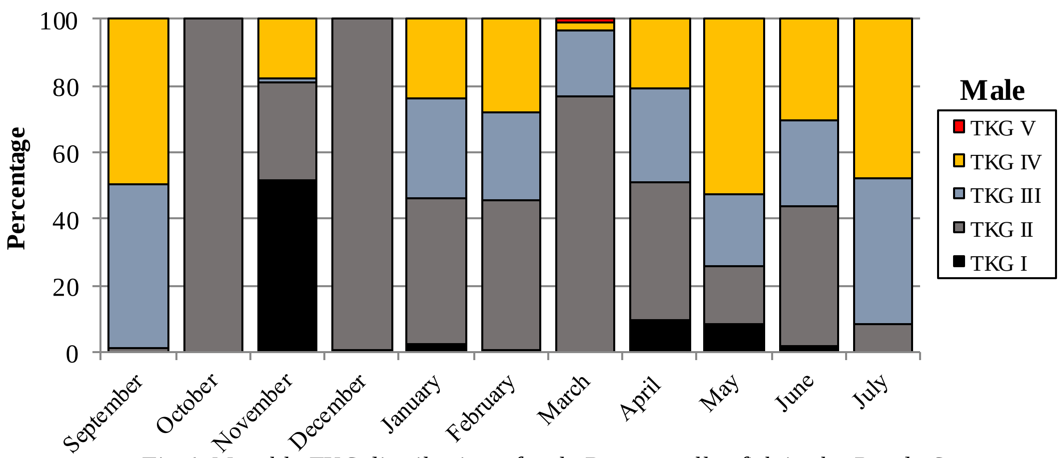

Fig 4. Monthly TKG distribution of male D. macarellus fish in the Banda Sea

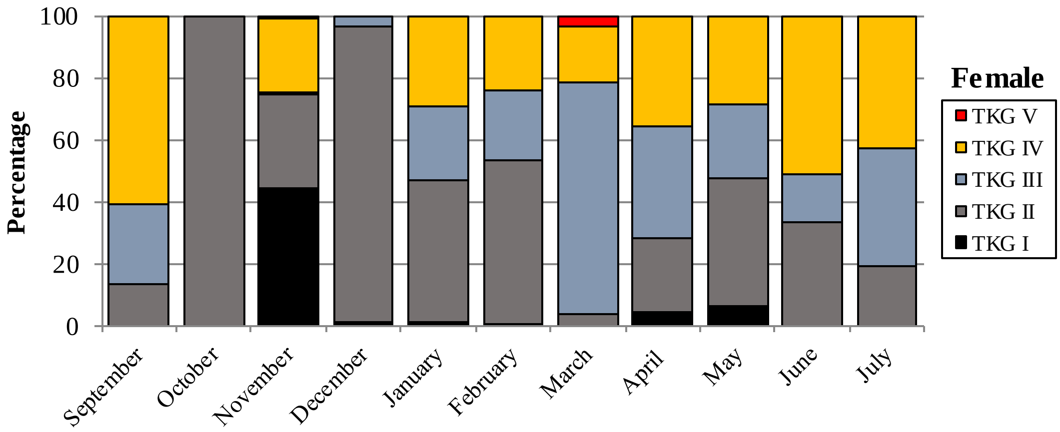

Fig 5. Monthly TKG distribution of female D. macarellus fish in the Banda Sea

3.4. Mortality and Exploitation Rate

Estimation of mortality and exploitation rate based on the data on the composition of fish length size using the FISAT II program (**Figure 6**). The mortality of *D. macarellus* exploited was caused by a combination of natural mortality (M) and mortality due to the fishing (F). The waters around Ambon Island obtained an F value of 1.36/year with an exploitation rate (E) of 0.53/year, total mortality rate (Z) = 2.58/year and a natural mortality rate (M) = 1.23/year.

The assessment results indicate the fishing mortality (F) is still greater than the natural mortality (M), meaning that the mortality of *D macarellus* fish in Ambon Island waters is caused by fishing factors. Judging from the rate of exploitation (E) in this study, namely 0.53/year, it is assumed that the pressure of fish exploitation is beyond the determined optimum sustainable value. The optimum exploitation rate occurs if there is a balance ratio between M and F, so it is assumed that the value of sustainable optimum exploitation (Eopt) is equivalent to E = 0.50 (Gulland, 1971).

This difference in the value of natural Mortality (M) has a relationship with the physical condition of the fish and the aquatic environment. According to Sparre and Venema (1999), the value of M will depend on disease, stress, spawning, starvation, old age, and according to Beverton and Holt (1957), it is caused by predation. According to Kaymaraman et al., (2014) the difference is very determined by the use of estimation methods, observation locations and sensitivity to growth parameters, namely K and L∞.

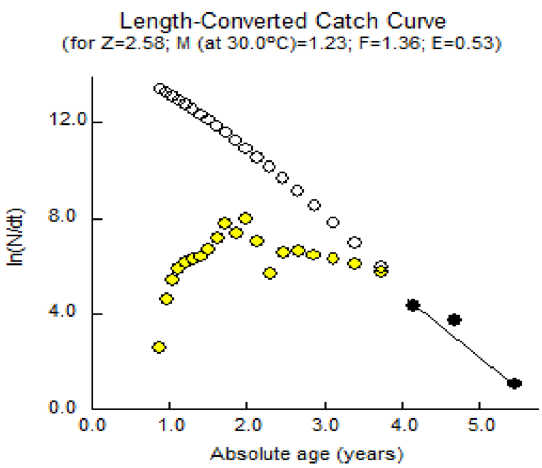

Fig 6. Mortality rate and exploitation rate of D. macarellus fish in the waters around Ambon Island

IV. CONCLUSION

1. Total length (TL) of fish caught during eleven (11) months of research ranged from 9.0 - 31.9 cm with an average length of fish caught of 20.11 cm.
2. Growth rate coefficient (K) = 0.560 per year with a longer asymptote length (L∞) of 33.35 cm, the theoretical age of fish when the length is zero (to) = -0.2799, and Response Surface Rn (Goodness of fit

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index) = 0.227 thus obtained a growth curve with an equation of Lt = 33.35 [1-exp0.560 (t + 0.2799].

3. Gonad maturity levels consist of the young phase (TKG I) of 8.13-10.16%, the initial maturity phase (TKG II) of 46.49-49.11%, the mature phase (TKG III) of 16.54 -18.93%, the spawning phase (TKG IV) of 24.34-26.02%, and the saline phase (TKG V) of 0.07-0.21%
4. Banda Sea obtained an F value of 1.36/year with an exploitation rate (E) of 0.53/year, total mortality rate (Z) = 2.58/year and natural mortality rate (M) = 1.23/year.

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Comparative Study between Three Sudanese Wheat Varieties Grown in Wad Madani, Sudan

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***Abstract*— *The objective of this study is to assess and compare the chemical composition of grain and flour of three Sudanese heat tolerant wheat varieties grown in Wad Madani, Sudan, namely; Imam, Gumria and Zkia. Heat stress in sub-Saharan Africa is a major constraint on wheat production. Heat-tolerant wheat varieties, developed by scientists at the International Center for Agricultural Research in the Dry Areas (ICARDA) and Sudan's Agricultural Research Corporation (ARC), are helping farmers to adapt this situation, bringing higher and more stable yields. Farmers across the wheat-producing regions of Sudan are now achieving up to sixty\ha over successive growing seasons. Proximate analysis was performed by determining of the moisture content, crude protein, ash content, crude fat, crude fiber and carbohydrates content. Rheological analysis was performed by determining of wet, dry and index of gluten, and alpha– amylase activity. The results showed that Wheat moisture content was highest in Zkia (7.69) followed by Gumria (7.55) and Imam (7.35). Flour moisture content was highest in Gumria (8.6) followed by Zkia (8.3) and Imam (8.1). Wheat protein content was highest in Gumria (14.098) followed by Zkia (13.699) and Imam (13.566). Flour protein content was highest in Gumria (11.92) followed by Imam (11.837) and Zkia (11.837). Wheat ash content was highest in Gumria (1.66) followed by Zkia (1.48) and Imam (1.45). Flour ash content was highest in Imam (1.1) followed by Gumria (1.01) and Zkia (0.90). Wheat oil content was highest in Gumria (2.90) followed by Zkia (2.40) and Imam (2.01). Flour oil content was highest in Gumria (2.03) followed by Zkia (1.80) and Imam (1.71). Wheat crude fiber content was highest in Imam (1.90) followed by Gumria (1.70) and Zkia (1.50). Flour crude fiber content was highest in Gumria (1.18) followed by Zkia (1.08) and Imam (0.95).Wheat carbohydrates content was highest in Imam (73.724), followed by Zkia (73.231) and Gumria (72.092). Flour Carbohydrates content was highest in Zkia (78.83) followed by Imam (76.303) and Gumria (75.26). Rheological analysis such as wet gluten of wheat was higher in Imam (38.5) followed by Gumria (34.8.) and Zakia (34.1), similar to the flour, Imam (36.2) was higher followed by Gumria (34.4) and Zakia (33.71), dry gluten of wheat was higher in Imam (15.2) followed by Gumria (11.3) and Zakia (10.3), similar to the flour, Imam (14.1) was higher followed by Gumria (10.8) and Zakia (10.4), Gluten index of wheat was higher in Imam (75.8) followed by Zakia (62.0) and Gumria (60.6), similar to the flour Imam (72.2) was higher followed by Gumria (63.0) and Zakia (60.3), Falling no. of wheat was higher in Gumria (586) followed by Zakia (578) and Imam (5378), while in flour Imam (680) was higher followed by Zakia (636), and Gumria (427). In conclusion all the three varieties are largely identical to standard of Sudanese Standard and Metrological Organization (SSMO 037/2007).*

***Keywords*— Chemical composition, Proximate analysis, Rheological analysis, Sudanese cultivars, Wheat.**

I. INTRODUCTION

Wheat is an important and most widely cultivated food crop in the world. This crop played a central role in combating hunger and improving the global food security. Wheat is ranked second in total cereal production behind corn, with rice being the third, FAO [1]. The grains of this plant provide about 20% of all calories and proteins consumed by people on the globe (Shiferaw *et al*. [2]). In

Sudan, wheat is the second most essential cereal food and the main staple food for many peoples in both rural and urban areas. This crop is traditionally cultivated in the northern region of Sudan where the winter conditions are favorable for plant growth and grain yield. However, in the last decade's wheat cultivation in Sudan expanded southward to latitudes lower than 15°N, entering a new and warmer environment and inhabiting most of the irrigated sectors in central and northern states (Elsheikh *et al* [3]). The rate of wheat grain production in the Sudan is far below the consumption needs. High temperature and drought stresses, low nitrogen content, and lack of quality seeds of improved varieties are the main constraints limiting wheat production in Sudan (Ali *et al*. [4] and El Siddig *et al*. [5]). To overcome these limitations wheat breeders have developed several varieties and inbred lines with enhanced tolerance to most of these stresses (Elahmadi [6] and Ali *et al* [4]), and with better grain yield and quality. Although the grain yield of these advanced wheat lines have been extensively studied by many researchers, reports on the end-use quality of these lines are rare (Ali *et al*. [4]). In recent years, demand for wheat has significantly increased as a result of the global population growth, and thus wheat production has a strategic role in food security and the world economy. As a result, horizontal expansion of wheat production has arisen in recent years by moving wheat into nontraditional areas formerly considered unacceptable for production. However, the global warming introduced various abiotic stresses such as drought, temperature extremes, and salinity that adversely affect the yield and grains quality of wheat (Huseynova and Rustamova [7]). To meet the demands of future population's explosions and ensure grain production in these environments, cultivars must be developed and evaluated for their high yield and high quality. Thus, the objective of wheat breeders is to produce well-adapted and high-yielding varieties with finest end use quality (Lopes *et al* [8] and Li *et al* [9]).
Therefore, the primary objective of this study was to assess and compare the chemical composition of wheat grain and flour of three Sudanese heat tolerant varieties grown in Wad Madani, Sudan, namely; Imam, Gumria and Zkia.

II. MATERIALS AND METHODS

2.1. SOURCE OF PLANT MATERIALS:

Three local wheat varieties namely; Imam, Gumria and Zkia were obtained from Wad Madani Agricultural Research Station, Agricultural Research Corporation, Sudan.

2.2. METHODS

2.2.1. SAMPLE PREPARATION

22.1.1. CLEANING:

Wheat samples were cleaned by aspiration sieving, manual separation of impurities by hand. The seeds were sieved by 2.8 mm to have uniform seeds and removing small grains.

2.2.1.2. MILLING:

Whole meal wheat flour was obtained by milling 500 g of wheat in tecator-mill through 0.4 mm sieve. Wheat grains (1 kg sample) were conditioned to 13% moisture for 24 hours, water to be added was calculated according to the general equation below: Water to be added (ml) to raise moisture to 13% =

$$\left[\frac{100-grain\ moisture}{100-moisture\ required\ (13\%)}\right]-1 \times 1000$$

The conditioned and tempered grains were milled in qyadramat junior mill using nylon sieve 160 mesh.

2.2.2. PROXIMATE ANALYSIS:

The proximate analysis Moisture content, crude protein Ash content, crude fat, crude fiber, and carbohydrate content) were determined using the procedure described by Association of Official Analytical Chemists (AOAC, [10]).

2.2.3. RHEOLOGICAL ANALYSIS

2.2.3.1. DETERMINATION OF GLUTEN

Gluten was determined according to International Association for Cereal Chemistry ICC Standard method, 1986. Ten grams of flour were mixed with 5.2 ml distilled water for 20 seconds in a test chamber with bottom sieve. The dough was first washed with 2% Na Cl for 15 minutes and then with distilled water in a test chamber which is automatically controlled. The gluten ball obtained was centrifuged for a minute and then weighed to give the wet gluten. It was then dried in a glutrok heater to give the dry gluten (the weight of gluten obtained was multiplied by 10 to give the percentage of gluten).

2.2.3.2. WET GLUTEN

Gluten quantity and quality were carried on wheat flour according to standard ICC method (1986), ICC [11] by using Glutomatic instrument (Type 2000),

2.2.3.3. DRY GLUTEN

Gluten quantity and quality were carried on wheat flour according to standard ICC method (1986) ICC [11] by using Glutomatic instrument (Type 2000).

2.2.3.4. GLUTEN INDEX

Gluten quantity and quality were carried on wheat flour according to standard ICC method (1986) ICC [11] by using Glutomatic instrument (Type 2000).

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2.2.4. FALLING NO.

Alpha – amylase activity was carried according to International Association for Cereal Chemistry ICC Standard method, 1986 ICC [10].

2.2.5 STATISTICAL ANALYSIS

Triplicates of each sample were analyzed using statistical analysis system. The analysis of variance was performed to examine the significant effect in all parameters measured least significant difference (LSD) test was used to separate the means, all statistical tests were carried out using the SPSS Statistical program.

III. RESULTS AND DISCUSSIONS

3.1. **PROXIMATE ANALYSIS:**

3.1.1. **MOISTURE CONTENT:**

The proximate composition of wheat grain and floor is shown in Fig (1). In comparison between grain and flour for the three studied varieties, we note that the highest moisture content recorded by the accurate category Gumria flour (8.6) followed by Imam (8.1), while the lowest moisture content recorded obtained Zekia flour (6.3). On the other hand moisture content obtained in wheat grain was ranged from (7.69) in Zkia followed by Gumria (7.55) and Imam (7.35) with significant difference. These results are lower than those reported by Mutwali [12], who reported a range of moisture were ranged from (10.21 to 13.13) for several Sudanese wheat cultivars grown in three different locations. These above results agree with Sudanese Standard and Metrological Organization (SSMO 037/2007) that recommended moisture content does not exceed 13.5%.

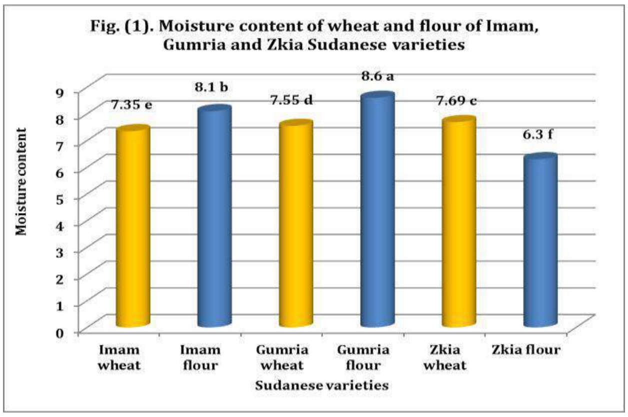

Fig 1: Moisture content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.1.2. **PROTEIN CONTENT:**

Fig (2) Shown the Protein content, grain protein is of primary importance in determining the bread making quality of wheat. Wheat grain protein content was highest in Gumria (14.098), followed by Zkia (13.699) and then Imam (13.566). Flour protein content were (11.92, 11.837and 11.837) for Gumria, Imam and Zkia respectively, with a significant difference. The results of Imam protein content of wheat flours was near to what was found by Ali [13], as (13.70%, 13.81%) respectively. These results are higher than that reported by Ahmed [14] and Mohammed [15] who found that the fiber contents for whole wheat were in the range of 1.75 to 2.34 and 1.85 and 2.25% respectively. These above results agree with Sudanese Standard and Metrological Organization (SSMO 037/2007) that recommended lowest recommended protein content 11%.

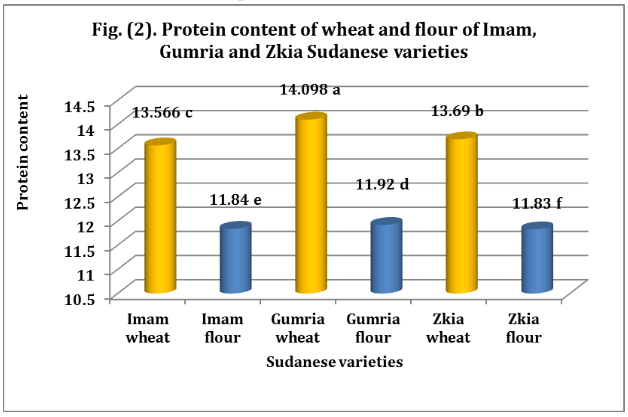

Fig 2: Protein content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.1.3. ASH CONTENT:

Fig (3) showed Ash content: Ash content has been considered an important indicator of flour quality. It gives some indication of the miller's skill and the degree of refinement in processing and it is directly related to the amount of bran in the wheat, and hence has a rough inverse relationship to flour yield (Zeleny [16]). Wheat ash content was highest in Gumria (1.66) , followed by Zkia (1.48) and then Imam (1.45) , on the other hand Ash content of wheat four was low (1.1.1.01 and 0.9) for Imam, Gumria and Zkia respectively.

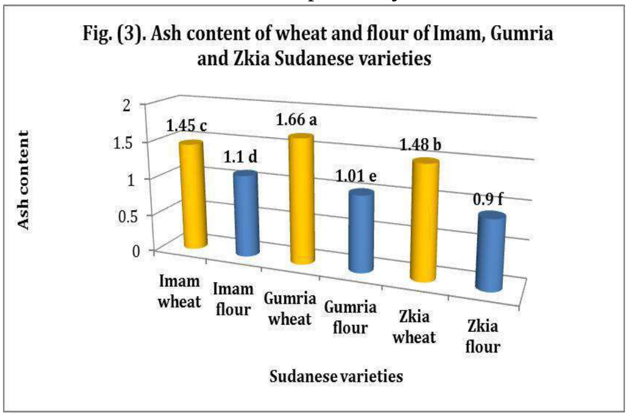

Fig 3: Ash content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

These results were higher than those reported by Mutwali [12] who found that the ash content of 20 Sudanese wheat cultivars was ranged between 0.47 to 0.85%. However, Sudanese Standard and Metrological Organization (SSMO 037/2007) recommended that ash content of whole flour does not exceed 1.7%.

3.1.4. OIL CONTENT:

The findings of the current study as shown in Fig (4) indicated that the oil content of wheat grain and flour are ranged from 2.9-2.01 and 2.03- 1.71, respectively. Wheat oil content was highest in wheat grain of Gumria (2.90) followed by Zkia (2.40) and Imam (2.01) (fig.4). Flour oil content was high in Gumria (2.03) followed by Zkia (1.80) and Imam (1.71) with a significant difference.

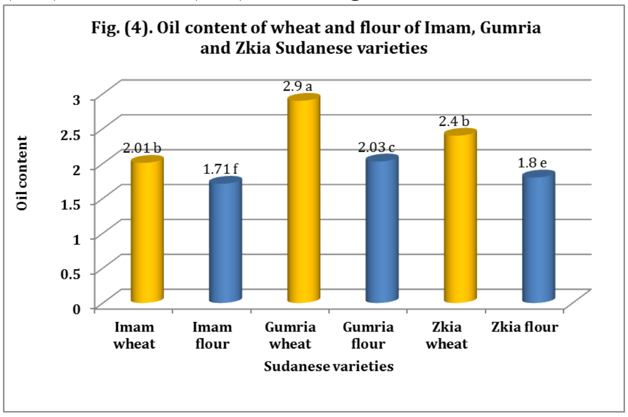

Fig 4: Oil content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.1.5. CRUDE FIBER CONTENT:

Wheat crude fiber content as shown in Fig (5) was highest in Imam (1.90) followed by Gumria (1.70) and Zkia (1.50). Flour crude fiber content was highest in Gumria (1.18) followed by Zkia (1.08) and Imam (0.95) with a significant difference. These results were near to that reported by Ahmed [14] and Mohammed [15] who found that the fiber contents for whole wheat were in the range of 1.75% to 2.34%.

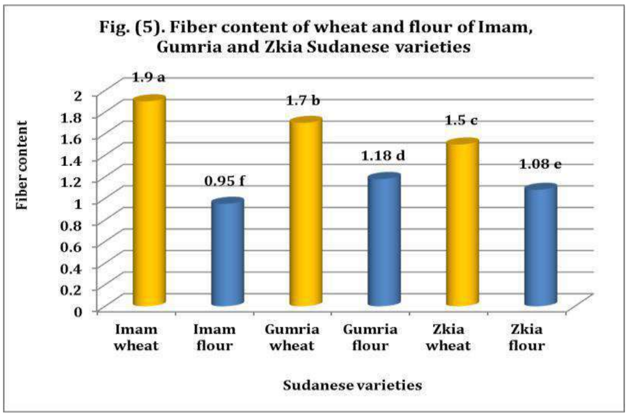

Fig 5: Fiber content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.1.6. CARBOHYDRATES CONTENT

As general floor carbohydrate content is higher than wheat grain carbohydrate content. Flour Carbohydrates content was highest in Zkia (78.83) followed by Imam (76.303) and Gumria (75.26). Wheat grain Carbohydrates content was high in Imam (73.724), followed by Zkia (73.231) and Gumria (72.092) as shown in Fig (6) with a significant difference.

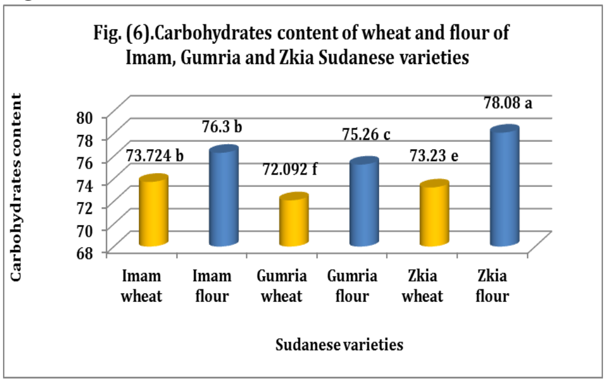

Fig 6: Carbohydrates content of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.2. RHEOLOGICAL ACTIVITIES

3.2.1. WET GLUTEN

Rheological analysis such as wet gluten of wheat grain and flour was studied, wet gluten of wheat grain was highest in Imam (38.5) followed by Gumria (34.8.) and Zakia (34.1), while in flour Imam wet gluten is (36.2) followed by Gumria (34.4) and Zakia (33.71) with a significant difference as shown in Fig (7). The wet gluten content agreed with Pakistan spring cultivars which ranged between 28.47% and 38.83% (Khan *et al* [17]). Moreover, Mutwali [12] reported that the wet gluten value of 20 Sudanese cultivars is ranged between 28.63% and 46.94%. However, Sudanese Standard Specifications (SDS) (SDS 036/2007) (SSMO 037/2007) that recommended the lowest Gluten content 27% for bread making.

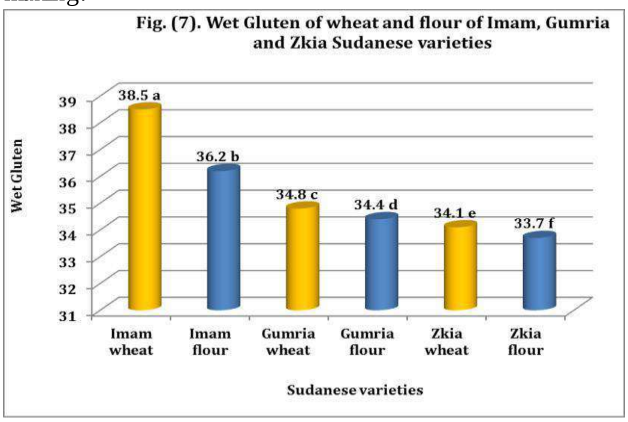

Fig 7: Wet Gluten of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.2.2. DRY GLUTEN

Dry gluten of wheat grain was highest in Imam (15.2) while in Gumria was (11.3) and Zakia (10.3), while in flour Imam dry gluten was (14.1) followed by Gumria (10.8) and Zakia (10.4) with a significant difference as shown in Fig (8). These result is disagree with, Mutwali [12] reported that the wet gluten value of 20 Sudanese cultivars is ranged between 28.63% and 46.94%, this may due to varied in cultivars.

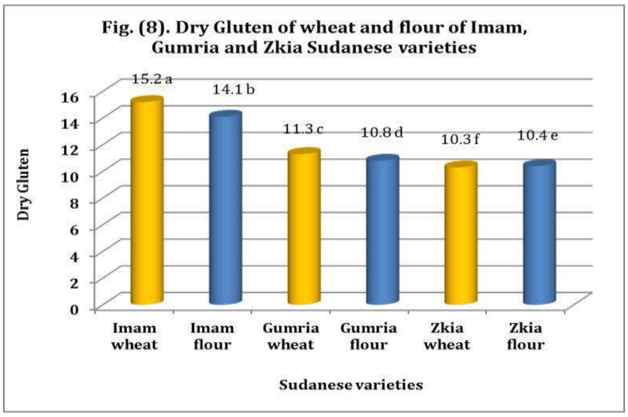

Fig 8: Dry Gluten of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.2.3. GLUTEN INDEX

Gluten index of wheat grain was higher in Imam (75.8) followed by Zakia (62.0) and Gumria (60.6), while in flour Imam gluten index was (72.2) followed by Gumria (63.0) and Zakia (60.3) as shown in Fig (9), with a significant difference. These results of Imam gluten index in agreed with (Ali, [13]) who postulated that Imam Wheat flour gluten index (75.87%).

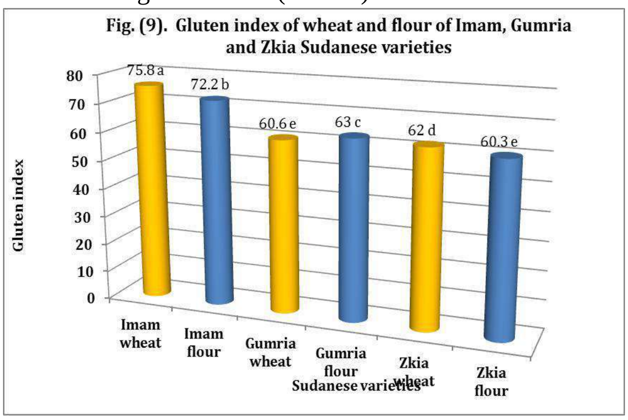

Fig 9: Gluten index of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

3.3. FALLING NUMBER

Falling No. of wheat grain was higher in Gumria (586) followed by Zakia (578) and Imam (537), while in flour falling number of Imam was (680) followed by Zakia (636), followed by Gumria (427) as shown in Fig (10) with a significant difference. The falling numbers to great extend agreed with the range of 508 to 974 sec that reported by Mutwali [12] for 20 Sudanese wheat cultivars. And agree with Mohammed [15] found that the falling number of four Sudanese wheat cultivars (Debaira, Alneelain, Condor and Sasaraib) ranged between 425 and 675sec. The falling number above 400 sec indicated that there is deficient alpha amylase and that the flour should be supplemented with alpha amylase to the desirable level of enzyme activity (Cauvain and Young [18]). These results agree with Sudanese Standard and Metrological Organization (SSMO 037/2007) that recommended falling number must be not less than 250sec.

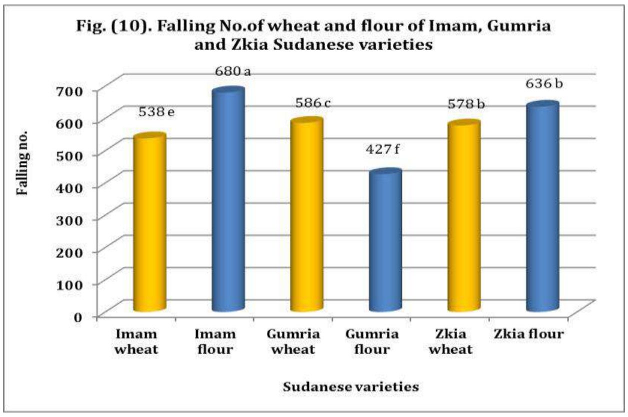

Fig 10: Falling number of wheat and flour of Imam, Gumria and Zkia Sudanese varieties.

IV. CONCLUSION

In conclusion all the three varieties are largely identical to standard of Sudanese Standard and Metrological Organization (SSMO 037/2007).

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Effect of Zinc Heavy Metal on Stress-Related Genes in Tomato (*Solanum lycopericum* L.) Plants

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***Abstract*— Heavy metal pollution is a major environmental problem all over the world. It is known that high concentration of heavy metals in soils and waters cause genotoxicity and damage to most of the functional biomolecules. The aim of this study was to determine the molecular changes in tomato (Solanum lycopericum L.) genome under heavy metal of zinc stress. Zinc is a microelement which should be taken in very less amounts by plants, animals and humans. In plants, zinc in low concentration is essential for root and stem elongation, RNA levels, the cell's ribosome content and protein formation mechanism. But at high concentrations, it is toxic for plants like cadmium, lead and copper.In this current study, the molecular response of tomato (Solanum lycopericum L.) plants to zinc stress was examined by transcript accumulation analysis of two stress-related genes: (i) MT2 (metallothionein) gene, coding for a metal-binding protein and (ii) GR1 (glutathionreductase) gene, a marker of enzymatic ROS scavenging mechanism. A quantitative Real-Time PCR experiment was performed with MT2 and GR1 genes using RNA isolated from tomato roots or shoots treated for 24h with zinc at concentrations ranging from 20 to 1280ppm. Results showed that the genes were over-expressed in zinc-stressed tomato. The highest relative fold change value was measured on GR1 for both root and shoot indicating the activation of the oxidative stress enzyme to tolerate zinc stress.*
***Keywords*— Zinc Heavy Metal, Tomato Plants, MT2, GR1.**

I. INTRODUCTION

Crop plants such as tomato are frequently exposed to avariety of abiotic stresses including drought, salinity and heavy metal pollutions. Several industrial activities, urban waste, spraying and fertilization held in agriculture and uses of heavy metal-containing pesticides are some of the sources of heavy metal pollution. These pollutants causes decrease in the quality of agricultural products [1-3]. Heavy metal toxicity effects biological molecules, for example, when metals binds to S group, blocks the active site of enzyme, and may cause conformational changes in enzymes, disrupts the cellular homeostasis and cause oxidative damage by generating reactive oxygen species (ROS) such as singlet oxygen, hydrogen peroxide, hydroxyl radical which cause lipid peroxidation, membrane defects and unstability of enzymes in higher plants [4-7]. Zinc (Zn) is indispensable metal for normal growth. Zinc is a microelement which should be taken in very less amounts by plants, animals and humans. In plants, zinc in low concentration is essential for root and stem elongation, RNA levels, the cell's ribosome content and protein formation mechanism. But at high concentrations, it is toxic for plants like cadmium, lead and copper [8, 9]. The toxic effect of zinc cause damages to the cell division and it especially gives damages to the cell nucleus of meristematic stem cellas cell division. Also genetic variations in sensitivity to Zn toxicity has been mapped in plants [10, 12]. Zinc (Zn) is a potential environmental toxicant for plants under excessive conditions. In this study, to understand the molecular response of tomato (*Solanum lycopericum* L.) plants to high zinc stress was examined by transcript accumulation analysis of two stress-related genes: (i) *MT2* (metallothionein) gene, coding for a metal-binding protein and (ii) *GR1* (glutathionreductase) gene, a marker of enzymatic ROS scavenging mechanism [13, 14].

So, in our study we demonstrated the activation of these genes under Zn treatment in nutrient solution. In addition this study reports that the activation of these genes could serve as a possible additional Zn-tolerance mechanism to cope with toxic level of Zn in tomatoes.

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II. MATERIAL AND METHODS

Plant growth and Zinc treatment

Tomato plants were grown in seedling trays were filled with sterilized perlite. Tomato seeds were germinated and grown hydroponically in pots containing 0.2 L of modified 1/10 Hoagland's solution. Tomato plants with three biological replicates, each consisting of one pot with ten plants were grown in a controlled environmental growth chamber with light of 250 mmol m^{-2} s^{-1} photosynthetic photon flux at 23-26 ºC, and with 50-60% relative humidity.

After 21 days of growth with hoagland solution containing macronutriens and micronutrients, seedlings were exposed to 20, 40, 80, 160, 320, 640, 1280ppm zinc solution ($ZnSO_4 \cdot 6H_2O$) for 24h. Roots and shoots were harvested and stored at -80ºC until RNA isolation.

RNA isolation and first strand cDNA synthesis

Total RNA of all root and shoot samples were extracted by using Trizol RNA extraction protocol followed by RNeasy mini kit (Qiagen, Cat no: 74104) to cleanup [15]. The quantity and quality of RNA was determined by NanoDrop Lite Spectrophotometer and also confirmed by gel electrophoresis which contains 1.5% agarose gel and formaldehyde. Extracted RNAs were stored at -80 °C.

First strand cDNA synthesis

A two-step procedure was used for real-time reverse transcriptase-polymerase chain reaction (RT-PCR). Reverse transcription reactions were performed with 2 µg of RNA, 2.5 µM Anchoredoligo(dT)18, 1X Transcriptor High Fidelity Reverse Transcriptase Reaction Buffer, 20 U Protector Rnase Inhibitor, 1 mM deoxynucleotide mix and 10 U Transcriptor highfidelity reverse transcriptase using the high fidelity cDNA synthesis kit (Roche). The quantity and quality of cDNA was determined by NanoDrop Lite Spectrophotometer.

qRT-PCR analysis of *GR1* and *MT2* genes

Real-time PCRwas performed using Light Cycler ® Nano System (Roche). Gene-specific qRT-PCR primers (Table 1) for *GR1* and *MT2*genes and actin (*ACT*) were designed using Primer 3 software [16] based on the sequence information of tomato genes available in the databank (http://www.ncbi.nlm.nih.gov/). Amplifications of the PCR product were monitored via SYBR Green I dye.

PCR conditions consisted of a 95 °C for 10 min, 40 cycles of 95 °C for 7s, 58-62 °C for 15s, 72 °C for 10s and a melting analysis of 52 to 95 °C with an increasing temperature 0.5 °C min^{-1}. The qRT-PCR analysis contained three biological replicates, consisting of three technical replicates.

Table 1. Sequences, melting temperatures of primers and accession numbers of genes used in qRT-PCR

Gene		Sequence (5'-3')	Tm (°C)	Accession no.
MT-2	Forward Reverse	GCTGTGGATCTAGCTGCAAGTGCG AAGGGTTGCACTTGCAGTCAGATC	60	EU884310
GR-1	Forward Reverse	CGTGCTGTGATACTTGGTGG TCGTGCAAGGATGCATAGTG	60	FJ265823
ACT	Forward Reverse	GGGATGGAGAAGTTTGGTGGTGG CTTCGACCAAGGGATGGTGTAGC	60	EU884309

Statistical analysis

The abundance of target genetranscripts was normalized to *ACT* and set relative to the $2^{-\Delta\Delta CT}$ method [17]. Changes in relative expression levels (REL) of the gene were checked for statistical significance according to one way ANOVA. $P<0.05$ was considered to be statistically significant.

III. RESULTS AND DISCUSSION

One of the effects of toxins is to prevent the root and body growth. The accumulation of heavy metals in plant causes negative effects on roots, stems and germination of seeds; when it is exposed to the increasing concentrations of heavy metals [18]. Similarly, as expected in tomato plants, the findings of this study on the length of tomato seedlings' roots and stems are similar with the related literature.

MTs protect plants from metal stresses. High transcription rate of MTs was particularly shown in metallophyte tolerant plant varieties [7, 14]. They have the ability to bind both physiological (such as zinc, copper, and selenium) and xenobiotic (such as cadmium, mercury, silver, and arsenic) heavy metals through their cysteine residue thiol groups. Also, MTs were proposed to function in both metal chaperoning and scavenging of ROS [19]. Studies showed that Arsenic and cadmium stress induces metalloprotein expression and accumulation [20].

GR is a potential enzyme of the ASH-GSH cycle and plays anessential role in the defense system against ROS by sustaining the reduced status of GSH [21]. It plays a crucial role in determining the tolerance of a plant under various types of stress [22]. It has recently been observed that the GR activity increases in the presence of Cd in various plants [21].

In this study, the tomato seedlings were subjected to Zinc for 24 hour. By referring to the several studies it was decided that 24 h is enough period to trigger to the early stress response.

The expression levels of the *MT2*, *GR1* and *ACT* gene at mRNA level were analyzed in, tomato samples by Real-time PCR (Light CyclerNano, Roche) and the results were summarized in Figure-1 and Figure-2. *MT2* and *GR1* gene transcript levels were calculated in tomato samples exposed to various concentration of zinc solution. To avoid error, real-time RT-PCR is typically normalized with *ACT* as an housekeeping and internal control gene and also with the control treatment samples. To evaluate the stability of the results, *MT2*, *GR1*and *ACT* transcript levels of all samples were measured three times for each time period.

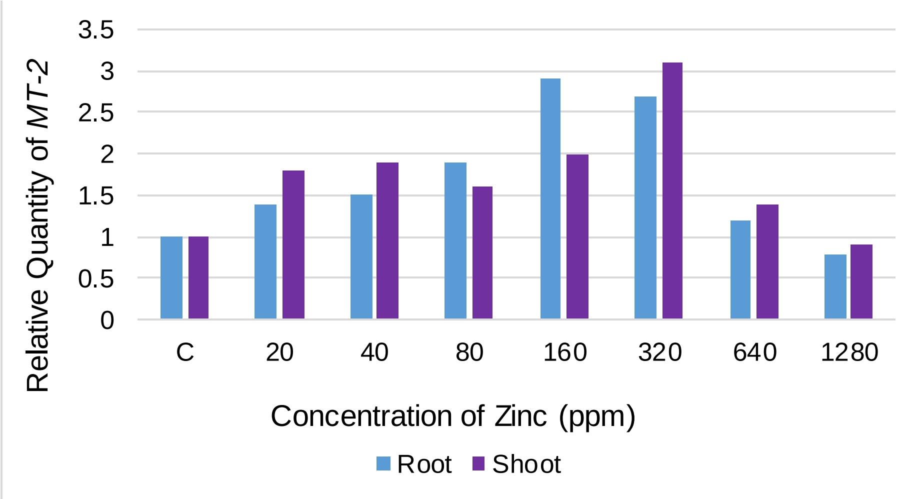

Fig.1: Metallothionein (MT) gene expression profile of root and shoot inthe tomato samples exposed to different concentration of zinc solution.

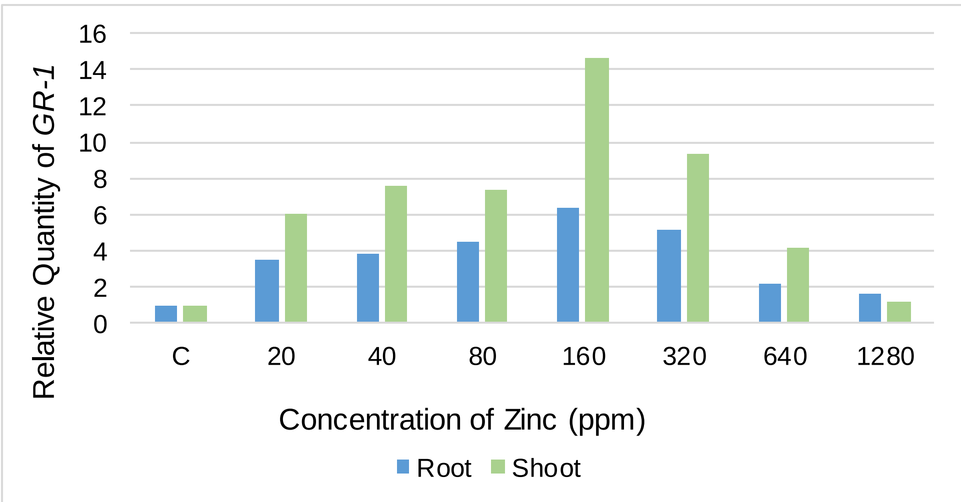

Fig.2: Glutathion reductase (GR) gene expression profile of root and shoot in the tomato samples exposed to different concentration of zinc solution.

In this study, the *GR1* accumulation was significantly observable under zinc stress for both roots and shoots ($P<0.01$). The highest relative fold change value was measured on *GR1* for both root and shoot. In roots, the abundance of transcript level reached to 6.4 and 5.2-fold increase at concentrations 160 and 320ppm, respectively [Figure-3, ($P<0.01$)].

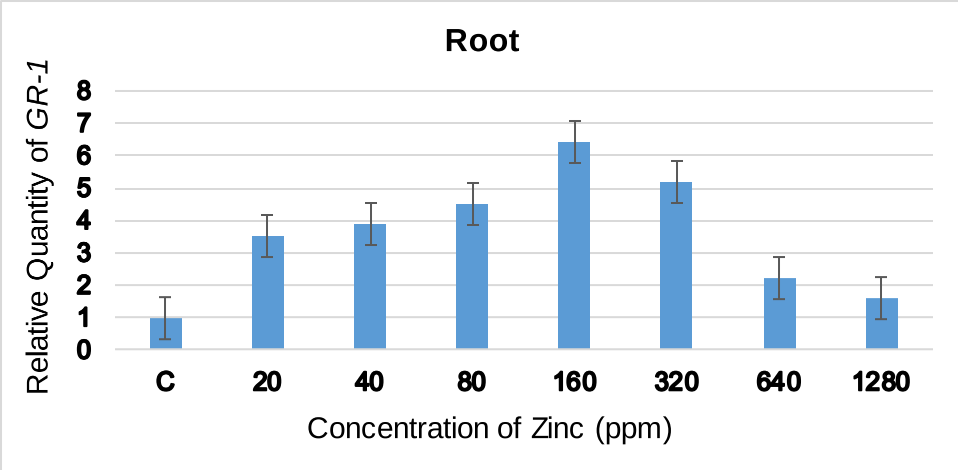

Fig.3: Glutathion reductase (GR) gene expression profile of root in the tomato samples exposed to different concentration of zinc solution.

In shoots the abundance of transcript level reached to 14.6-fold increase at 160ppm concentration and 9.4-fold increase at concentration of 320ppm [Figure-4, (P<0.01)].

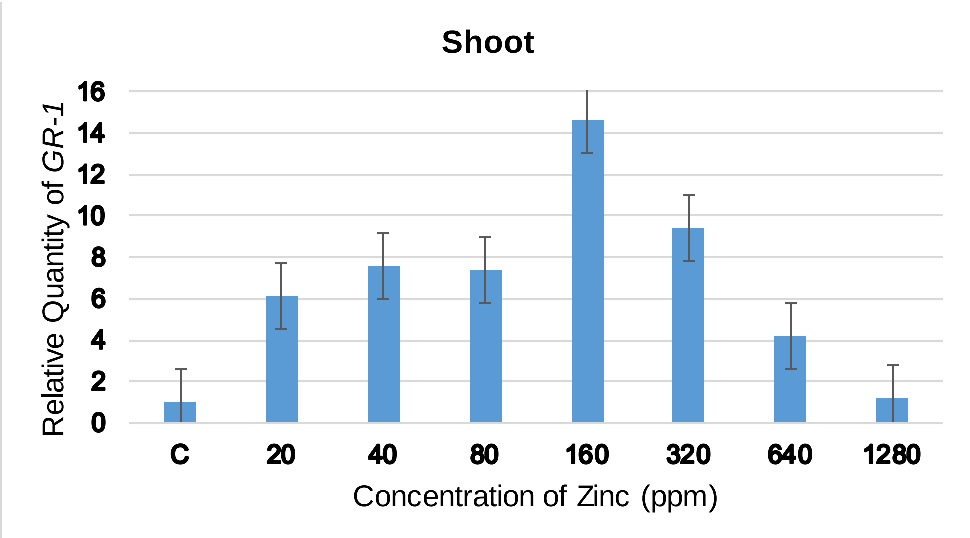

Fig.4: Glutathion reductase (GR) gene expression profile of shoot in the tomato samples exposed to different concentration of zinc solution.

After the concentration of 160 ppm, the abundance of *GR1* dramatically decreases nearly down to the same as in the control group for both root and shoot, indicating that the resistance mechanism does not allow any protection for the amelioration of the zinc stress by using the GR pathway, due to possible cellular damage. Similar results were observed in zinc-treated tomato root and shoots that of *MT2* accumulations was apparent. *MT2* accumulation was significantly observable under zinc stress for both roots and shoots (P<0.01).

In roots, the abundance of transcript level reached to 2,9 and 2,7-fold increase at concentrations 160 and 320 ppm, respectively [Figure-5, (P<0.05)].

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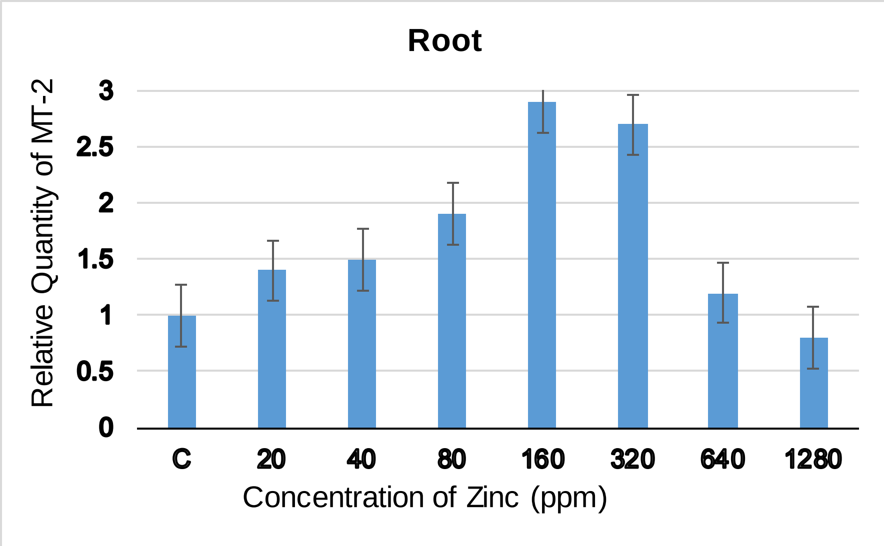

Fig.5: Metallothionein (MT) gene expression profile of root in the tomato samples exposed to different concentration of zinc solution.

In shoots the abundance of transcript level reached to 2 and 3.1-fold increase at concentrations 160 and 320 ppm, respectively. These results indicated that metallothionein binding protein-*MT2* transcript accumulation may induce the zinc-toxicity tolerance in tomato plant [Figure-6, ($P<0.05$)].

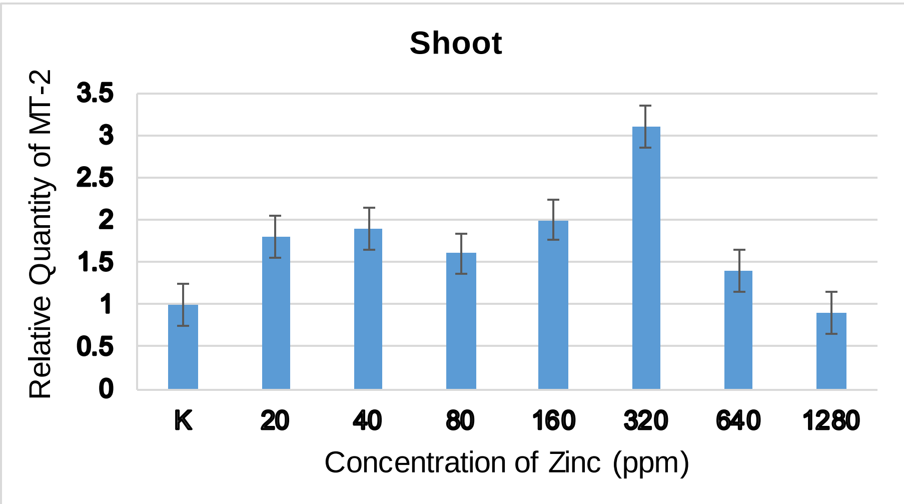

Fig.6: Metallothionein (MT) gene expression profile of shoot in the tomato samples exposed to different concentration of zinc solution.

In conclusion, it was shown here that the activation of *MT2* and *GR1*like protein transcripts under zinc stress. The accumulation of these genes increases at first and then, the curve reflects a descending profile, revealing the disruption of mechanisms which regulates the cellular homeostasis under high zinc levels. The activation of these genes could be a protection mechanism to zinc stress and play important role in the detoxification or tolerance mechanism.

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Study Food Habits of Fishes in Tempe Lake

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Abstract**—** *This study aims to analyze and classify the food habits of fish with economic value in the waters of Lake Tempe in several different types of fish.*
The research was conducted in February, March, April, and June 2017 at Tempe lake in South Sulawesi. The research method used is the method of field observation and observation in laboratory. Several samples of fish species observed were 25 Snakeheadfish (Channa striatus), 30 Goldfish (Cyprinus carprio), 40 Snakeskin fish (Trichogaster pectoralis), 40 Javabarb fish (Barbonymus gonionotus), 40 As many as 40 Tilapia (Oreochromis niloticus), and 40 Damselfish (Anabas testudineus). The types of organisms found in the fish's gastric are then identified by using the 1979 Yamaji plankton identification book, and then calculating the frequency of occurrence to classify the food habits of fish.

The results showed that Snakeskin fish and tilapia fish were classified as herbivore fish based on gastric contents analysis found in phytoplankton, zooplankton, detritus, aquatic plants, insects, other benthic invertebrates and worms. Goldfish and Damselfish are classified as omnivoro fish based on gastric contents analysis obtained by water plants, phytoplankton, zooplankton, zoobentos, detritus, insects, molluscs, worms, eggs or fish larvae and other invertebrate larvae. While Javabarb fish are classified as planktivor fish based on gastric contents analysis found phytoplankton, zooplankton, aquatic plants, insects, and other invertebrate larvae. Fish Snakehead fish classified as carnivore fish based on gastric contents analysis found zoobenthos, fish, shrimp, crustaceans, worms, frogs, and nekton. Based on the measurement of water quality parameters shows that the carrying capacity of the environment as a habitat is still very supportive for the growth of fish in the waters of Tempe lake.
Keyword**— *Food Habits, Snakehead fish, Goldfish, Snakeskin fish, Javabarb fish, Tilapia, Damselfish, Tempe lake.***

I. INTRODUCTION

Tempe lake is one of the largest lakes in Indonesia located between 3 districts of Wajo, Soppeng and Sidrap regencies. The area of Tempe lake between 13.000 – 15.000 hectares, has an important role in the economy People living around the lake.

Tempe lake has a wealth of abundant freshwater fish, presumably because the island of Sulawesi including the Wallacea region which is a transition between Oriental and Australian zoogeography (Whitten et al., 1987), there are many species of endemic flora and fauna, including fish. Some studies suggest that extreme geographic differences may affect the existing fish community structure in these waters (Carmona et al. 1999 and Pyron and Lauer 2004).

Indonesia is the second highest country of freshwater diversity after Brazil of 1300 species and Tempe lake is the largest supplier of freshwater fish consumption in Indonesia (Tamzil, 2000). The waters that have many sources of fish food, Tempe lake become an ideal ecosystem for breeding freshwater fish. In addition to freshwater fish for consumption, Tempe Lake is also rich in freshwater ornamental fish. From the process of forming the lake, making Tempe lake has several species of endemic freshwater fish. Several types of endemic fish is also a commodity export even to the European and American kebenua. For example Celebes Rainbow fish (*Marosatherinaladigesi*) and Binishi fish (*Oryzias celebensis*) (Effendie, 2007).

Some species of fish found around Tempe lake are snakehead fish (*Channa striata*), damselfish (*Anabas*

Testudineus), snakeskin (*Trichogaster pectoralis*), catfish (*Clarias batrachus*), goldfish (*Cyprinus carpio*), javabarb fish (*Puntius javanicus*), nilem (*Osteochilush asselti*), mujair (*Oreochromis mossambica*), tilapia (*O. niloticus*), beloso fish (*Glossogobius giuris*), Eel (*Anguilllamar morata*), Swamp eel (*Monopterus albus*) and Mullet (*Mugil cepha*), and Sapu-sapu fish (*Liposarcus pardalis*) (Samuel, et al. 2010). These fish species are fish that many consumed by society and some have been cultivated.

Based on interviews from the Fisheries and Maritime Affairs staff of Soppeng and Wajo districts as well as interviews from fishermen communities around Tempe Lake that Tempe Lake is silting due to the many weeds or water hyacinths that grow where both of these plants roots to the bottom so that this roots as a war, waste vessels, and others carried by rivers connected to the lake (Unru, 2010). Such conditions can lead to reduced fish diversity.

Therefore, our research aimed to find out the favorite natural foods of some dominant fish caught and whether the fish belong to herbivorous, omnivorous or carnivore fish species, so with this research it is easier for the fishermen community if they want to cultivate the fish on ponds or ponds. It is also hoped that with this study we can find out whether the carrying capacity of the environment as a habitat is still high enough to support the growth of the fish in Tempe lake as stated by Khoiriya (1999) in Widyorini, N. (2009) that the growth of a population or individual is closely related to the existence of food in their area of life.

II. RESEARCH METHODS

The research was conducted in Tempe lake of Soppeng Regency for 4 months (February, March, April, and June) in 2017. The method used in this research is the field observation and observation in the laboratory.

Fish sampling is done in a complete random manner called Complete randomized Sampling (Zar, 1984). It is a sampling technique by providing equal opportunity for each member of the population to be a research sample. Determination of fish species that analyzed the contents of the gastric is based on the dominance and economic value of the fish species caught during the study. There are several species of fish caught but the dominant are Snakeskin fish (*Trichogaster pectoralis*), goldfish (*Cyparinus carpio*), Javabarb fish (*Barbonymus gonionotus*), Tilapia (*Oreochromis niloticus*), Damselfish (*Anabas testudineus*) and Snakehead fish (*Channa striatus*). The number of fish samples analyzed the contents of the stomach each month are 25 fish Snakehead fish, 30 goldfish and 40 Snakeskin, Javabarb,Tilapia and Damselfish.

Sampling of the dominant fish is the first measured the length and weight of the body, then dissected and removed the intestines or intestine fish intact. The gastric weight of fish that has been dissected and then weighed and preserved with a solution of 4 - 10% formalin solution in the sample bag is further identified and analyzed in the laboratory (Hatta, 2010).

Identification of food type in fish intestines aims to know fish food habits (Effendie, 1979) by observing the contents of fish digestive organs, observations performed under a microscope. Identification of food type was done by using plankton identification book from Yamaji, (1979). The types of organisms found in fish hulls were then identified and calculated the frequency of occurrence for the classification of feeding habits (planktivore / herbivore, omnivore and carnivore) Paulyat.all (2000).

Physical and chemical parameter data of waters is measured as supporting data. Measurements were taken in conjunction with fishing. Physical and chemical parameters measured include temperature, salinity, current velocity, depth and brightness.

III. RESULT AND DISCUSTION

3.1. Food Habits

The results of observations of gastric contents of the six dominant fish species found in Tempe Lake and the classification based on the main food are presented in Table 1.

Table.1: Types of food and classification based on main food 6 dominant fish species found in Tempe Lake

Types of fish	Length and weight of fish	Types of food	Classification by main food
Snakeskin fish	P: 11,5-17,1 cm W:21,3 – 40,8 gr	phytoplankton, zooplankton, detritus, aquatic plants, insects and other benthic invertebrates	Herbivore
Goldfish	P :20 cm – 25 cm W:200 – 300 gr	water plants, zooplankton, zoobenthos, crustaceans, insecta, worms, eggs or fish larvae and detritus	Omnivore
Javabarb fish	P:16,2 – 19,2 cm W:62,0 – 97,8 gr	phytoplankton, zooplankton, aquatic plants, insects, and other invertebrate planktons	Planktivore

Tilapia fish	P:9,5 – 29 cm W:50 gr – 500 gr	Water plants, phytoplankton, zooplankton, zoobenthos, detritus, insects and worms	Herbivore
Damsel fish	P :10 cm-14,5 cm W:10 gr-70 gr	Water plants, phytoplankton, zooplankton, zoobenthos, detritus, insects, molluscs, worms, eggs or larvae of fish and other invertebrate larvae	Omnivore
Snakehead fish	P:15- 39 cm W:40 – 710 gr	zoobenthos, fish, shrimp, other crustaceans, worms, frogs and other nekton	Carnivore

The result of gastric contents analysis showed that Snakesin fish and tilapia fish is dominant to be classified as herbivore fish because in the gut obtained a high proportion of water plants with high emergence frequency. Both types of fish also consume plankton and detritus. Javabarb dominant to be planktivorous with the proportion and appearance of plankton high enough in the intestine. The same thing has been observed by Samuel et al (2010) in Tempe Lake that states that Snakeskin fish, tilapia and javabarb are plankton eater especially phytoplankton, although in the third intestine the fish are found some insecta animal organism does not mean the fish are eater of the organism but the likelihood of insecta is prevalent in these waters, as Effendie (1979) says, that the spread of the most types of food will cause the uptake of the species to increase.

From the table one it is also seen that the goldfish eat in the form of plankton, aquatic plants, insects, worms and eggs or other fish larvae, so the goldfish was classified as omnivore fish. Pudjirahayu.dkk (2008) stated that goldfish usually dig the basic substrate in the turbid waters to get the food but the goldfish are also able to utilize the stems, leaves and seeds of both water and ground plants. Damselfish classified as omnivorefish that tend to be carnivore because in the gut found a type of eating that is very varied as goldfish but found also some types of molluscs and other invertebrate larvae. Snakehead fish is supposed to be carnivore fish because in the contents of its stomach many found some other fish such as snakeskin fish, damselfish, tilapia and other types of fish smaller size, besides snakehead fish also preyed some other animal like frog and very often got intestine full with one or more fish.

Based on the observation time it is seen that herbivore fish such as snakeskin fish and tilapia have the composition of the fraction per item of gastric contents related to rainfall. In the rainy season where the volume of Tempe water increases so that the water boundary extends towards the land hence the contents of the hull of both types of fish this has a percentage of aquatic plants such as parts of grass and leaves are quite high. This is because in such conditions the fish tend to migrate to the boundary of water that contains many foods in the form of water plants that border on land, as stated by Binder T.R. at.all, (2011), that one of the causes of migration from fish is due to food. This is evident from the increased catch of fishermen who install nets or trawlers in shallow waters on the coast when the water rises. Usually fishermen install fishing gear in areas that have vegetation such as rice fields and vegetated coastal areas.

Unlike snakeskin fish and tilapia fish, javabarbfish that prey on plankton dominant to inhabit clearer waters and prefer to be on the surface so that despite migration when the water rises but not too to the edge like fish snakeskin fish and tilapia. This causes the variation of intestinal contents of tawes fish more influenced by the abundance of plankton in water. Goldfish that are close relatives to javabarb have a larger food spectrum compared to javabarb fish. Goldfish have the ability to consume water plants are relatively larger and other food items in the form of worms and insects show that goldfish has a relatively larger choice of food when compared with javabarb fish. However, goldfish does not show significant differences between observations that indicate that although the availability of one type of food overflows in a certain time but the goldfish still consume other types of food items so that the variation of the content of the gastric is not too different from time to time.

Damselfish is a fish that categorized all the food with the most diverse food items when compared with other types of fish. They are able to consume almost all types of food ranging from plankton, aquatic plants, detritus, insects, molluscs, eggs / larvae of fish and various other types of invertebrate larvae. Its ability to adapt to a variety of habitats and utilize various types of food causes this type of fish is almost obtained in all water conditions. The fish is able to adapt to extreme environments such as in mud and water shortages. The tendency to prey on different types of fish and other invertebrate larvae appears to be consistent with the increasing size of fish. Worms as fish food damselfish utilized by the fisherman anglers as bait, especially earthworms the size is rather smooth

Snakehead fishis a predatory fish that preys on various types of fish, shrimp and various other nekton species including amphibious animals such as frogs and other reptiles. Observation of the contents of the stomach shows that very often found snakehead fish hull filled with one or several species of fish such as snakeskin fish, tilapia, damselfish and frog are still intact and very easy to identify. In other conditions found the contents of snakehead fishgastric consists of fish or shrimp that is not clear the type but still can be distinguished of parts such as head and tail but has crushed the scales and fins. In empty intestine conditions the snakehead fish usually only consists of a rather coarse material such as sand mixed with other parts of the fish but has been destroyed.

As a carnivore, snakehead fish adjusts the size of its food by exchange opening its mouth. Smaller snakeheadfish usually found in the gastric fish or shrimp are smaller, the size of the food also increases with the increase in the size of fish. As a carnivor fish use oral organs that have a wide enough openings and equipped with strong enough teeth (War at.all, 2011). Intestine orgastric is very thick though short so as to enlarge and shrink according to the size of the food. When viewed from the frequency of presence of fish species that are often found in snakehead fishhulls it appears that fish javabarb fish and goldfish relatively more rarely found when compared with snakeskin fish, tilapia and damselfish. This is caused by the habit of snakehead fish that inhabit the bottom of the waters with a little vegetation has the likeness of the favorite habitat of snakeskin fish, tilapia and damselfish. Thus the intersection between snakehead fish with these three types of fish is relatively larger and facilitate the occurrence of predation.

Changes in the type of fish food damselfish as omnivor fish that tend to carnivore and snakehead fish as carnivore fish showed the variation between time observations. This change is related to changes in the type of food that is influenced by environmental factors. This is particularly evident when the lake's surface water conditions rise (rainy season) occurring in June where the food items of the fish species declined somewhat compared to the previous month where the volume of Lake Tempe water was smaller. These food item changes are related to the behavior of prey fish who migrate and tend to the edge to look for food such as snakeskin fish and tilapia. This reduces the chances of predation because corks that tend to survive in a particular territory do not follow the movement of their prey so quickly that their food items from other groups such as worms, insects and other vertebrates increase. The damselfish of the moon also migrate to the waterfront to feed on water plants and larger ones and have mature gonads utilize these conditions for spawning. This migration also affects the fish food item of the fish in the month.

Referring to the results of the gastric contents analysis when it is associated with habitat and response to environmental changes, there is a link between habitat preference and the eating habits of the six fish species studied. Further linkage is related to the existence and survival of each species in the ecosystem in Tempe lake. The snakeskin fish as herbivore with main food of natural aquatic plants usually spawn early in the rainy season so that juvenile fish have adequate availability of food at the height of rising water and the opportunity to the edge of the lake to eat various types of vegetation is quite abundant. This leads to the peak of the rainy season where the maximum water content of the snakeskin fish species is found to be abundant otherwise in the summer season the population declines as a result of declining food availability.

Tilapia food habits are similar to snakeskin fish and the frequency of spawning that is more frequent with the guarding of the tillers causes the tilapia to have greater survival rate and competition ability. As a herbivore fish with slightly more diverse food items compared to snakeskin fish, it is possible for tilapia to compete more with other types of fish in terms of space, food and recruitment so that this type of fish is almost abundant throughout the year.

Javabarb fish classified as planktivore fish who prefer to live on the surface with clear water conditions cause limitations in obtaining food in the form of plankton. Plankton abundance (fitolankton and zooplankton) is strongly influenced by water quality especially nutrients and sunlight (Parson at all.1998) During the rainy season the nutrient runoff of nitrate and phosphorus is much inland but low light intensity decreases with low plankton abundance. Therefore the abundance ofjavabarb fish food mainly occurs a few weeks after the peak of the rainy season where besides high nutrient sunlight is also available. The result is that the javabarb fish are not found abundantly in any time for a year as is the case with tilapia and it has something to do with the javabarb food habits.

As an omnivore fish that tends to be carnivore and tolerant to extreme environmental conditions causes fish to be obtained almost in all habitats and available throughout the year. However, the fecundity of this relatively small fish is only found during the rainy season unlike snakeskin fish and tilapia fish, it is said by Prianto, et al. (2014). The maturity level of fish gonad is affected by changes in water level. Based on eating habits and its tolerance to extreme habitats causes the fish to have a high competitive ability to survive in the lake ecosystem.

Snakehead fish as carnivore fish and predators of various types of fish and other nekton animals have a high dependence on the prey population in the availability of food. As a top predator in the lake ecosystem of the species of biomass fish is largely determined by the biomass of the fish that is prey. Conceptually predator fish population such as snakehead fish has smaller amount and biomass than their prey population. Another thing that causes the population of snakehead fish is not as much as herbivore fish and omnivore is a high economic value because it tastes good to be the target of fishing and must be one of the causes of low natural manipulation.

3.2. ENVIRONMENTAL PARAMETERS

The result of the measurement of several environmental parameters of Tempe lake at the time of the study were temperatures ranging from 30.7 - 31.4, pH: 7.76 - 7.90, DO: 4.7 - 5.90, nutrient phosphate : 0.0359 - 0.0687, Nitrate: 0.0015 - 0.0154 and chlorophyl: 0.059 - 3.212. the measured environmental parameters data are all still within the limits that still strongly support the growth of existing organisms in the waters of Tempe lake.

IV. CONCLUTION AND SUGGESTION

4.1. Conclution

4.1.1.Snakeskin fish and tilapia are classified as herbivore because from the analysis of the gastric are obtained phytoplankton, zooplankton, detritus, aquatic plants, insects and other benthic invertebrates and worms.

4.1.2.Goldfish and damselfish are classified as omnivore because based on gastric analysis are obtained water plants, phytoplankton, zooplankton, zoobenthos, detritus, insects, molluscs, worms, eggs or fish larvae and other invertebrate larvae.

4.1.3.Javabarb fish are classified as planktivorous fish because of the analysis of the gastric are obtained phytoplankton, zooplankton, aquatic plants, insects, and other invertebrate.

4.1.4.Snakehead fish is classified as carnivore because of the analysis of the gastric are obtained zoobenthos, fish, shrimp, other crustaceans, worms, frogs and other nekton

4.1.5.Based on the results of measurements of environmental parameters it was concluded that the carrying capacity of the environment as a habitat is still very supportive for the growth of fish in Tempe lake.

4.2. SUGGESTION

Need to research about trofik level and trofic level structure so that the waters condition ofTempe lake can be known how to transfer energy from one tropic to the next tropic.

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Impact of Fiscal Policy Instruments' Dynamics on Resource Sustainability in Nigeria

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Abstract**—***This research examined the impact of fiscal policy instruments on agricultural resources sustainability in Nigeria for the period 1980-2018. Specifically the study examined the causal relationship between fiscal policy instruments and resource sustainability; analyzed the instantaneous and compound growth rate of government expenditure, debt policy instruments and agricultural resources sustainability and; examined the impact of government expenditure and debt policy instrument on resource sustainability. Data were obtained from Central Bank of Nigeria (CBN) Statistics Data Base: and Food and Agriculture Organization Statistical data (FAOSTATS). From the findings, there exist a unidirectional relationship (P<0.05) from government expenditure and debt to resource sustainability index. Government expenditure and debt instruments had instantaneous and compound growth rate (P<0.05) of 7.62%, 7.92% and 1.23% and 1.24% respectively. The instantaneous growth rate for forest resources (P<0.05), arable land (P<0.05) and human capital (P<0.05) were -1.57%, 0.33% and -1.93% with a compound rate of growth of -1.58%, 0.34% and -1.93%, -1.95% respectively. Government expenditure policy instruments yielded significantly (P<0.05) positive impacts of 0.37% while increased debt profile significantly (P<0.05) decreases sustainability index by -0.27%. Thus, fiscal policy instruments dynamics is essential for the attainment of inter-temporal efficiency of resources, hence sustainability. It was recommended that non- sustainable activities such as land degradation, deforestation and human capital depletion driven by unfavorable policies needs to be reappraised.*

Keywords— **Expenditure, debt, fiscal policy, resources and sustainability.**

I. INTRODUCTION

Government activities are usually organized, directed and executed within the framework of policies. General policy instruments are classified into monetary and fiscal policies. Public expenditure is a good example of fiscal policy instrument that has variously been used in Nigeria government to sustain the economy. General policy instruments are tools that policy makers utilize to achieve their goal similar to pliers, spanners, and screw drivers in the hands of the mechanic. According to Blejer and Khan (1984) aggregate macroeconomic policy instruments covers government expenditure, debt and wage rate among others. Hussein (2005) described sustainability as non-declining natural capital. Sustainability of resources is necessary for the survival of humans, other organisms as well as agricultural growth. This is because agricultural growth revolves around resources and humans derive benefits from the natural resources and from properly-functioning ecosystems. Living sustainably can take many forms ranging from sustainable agriculture or using science to develop new technologies to policies objectives designed in a flexible and reversible manner that conserve natural resources (Hanley, Shogren and White 2007; Norton and Toman 1997).

However, policy makers face the challenge of creating the right incentives to optimize resource use from an economic, environmental and social perspective due to lack of concepts and methods for analyzing the environmental effect of policies. The environmental and social consequences of agricultural policies are also complex hence they are less frequently included in the national agricultural policies (Arene, 2016). These may have led to acute depletion of resources. For instance empirical studies on sustainability revealed that undisturbed areas which represent 46% of the earth's land surface and forests which covered about 50% of the earth's land area 8000 years ago,

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cover just about 30% today (Mittermeier, Mittermeier, Gil, Pilgrim and Fonseca, 2003). Out of the 98.321 million hectares of land available in Nigeria, about 75.30% is considered as arable land, with 10% under forest reserves and the remaining 14.70% assumed to be made up of permanent pastures, built up areas and uncultivable waste (Olayemi, 1998). Yet, annual deforestation rate in Nigeria remained at the rate of 2.38 % per year due to higher demand for agricultural land, fuel wood and rapidly growing population with land degradation caused by soil erosion (UNEP, 2011).

Furthermore the empirical and theoretical work of Munasinghe (1997) showed that policy instruments such as wage rate, exchange rate and trade liberalization policy contributed concurrently to economic, social and environmental sustainability. Munasinghe (1997) further opined that the application of policies for macroeconomic stability may result in unforeseen adverse short and long-term impacts on sustainability issues. Studies by Atkinson and Hamilton (2002) on sustainability indicators in Chile revealed that increased expenditures on education resulted in sustainability of resource stocks. Similarly, Munasinghe (1997) revealed that $1 worth of educational expenditure yields a $1 increase in human capital. United Nation (2008) revealed that intact natural resource suitable for supporting a diversity of plants and animals among others is a good measure of sustainability. Other things being equal, as population and waste grow, resource depletion is also likely to grow at a faster rate (Sloman and Wride, 2009). Economic theory also suggests that as more and more people crowd on to the fixed supply of world land, so diminishing returns to land will occur. While not denying a role of population growth or poverty, most case studies fail to confirm this simplification (Anderson, 1996; Rudel and Roper, 1996; Fairhead and Leach, 1996; Barraclough and Ghimire, 1996). Results of careful surveys of tropical deforestation support the view that population growth is never the sole and often not even the major underlying cause of forest-cover change (Angelsen and Kaimowitz, 1999; Geist and Lambin, 2001). However, deforestation is linked to changes in policies by national governments that pull and push migrants into sparsely occupied areas (Rudel and Roper, 1996). Mather and Needle (2000) reported that high rates of deforestation within a country are most commonly linked to population growth and poverty, shifting cultivation in large tracts of forests. Interestingly, government expenditure in human resource for accessible and quality education is required for skilful labour force while lack it may warrant depletion of skills and hence unsustainable development. Reduced government expenditure may also lead to depletion of resources e.g. logging (indiscriminate cutting down forest trees) especially in rural communities with its attendant consequences on resource sustainability. The simple reality that higher expenditure and growth in agriculture may warrant cutting down of trees (deforestation) if government intends to construct roads, dams, buildings etc, however should not be ignored.

There is an ongoing debate on the appropriate policy instruments in developing countries and Nigeria in particular however, empirical research on impact of policy instruments on agricultural resource sustainability is scanty with less emphasis on indirect policy outcomes. Most studies (e.g. Maskus, 1986; Ajayi 1995; Osagie, 1985 and Calvo and Reinhart, 2002 etc) focused on the concentrated on agricultural specific instruments e.g. agricultural subsidies, taxes and tariff, quotas, irrigation policies etc without looking at the effect of general policy instrument e.g. taxation, debt, general tariff level and aggregate expenditure. While studies (e.g. Abu and Usman, 2010; Fan and Rao, 2003) that attempt to address it from this perspective rather consider it from the narrow perspective without empirically examining drivers of resource sustainability and with little or no consideration of the fact that natural resource depletion has a cost to society and the economy as a whole and can distort national economy policy objectives. A review of past studies under the macroeconomic frame-work indicated a positive link between policy instruments that enhance public spending, agricultural growth as well as resource sustainability (Hartwich et al., 2010; Fan and Saurkar, 2008; Hanley, Shogren and White, 2007; Hanley and Atkinson, 2003). Fan and Rao (2003) showed that government spending on agriculture has provided a strong contribution to economic growth in Asia. Amassoma, Nwosa, and Ajisafe (2011); Abu and Usman (2010) showed that spending on rural infrastructure and productivity enhancing investments in agricultural export crops and livestock has the most promise for growth in income and food consumption in Africa. According to Obansa and Maduekwe (2013) agriculture remains the mainstay of the economy given its share in employment. Yet, in the majority of developing countries, public expenditure in agriculture is stagnant or declining, and this is reflected in poor contribution of agricultural outputs to GDP (Hartwich et al., 2010; World Bank, 2007; Olomola, 2007; Manyong et al., 2005). Still, most agricultural based economies depend on agriculture for a large share of their foreign exchange as exemplified by tobacco exports in Malawi and labor intensive nontraditional exports in Kenya and Senegal (World Bank, 2008).

II. THEORY OF RESOURCE SUSTAINABILITY

Following Hanley, et al. 2007 we consider an economy with representative agent who derives utility from consumption of both produced goods and environmental amenities, given by a vector C_t, where t indexes time. Production is determined by the aggregate (man-made + natural + human) capital stock, a vector K, and technological progress which depends on solely the passage of time. An economy is deemed to be sustainable at time t if utility is less than or equal to maximum sustainable utility at this time. Where sustainable here means consistent with non-declining value of utility over infinite time, at a constant discount rate p:

$$\underbrace{Max}_{c.k} \int_0^\infty U[C_t]e^{-pt}\,dt \text{………………………… ……. (1)}$$

Pezzey and Toman show that for this economy to be sustainable, green net national product Y^t, defined by

$$Y^t = \text{P(t).C(t)} + \text{V(t)K(t)} \text{………………………………(2)}$$

Where K is the rate of change in K per unit of time subject to production possibilities given by K(t) and t and where P is the relative price for the consumption goods and environmental amenities and V is the price for each element of the capital stock, must be non-declining at a time t, that is

$$\text{Y(t)} \leq 0 \Longrightarrow \text{U(t)} > U_m(t) \text{………………………………..(3)}$$

That is if the green net national product is declining at a time t, then utility must exceed the maximum sustainable level.

In equation (1) both the K and C terms are augmented, which means they include a value of time: this the discounted value of future exogenous technological improvements and resource price appreciation in a resource exporting country together with the capital gains on net foreign capital. The 'value of time' is shown in equation (2) but one can think of it intuitively as the discounted value of 'time passing' to the economy, in terms of its capital gains from both held overseas and from its natural resource net exports. Since consuming or utilizing more resources now than in the near future means attaching more utility to the present which implies discounting the future. It is therefore reasonable to argue that diminishing resources- forest, land and labour among other resources, in quantity and value simply is not sustainability but unsustainable development path.

III. METHODOLOGY

The study utilized secondary source of data. The study adopts a survey design. Information on arable land, forest area and agricultural land area were obtained from Food and Agriculture Organization Statistical data (FAOSTATS). Data on Government expenditures, and debt policy instrument were obtained from Central Bank of Nigeria (CBN) Statistical Data Base. Following the Joint UNECE/Eurostat/OECD Working Group of the UN on Statistics for Sustainable Development which was established in 2005 to identify good concepts and practices to assist national governments and international organizations in the design of sustainability indicator sets, three (3) resource sustainability indicators were considered among others. There are human capital resource, forest resource and arable land. These sustainability indicators cover both natural and human resources, by so doing the three predominant perspectives namely ecological, Hart-Wick Solow and the Safe minimum approaches to sustainability were appropriately captured. Thus the index of sustainability was computed using the weighted average index as shown in Appendix 1. Data for the study were analyzed through the application of both descriptive and inferential statistical tools. Unit root test (ADF) was adopted as a pre-estimation technique. Objective I was achieved using Granger Causality; Objective II was achieved using Trend analysis and; Objective III was achieved through the use of dynamic regression model. After the estimation, a diagnostic test of misspecification, robustness/ heteroscedasticity, autocorrelation and multicollinearity were carried out to assess the validity of the empirical model.

3.1 Unit Root Test -Augmented Dickey-Fuller (ADF) Model

The Augmented Dickey–Fuller (ADF) test consists of estimating the following regression:

$$\Delta y_t = x'_t\beta + \delta y_{t-1} + \sum_{i=1}^{p} \Delta y_{t-p} + \varepsilon_t \text{……………. (4)}$$

Where Δ= difference operator; y=vector of the n variables (i.e. interest rate, exchange rate, government expenditure, etc); x = optional exogenous regressors which may consists of constant or a constant and trend; p = number of lags; ε_t= error term. Null hypothesis: H_o: $\delta = 0$ (i.e., there is a unit root or the time series is non-stationary, or it has a stochastic trend).Alternative hypothesis: H_1: $\delta < 0$ (i.e., the

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time series is stationary, possibly around a deterministic trend). If the ADF statistic is greater than the critical value at 5% level of significance, that means the series is stationary, if the ADF statistic is less than the critical value at 5% level of significance, it means the series is non-stationary.

3.2 Trend Analysis of sustainability Indicators over the Period

Growth trend Model

$Yt = Y_0 (1 + r) t$ ……………………………………..…(5)

Where Y_t= rate of growth of sustainability indicators; Y_0 = rate of sustainability indicators in a base year; r = compound rate of growth of Y; t = time in chronological years in natural log form we have

$InY_t = lnY_0 + tln(1 + r)$ …………………… ….........(6)

Substituting InY_0 with β_1 and $Ln(1 + r)$ with β_2, we re-write equation as

$InY_t = \beta_1 + \beta_2 t$ ………… …………………….….... (7)

Adding the disturbance term to equation we obtain

$InY_t = \beta_1 + \beta_2 t + \mu t$ …………………………………… (8)

Equation (8) is a growth rate model developed for this study. A semi-log growth model was developed for this study instead of a linear trend model because the point of interest in this study is both absolute and relative change in the parameters of interest. The most important parameter in equation (8) is the $coefficient \beta 2$. This is the coefficient of the slope which measures the constant proportional or relative change in Y for a given absolute change in the value of the regressor, t. Multiplying $\beta 2$ by 100 gives the instantaneous growth rate at a point in time.

$IGR = \beta_2 \times 100$……………………………… ………. (9)

Where: IGR= Instantaneous growth rate

According to Gujarati (2009) β_2 is the least-square estimate of the coefficient of the slope $\beta 2$, then taking the anti-log of β_2 and subtracting 1 from it and then multiplying the difference by 100 give the compound growth rate (CGR) over a period of time:

CGR = [antilog β_2 – 1] x 100 ……………………………………. ……………………….(10)

If the coefficient β_2 is positive and statistically significant or negative and statistically significant there is acceleration or deceleration in growth process respectively. If β_2 is not statistically significant there is stagnation in the growth process.

3.3 Dynamic Regression Model

$Rsus_{tij} = \alpha + \sum_i^j \vartheta_1 pcnstr + \sum_i^j \vartheta_2 pcnsrt_{t-1} + \cdots + \sum_i^j \vartheta_q pcnsrt_{t-q} + v_t$ …………… (81)

Where $t = q + 1, \ldots, T$, $InRsus_{tij}$ = sustainability index of i- j resources namely land(*arable*), forest resource (*forest*) and human capital (*h_cap*). *h_cap*= human capital resource approximated by aggregate government expenditure on education per capita *forest*= represents forest resource approximated by forest product per forest land area *arable*= arable land, measured as the productivity of agricultural land i.e. total agricultural output per hectare *cstock* = total capital resource stock approximated by gross fixed capital formation in millions of current USD. $pcnsrt$ = fiscal policy instruments (government expenditure and debt) government expenditure (*expn_agric)* = expenditure on agriculture measured as share of agriculture in the government expenditure outlay in millons of naira; *debt instrument (debt)* = external debt measured as the external debt stocks, total (current US$) to gross domestic product. It is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, short-term debt, and use of IMF credit; wage_rate= wage rate, control variable approximated by per capita income; $pcnstr_{t-1}$ = lag of policy instruments; e_t = is a stochastic error term that satisfies the normal classical regression assumptions. It is expected that increased in public expenditures and wage rate will yield aggregate agricultural growth ceteris paribus.

IV. RESULT AND DISCUSSIONS

4.1 Pre-Estimation Test: Unit Root Test

Table 4.1 reports the Unit root test results for Value Gross capital formation in current US (*c_stock;)* Arable land area and Permanent crops (1000ha) (*arable*); Forest products in million tonnes (*forest_prd);* Primary forest land area in 1000ha (*forest_land*); human capital (*human_cap*) proxied by education expenditure US$) (*expn_edu*); Expenditure on Agriculture (current US$) (*expn_agric*)

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Table 4.1: Results of aurgumented Dickfuller Unit root test

Variable	ADF Statistics Z(t)	Mackinnon critical value@5%	differenced level	P-value Z(t)	Remarks
expn_agric	-2.503	-1.688	1(0)	0.008***	Stationary
ext_debt	-3.668	-1.688	1(1)	0.001***	Stationary
Arable	-3.668	-1.688	1(0)	0.040**	Stationary
human_cap	-1.342	-1.688	1(1)	0.094*	Stationary
forest_prd	-4.410	-1.688	1(1)	0.000***	Stationary
forest_land	2.966	-1.688	1(0)	0.042**	Stationary
c_stock	-2.664	-1.688	1(0)	0.006***	Stationary

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

Source: Computed from secondary data, 2018

The results are summarized in the table 4.1. From the table, the variables government expenditure*(expn_agric)* (P=0.000<0.01)*;* Arable land *(Arable)* (P=0.000<0.01)*;* Forest land (*forest_land)* (P=0.000<0.05) *and* capital stock *(c_stock)* (P=0.000<0.01) were stationary at level while external debt (*ext_debt)* (P=0.000<0.01); human capital *(human_cap)* (P=0.000<0.01) *and* forest products *(forest_prd)* (P=0.000<0.01) were stationary at first difference order I(1). Therefore the null hypothesis of non-stationarity is rejected at 5% level of significance.

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4.2 Granger Causality Test between policy instruments and resource sustainability

The result of the pair wise granger causality test between policy instruments and resource sustainability is presented in table 4.2.

Table 4.2 Granger pair wise causality test between policy instruments and resource sustainability

Null Hypothesis	Df	Chi2- Statistics	Probability	Decision
debt does not granger cause *ndexstk*	3	30.426	0.000***	Rejected
ndexstk does not granger cause *debt*	3	4.008	0.261	Not rejected
exp_agric does not granger cause *ndexstk*	3	33.734	0.000***	Rejected
ndexstk does not granger cause *exp_agric*	3	4.144	0.246	Not rejected

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

The result of the causality test in table 4.2 revealed that at least a unidirectional causality exists between *debt* (P=0.000<0.01), *exp_agric*(P=0.000<0.01) and sustainability index (*indexstk)* (P=0.000<0.01). This indicates that the government expenditure and debt policy instruments granger cause sustainability indicators in Nigeria. Therefore the null hypothesis should be rejected while the alternate hypothesis is not rejected. The implication is that fiscal policy instruments are relevant determinants of agricultural resource sustainability in Nigeria.

4.3 Instantaneous and Compound Growth Rate of Policy Instruments and Sustainability Indicators

The result from trend analysis of agriculture output (*agrth*); Expenditure on Agriculture (current US$) (*expn_agric*); Primary forest land area in 1000ha (*forest_land*); Arable land area and Permanent crops(1000ha)(*arable*); human capital (*human_cap*) proxied by education expenditure US$) (*expn_edu*); and resource sustainability index(*Rsus_index*) are presented in Table 4.3. From the table the trend of policy instrument showed that there was acceleration in the growth in fiscal policy instruments but deceleration in resource sustainability indicators with no recorded stagnation during the period under review. The result showed further that there was a deceleration in the index resource sustainability (P=0.068<0.1) during the period of study with instantaneous growth rate and compound growth rate of -2.81% and -2.84% respectively. However, there was a deceleration in the index of resource sustainability during the period of study with instantaneous growth rate and compound growth rate of -2.81% and -

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2.84% respectively. There was acceleration in growth for with instantaneous and compound growth rate of expenditure to agriculture (P=0.000<0.01), external debt (P=0.082<0.1) with instantaneous and compound growth rate of 7.62%, 7.92%; 1.23%, 1.24% respectively.

Table 4.3: Instantaneous and Compound Growth Rate

	Instantaneous growth rate%	Compound growth rate%	P-value
Agrth	5.90	6.08	0.000***
lnexpn_agric	7.62	7.92	0.000***
Inexdebt	1.23	1.24	0.082*
forest_land	-1.57	-1.58	0.008***
Arable	0.33	3.38	0.470
human_cap	-1.93	-1.95	0.005***
Rsus_index	-2.81	-2.84	0.068*

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

Although efforts were made through the use of monetary and fiscal policies to improve macro-economic stability and stimulate growth (Oluwatobi and Ogunrinola 2011) the growth rates were not sufficient enough to spur growth may well suggest failure of policy instruments application in this regard. The implication of the empirical results is that given the current pressure on natural resources the targets sets by the government of Nigeria may not be achievable since government has not utilized macroeconomic policy instruments such that revenue generation is increased through the productivity of resources to meet national objective for sustainability of available agricultural resources. The instantaneous growth rate for forest resources (P=0.008<0.01), arable land (P=0.47>0.01) and human capital (P=0.005<0.01) were 1.57%, 0.33% and 1.93% with a compound rate of growth of -1.58%, 0.34% and -1.95% respectively. This means that the relative change in forest resources, arable land and human capital with respect to absolute change in the trend variable were -1.57%, 0.333% and 1.93% respectively. Therefore there was a deceleration in forest resources and human capital while arable land was stagnant. These are clear indications that agricultural resources are not on sustainable path and more effort may be required to enhance sustainability of this resources however this cannot concluded without further analysis.

4.4 Impact of general policy instruments on index of resources sustainability

The result of the impact of government expenditure and debt policy instruments on resource sustainability is presented in Table 4.4 utilizing index of sustainability with useful insights. The result of finite distributed lag model considers the coefficient of the parameters as impact propensity. From the table, the intercept term has a coefficient of 2.4050 this implies that without policy instruments sustainability index will remain at 2.41%. The R^2 was 0.8528. This means that 85.28% of the variation in sustainability index is accounted for by debt and government expenditure *(expn)*. The F-statistics (P=0.000<0.01) was statistically significant at 1% indicating that all the variables included in the model jointly exert significant impact on agricultural growth.

Table 4.4: Results of Impact of fiscal policy instruments on index of resources sustainability

Variables	B-Coefficient	Standard error	T-value	P-value
Dependent	= Index of sustainability			
Lndebt	-0.2745	0.1155	-2.380	0.024**
New_indexcstkL1.	0.5907	0.1250	4.720	0.000***
lnexpn L1.	0.3688	0.1127	3.270	0.003***
_cons	2.4050	0.7119	3.380	0.002***
Number of obs	=	37.0000		

F(5, 31)	=	35.9100
Prob > F	=	0.0000
R-squared	=	0.8528
Adj R-squared	=	0.8290
Root MSE	=	0.1391

Source: Computed from secondary data, 2018

Note: *** significant at 1%; ** significant at 5% and * significant at 10%.

The coefficient of government expenditure was 0.37d.p and statistically significant at 5%. This means that a proportionate rise in government expenditure increased sustainability index by 0.37% ceteris paribus. This is in agreement with (NBS, 2016) who opined that for the 1990-2005 interval Nigeria lost 39.2% of its forest and woodland habitat tend to support this realization. The implication is that government expenditure in human resource for accessible and quality education is required for skillful labour force while lack it result in depletion of skills and hence unsustainable development. It also implies that poor policy instruments utilization may have discouraged sustainability of resources through low agricultural investment, over utilizing land, labour and other resources. Although higher expenditure may warrant cutting down of trees (deforestation) due to government interest in development through construction of roads dams, this result proved that government expenditure as policy instrument increased the sustainability of resources. It is pertinent to state that decrease in sustainability may not be unconnected with the conceptualization of this work too. Policy instruments targeted at growth in agriculture has the potential for increasing environmental damage resulting in unsustainable outcomes because agricultural growth relies on the world's natural resources to create wealth and share the need for infrastructures and both entails the risk of environmental damage however, this study is unable to establish this realization.

According to Hanley, Shogren and White, (2007) if natural capital turns out to be the binding constraint on output and stock of natural capital is allowed to decrease substantially, agricultural growth and sustainability will continue to decline and subsequently social welfare irreversibly diminished. Human capital development and dynamic agricultural innovation systems are critical to attract further investment in agriculture (Hueting, 2011). Therefore policies should support high-quality education and well-functioning extension services, innovative technology to restore forest resource and enhance human capital development and sustainability of other critical resources. The coefficient of debt (*Indebt*) was -0.27 and statistically significant at 10%. This means that a proportionate rise in debt resulted in less than a proportionate change in sustainability index by -0.27% ceteris paribus. The implication is that elasticity of debt with respect to sustainability index is inelastic. Consuming or utilizing more resources now than in the near future means attaching more utility to the present thereby discounting the future. Furthermore, to prefer benefits now and place a lower value on benefits received later is to "discount" future benefits" (Anderson, 2010). The results from Table 4.4 showed a statistical significant with F-statistics of ($P=0.000<0.01$) indicating that general policy instruments had impact on resource sustainability. Therefore the null hypothesis that says the impact of policy instruments on resource sustainability is not statistically significant is rejected at 1% significant level. The implication is that policy instruments have impact on resource sustainability.

Increased expenditure on agricultural sector is needed to purchase land, construct buildings, acquire machinery and equipment, and hire labour, carry out research and development etc (Obansa and Maduekwe, 2013). For instance improvements in water well drilling technology and submersible pumps, combined with the development of drip irrigation and low-pressure pivots, have made it possible to regularly achieve high crop yields (UN, 2008). According to Mohawesh, Yasser; Taimeh, Awni; Ziadat (2015) in the coming decades, cropland will continue to be lost to industrial and urban development and many tools will be called upon to offset these projections. In Europe, one such tool is a geo-spatial data system called SoilConsWeb (Shenoy and Kalagudi, 2012). Increased investments in sustainable agriculture and the use of favorable macroeconomic policy instruments are critical to the attainment of resource sustainability more so that unsustainable exploitation of resources on a large scale has led to massive negative effect on the environment and human capital (United, 2008). Expenditure in sustainable agriculture is needed in generating the necessary level of investment, both public and private, in technology and infrastructure to facilitate economic growth in Nigeria while and debt profile will retard growth. Therefore, Government policies that failed to utilize fiscal policy instruments correctly may deplete natural resource with negative consequences on agricultural growth and worsening poverty conditions of poor farmers as millions of them depend on agriculture for their subsistence (UNCTAD, 2016).

V. CONCLUSION

The findings revealed that resource sustainability index adjusted fairly to the dynamics of macroeconomic fiscal policy instruments in Nigeria. Unfavorable macroeconomic fiscal policy instruments such as increased debt and reduced expenditure on agriculture driven by increased demands for natural resources in Soil, Forest resources as well as Human capital depletion among others impacted negatively sustainability of resources. Government expenditure policy instruments yielded significantly ($P<0.05$) positive impacts of 0.37% while increased debt profile decreases sustainability index by -0.27%. The study brings to the fore the inter-connectedness that exist between macroeconomic policy instruments and sustainability of resources and the reality that agricultural growth revolves around services provided by the natural resource and humans derived benefits from these natural resources and from properly-functioning ecosystems is further deepened. The implication is that favorable policy instruments that strengthen inter- link between natural capital and agriculture will reduce poverty and raise development and sustainable resource management. It will allow agricultural investors to maximize returns on their investment by harnessing long-term economic benefits. Therefore, the attainment of macroeconomic goals required the use of fiscal policy instruments with possible positive impact on sustainability of agricultural resources. The study recommended that the rate of utilization of agricultural resources should equate or less their rate of replenishment and any critical thresholds they exhibited. Government should refrain from accumulating debt but rather increase government expenditure to education, investing in human capital development through budgetary allocations as well as intervention funds so as to secure future growth.

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Appendix 1

Table 3.1 Index of Agricultural growth, human capital, Forest Arable land and capital stock

Year	index_agrth	index_human	index_forest	index_Arable	Rsus_index
1980	100.00	100.00	100.00	100.00	100.00

1981	109.24	119.77	97.20	109.24	108.74
1982	102.60	82.82	100.41	102.60	95.28
1983	99.30	62.73	99.49	99.30	87.17
1984	95.62	71.61	100.10	95.62	89.11
1985	118.56	89.12	99.85	113.56	100.84
1986	109.37	60.45	99.95	100.11	86.84
1987	96.81	96.01	99.80	96.27	97.36
1988	109.78	86.95	99.90	108.98	98.61
1989	104.77	77.20	99.95	104.09	93.75
1990	104.17	93.10	99.55	103.49	98.72
1991	103.64	58.01	103.87	99.84	87.24
1992	102.34	105.67	103.19	101.52	103.46
1993	101.87	51.01	103.48	100.91	85.13
1994	102.56	117.04	103.81	100.78	107.21
1995	103.59	167.33	104.20	100.28	123.94
1996	103.93	124.43	104.65	103.62	110.90
1997	104.16	102.53	105.19	103.86	103.86
1998	103.94	86.88	105.83	102.67	98.46
1999	105.10	117.88	106.61	103.25	109.25
2000	102.92	116.99	107.58	102.34	108.97
2001	103.79	99.52	109.60	106.48	105.20
2002	155.58	132.41	111.27	153.15	132.28
2003	107.01	113.16	113.52	105.29	110.66
2004	106.26	129.99	116.69	106.19	117.62
2005	107.07	126.79	121.50	105.74	118.01
2006	107.41	142.38	115.80	106.53	121.57
2007	107.20	109.81	120.48	106.62	112.30
2008	106.27	124.78	128.36	107.73	120.29
2009	105.88	80.31	144.27	111.56	112.04
2010	105.83	125.64	122.51	104.32	124.15
2011	102.92	111.31	109.13	101.47	107.30
2012	106.70	112.78	111.19	105.22	109.73
2013	102.94	111.54	114.13	104.68	110.12
2014	112.72	112.28	103.59	112.72	109.53
2015	93.27	85.24	114.42	93.53	97.73
2016	68.12	84.78	102.82	68.70	85.43
2017	117.87	99.70	100.67	115.78	105.39

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Maize/Joint Velch Intercropping and N Fertilization Effects on Striga Infestation and Maize Grain Yield in the Southern Guinea Savanna of Nigeria

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***Abstract*— *The parasitic weed Striga poses a serious threat to cereal production in sub-Saharan Africa. For many years, technological packages for the control of this weed were proposed and implemented on farmers' fields. A study was conducted in 2012 and 2013 to determine maize/ Jointvetch (Aeschynomenehistrix) and N fertilization effect on Striga infestation and maize yield. The intercropping trial consists of six treatments, four inorganic N fertilizer levels of 0, 60, 90, 120 kg ha^{-1}, alternate hill and same hill intercropping of A. histrix. The experiment was laid out in a randomized complete block design with three replicates. Alternate hill and same hill intercropping significantly ($P < 0.05$) reduced Striga infestation with respect to Striga shoots per m^{-2} and plot, Strigareation score and enhanced maize grain yield. There was a significant decline in the level of damage by Striga on maize in plots that received 60 – 120 kg N ha^{-1}. Alternate hill and same hill intercropping had maize grain yield of 3295 kg ha^{-1} and 2616 kg ha^{-1} which were significantly higher than those obtained without inorganic N application (306 kg ha^{-1}). Inorganic N application had a significant ($P < 0.05$) effect on grain yield. Lowest grain yield of 306 kg ha^{-1} was obtained without inorganic N application, which was significantly ($P<0.05$) different from those fertilized with inorganic N, that had comparable grain yields. Inorganic N fertilizer rate of 60 kg ha^{-1} seems to be optimum for maize.*

***Keywords*— **Grain, intercropping, Jointvelch, Maize, Striga.**

I. INTRODUCTION

Maize (*Zea mays* L.) commonly known as corn is one of the cereal crops which belongs to the grass family, Poaceae. It is one of the most important cereal crops of the world after rice with respect to cultivated area. In Nigeria, in 2007 and 2008, maize production amounted to 67.4 and 75.3 million metric tons, respectively [1]. The phenomenal increase in maize production in Nigeria over the past few years was attributed to increase in its utilization for various food items, livestock feed and industrial materials, as well as research activities leading to the development of input and management of technologies resulting from increased grain yields [1].

*Strigahermonthica (*Del.*)*Benth is an important parasitic weed of cereals in the semi- arid tropics. In general, low soil fertility, nitrogen deficiency, well- drained soils and water stress accentuate the severity of *Striga* damage to the host. These are typically the environmental conditions for *Striga* hosts in the semi- arid to sub humid tropics [2]. *Striga* plant has a high fecundity and longevity of seed reserves, that is, it produces numerous seeds which can remain dormant in the soil for 15 – 20 years and thereafter readily germinate [3].

Jointvetch *(Aeschynomenehistrix)* (Poir) belongs to the family Fabaceae (or Papilionaceae). It is a tap-rooted herb or sub-shrub with moderately pubescent or hispid stem and a prostrate to semi erect growth habit. The flower of this Papilionaceae is about 5-

7 mm long producing 1.5-2 mm long seeds which are black in colour. This herbaceous plant thrives well in habitat with sandy acid and low fertility soils, sometimes in sandy loam and clay soils, and it is moderately drought tolerant. It is a fast growing and decomposing green manure with high potential as legume fallow in the humid tropics [4]. *A.histrix* has the ability to fix large quantities of N, thus enriching the poor tropical savanna soils [5]. It grows wildly and widely in the southern Guinea Savanna of Nigeria.

Intercropping is a common practice in Africa. The use of intercropping host crops with legume crops is to serve as trap, whereby the *Striga* soil seed bank is depleted in the long run. The trap crop stimulates *Striga* seeds to germinate without being parasitized, a phenomenon known as suicidal germination and improve soil fertility [6]; [7]. However, it was discovered that the species and varieties of the crops exhibit a wide variation in their ability to stimulate *Striga* seed germination. [8] noted that maize intercropped with groundnut (RMP12) did better than plots intercropped with cowpea (IAR, 48). In a similar study,[9]observed increased maize grain yield when groundnut was intercropped with it than with soybean. Furthermore, [10] and [11] found intercropping sorghum and millet with groundnut, to reduced *S. hermonthica*infestation compared with sole cropping. Also, [10] noted that the resistant sorghum varieties supported fewer numbers of *Striga* shoots than the susceptible varieties. In addition, [12] observed fewer *Striga*shoots and higher grain yield in *Striga*resistant maize. In a similar study, [13] observed that sorghum interplanted with Jointvetch (*A.histrix*) delayed *Striga* shoot emergence by about two weeks and reduced its density by about 60 % thereby, increasing sorghum grain yield by about 74 % above the control.

When resistant maize variety, ACR 97 -TZL COMP. l - W was intercropped with soybean and groundnut, it consistently resulted in lower *Striga* incidence, infestation and severity than the farmer's local cultivar 9(Kuchinda*et al*., 2003). Intercropping maize with two varieties of soybeans did not significantly reduced *Striga* incidence, infestation, crop syndrome reaction score and grain yield, an indication that the two soybean varieties had similar potentials for use as trap crop [14]. In the same vein, [15] have reported that intercropping *Celosia argentea*(Striga – chaser) into sorghum reduced *Striga* emergence by an average of 55 % in a season and increased the yield of a susceptible sorghum variety in the field by 35 % compared to sole sorghum treatment. The objective of this experiment is to determine the effect of Jointvelch (*A. histrix)* intercropping with maize and N fertilization on *Striga* infestation and maize performancein Mokwa, southern Guinea savanna.

II. MATERIALS AND METHODS

2.1 Experimental Site

Field experiments were conducted on a *Striga* infestedfield in 2012 and 2013 rainy seasons at the Teaching and Research Farm of Niger State College of Agriculture, Mokwa (09^0 18 N; $05^0$50 E), situated in the Southern Guinea savanna agro ecological zone of Nigeria. The soil of the experimental site was Alfisols with surface soil texture of sandy-loam, acidic, low in nitrogen but moderate in phosphorous. Rainfall pattern is monomodal with the rainy season starting in March or April and ending in October. Monthly rainfall during the period of study is shown in Table 1. The field was heavily infested with *Strigahermonthica* which makes it to be sparingly cultivated with maize over the years with no fertilizer application.

Table 1: Monthly rainfall (mm) during the period of study

Months	**2012**	**2013**
January	-	-
February	0	0
March	20.1	187
April	43.4	39
May	165	186.3
June	174	399.1
July	346	309
August	423.2	81
September	487	371
October	76.3	129
November	12.1	-

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December	0	0
Total annual rainfall	1747.1	1701.4

Source: Niger State College of Agric, Mokwa, Meteorological Station.

2.2 Treatments and experimental design

The treatments were four inorganic N fertilizer levels (0, 60, 90, 120 kg ha^{-1}), alternate hill and same hill interplanting of *A. histrix*. The treatments were laid out in a randomized complete block design with three replicates. There were 18 experimental plots, such that gross plot size was 8 m × 4 m (32 m^2) and the net plot size was 18 m^2, separated by 1m alley. The number of ridges in the plot was five while the length of ridge was 8 m.

2.3 Agronomic practices

The field was manually cleared and ridged using hoe at 75 cm apart in 2012 and 2013. The maize variety, SUWAN 1, obtained from premier seeds, highly susceptible to *Striga* was manually planted at 3 seeds per hill, spaced 50 cm within rows. The seedlings were thinned to two plants per hill at two weeks after sowing (WAS) to give a plant population of 53, 3333 plants h a^{-1}. Basal application of 30 kg P ha^{-1} as single superphosphate and 30 kg K ha^{-1} as muriate of potash were carried out at 2 WAS after thinning. Inorganic N fertilizer as urea was split – applied to plots that were to receive N fertilizer. At 2 WAS, one- third of the N was applied, while the remaining two- third was applied at 6 WAS. Fertilizers were applied by side banding at about 5 cm away from the seedlings and at about 5 cm deep along the ridge. The first hoe –weeding was carried out at 3 WAS while the second weeding was at 5 WAS followed by careful hand- pulling of weeds other than *Striga*.

2.4 *Striga* infestation parameters

The number of *Striga* shoots per maize plant was taken by counting each *Striga*shoot present per maize plant stand starting from 6 WAS. The number of *Striga* shoots flowering was taken by counting closely the number that flowered in each plot. The number of *Striga* shoots per meter squared was taken by counting closely the number of *Striga* present in each plot per m^2. Days to 50 % *Striga*shoot flowering was carried out by counting the number of days from the day the first *Striga* shoot emerged to the day that 50 % of *Striga* shoots flowered. The *Striga* reaction score was taken on the scale of 0 – 9 using visual observation to measure mild, severe and very severe or death infestation of *Striga* on maize plant.

2.5 Observations on growth and yield parameters

Ten maize plants from each of the net plot were randomly tagged for periodic observation at 3, 6 and 9 WAS. The following observations made were:

The maize plant population was carried out by counting individual plants at 3, 6 and 9 WAS. This is also known as plant population count and expressed in hectare. The maize plant height was observed by tagging ten plants from the inner rows at random which were used throughout for taking the measurements. The plant height was measured using meter rule from the top of the uppermost leaf to the base of the plant at 3 and 6 WAS but from the base to the tip of the tassel at 9 WAS and expressed in centimeters. Days to 50 % maize tasselling was taken through observation by counting the number of days from the sowing date to the day when about 50% of all the maize plants in each plot has tasseled and expressed in percentage. The average cob length of 10 harvested tagged maize plant from the inner row of each plot were taken and measured using meter rule and expressed in centimeters. The number of maize cobs from the inner rows of each plot was counted and estimated per hectare. This was done when the plant attains physiological maturity. The number of maize grain per cob was also obtained by weighing those harvested from the inner rows and shelled at harvest time. This was done by counting. 100 maize grain weights was taken from the ten harvested cobs from each plot, shelled and weighed using a weighing balance, expressed in grams.

2.6 Grain yield and yield components analysis

The maize grain yield analysis was carried out by harvesting maize ears in the two central rows leaving out the border plants at both ends (net plot of 18 m^2). These were shelled, air- dried and weighed. The grain yield was adjusted to 12 % moisture content for each plot and weighed.

III. STATISTICAL ANALYSIS

The data collected were subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test at 5 % level of probability. The statistical package used was Statistical Analysis System (SAS), version 9.2(2002).

IV. RESULTS

Initial soil properties of the study area

The initial soil properties of the experimental site before the commencement of the study are shown in Table 2. The soil of the experimental site for this trial was loamy sand, acidic, low in organic carbon but moderate in nitrogen and phosphorous. The soil had a loamy sand texture which is suitable for the cultivation of maize with minimum tillage.

Vegetative growth parameters

The effects of intercropping and nitrogen fertilization on maize plant height is shown in Table3. Maize plant height was significantly ($P < 0.05$) affected by intercropping and N- fertilization at 3 WAS and at 6 and 9 WAS in 2012. Plots given 60 kg N ha^{-1} obtained taller plants at 6 and 9 WAS which was 48 and 33 % higher than the control. The trend was slightly different in 2013 cropping season where the heights was significantly increased by intercropping and N fertilization across the sampling weeks such that plots given 120 kg N ha^{-1}had taller plants at 3 WAS. The application of 90 kg N ha^{-1} and same hill intercropping produced similar taller plants than all others except plots given 120 kg N ha^{-1}at 6 WAS. The trend over the two years show a consistent increase in plant height with the use of 60 kg N ha^{-1} in 2012 and same hill in 2013.

The effect of intercropping and N fertilization on days to 50 % tasselling is shown in Table 4. Days to 50 % tasselling was significantly ($P < 0.05$) influenced by intercropping and N fertilization in 2012 and 2013 cropping seasons (Table 4). In this, alternate hill intercropping, 60, 90 and 120 kg N ha^{-1} had shorter number of days to 50 % tasselling, compared with the control which had longer days in both years though similar to same hill in 2012 only. The effects of intercropping and N fertilization on number of maize cobs are also shown in Table 4. The number of maize cobs per plot differ significantly ($P < 0.05$) due to intercropping and N fertilization in 2012 and 2013 rainy seasons. Application of 60 kg N in 2012 and 90 kg N in 2013 produced greater number of cobs, which were similar to plots given 90 kg N, 120 kg N and alternate hill in 2012 only. Application of 0 kg N ha^{-1} obtained lower number of cobs per plot in both years. Intercropping and N fertilization had a significant ($P < 0.05$) effect on cob length such that the use of 120 kg N ha^{-1} produced longer cobs than the other treatments except plots given 60 kg N ha^{-1} in 2013. In the same vein, application of 60 kg N ha^{-1} and alternate hill obtained similar longer cobs than 0 kg N ha^{-1} plot only in 2013.

***Striga* infestation**

The effects of intercropping and N fertilization on *Striga* shoots per m^{-2}, *Striga*reation score and *Striga* shoots per maize plant at 9 and 12 WAS in 2012 and 2013 are shown in Tables 5, 6 and 7, respectively. Intercropping and N fertilization had a significant ($P < 0.05$) effect on *Striga* population (m^{-2}) (Table 5). In both 2012 and 2013 cropping season, *Striga* population was significantly reduced by 120 kg N ha^{-1} than 0 and 60 kg N ha^{-1} only at 9 WAS in 2012, while 90 kg N ha^{-1} and same hill were statistically similar at 12 WAS in 2012 except 0 kg N ha^{-1}. Similarly in 2013, application of 60 kg N ha^{-1}, had lower number of *Striga* shoots compared to the control only which had the highest at 9 WAS. At 12 WAS, 90 kg N ha^{-1} and same hill obtained higher number of *Striga* shoots, compared to 60 and 120 kg N ha^{-1} which had the lowest, which were also in turn not significantly different from 0 kg N and alternate hill.

*Striga*reaction score was significantly ($P < 0.05$) affected by intercropping and N fertilization in both cropping seasons (Table 6). There was a significant decline in the level of damage caused by *Striga* on maize in plots that received 60 – 120 kg N ha^{-1}, same hill and alternate hill in both sampling times in 2012, while the reverse was the case with 0 kg N ha^{-1} during this time. The trend in 2013 rainy season showed that 60 kg N had lower level of infestation at both sampling times, and were similar to 90, 120 kg N ha^{-1} and same hill at 9 WAS, and 120 kg N ha^{-1} at 12 WAS only. The application of 0 kg N ha^{-1}consistently had higher*Striga* reaction scores on maize in this study.

Intercropping and N fertilization had a significant ($P < 0.05$) effect on *Striga* shoots growing with maize (Table 7). The number of *Striga* shoots growing with maize was significantly reduced in alternate and same hill intercropping which were in turn similar to other treatments except 0 kg N ha^{-1} which obtained higher shoots at each sampling time in 2012. The trend in 2013 showed that 60 kg N ha^{-1} plots at 9 WAS had lower number of *Striga* shoots more than the 0 kg N ha^{-1} and same hill plots only. At 12 WAS, there was no significant difference of this treatments on this parameter.

Maize yield and yield components

The effects of intercropping and N fertilization on maize yields and yield attributes in 2012 and 2013 rainy seasons are shown in Table 8. Intercropping and N fertilization significantly ($P < 0.05$) affected 100 grain weight (Table 8). In 2012, application of 60 kg N was found to have heavier seeds, which were comparable to other treatments except the control in both years. Furthermore, grain yield was significantly ($P < 0.05$) affected by intercropping and N fertilization such that application of 60 kg N produced higher grain yield more than the 0 kg N ha^{-1} by 59.7 % and 36.6 % in 2012 and 2013, respectively. Stover yield was significantly affected by intercropping and N fertilization such that application of 120 kg N in 2012 and alternate hill in 2013 obtained heavierstover than same hill and 0 kg N ha^{-1} in 2012 and 0 kg N ha^{-1} in 2013 only.

V. DISCUSSION

The slightly acidic nature of the soil make most soil nutrients to be available for plant uptake [16]. The low organic carbon content of the soil will necessitate incorporation of crop residues and other organic materials into the soil to increase its fertility especially N, which was low. Soil organic matter is the main source of N in the soil [16]. Available phosphorus content was moderate implying that the soil might not need application of phosphorus fertilizer in the short run for optimum yield of maize. The very low base saturation suggests the domination of the exchange sites by exchangeable bases with consequent low exchangeable acidity.

Plant height, days to 50 % tasselling, number of cobs $plot^{-1}$ and cob length were increased but varied between N fertilizer levels and *A. histrix* intercropping with maize in this study. The positive response (increase) observed in this study for plant height, number of cobs per plot and cob length due to N application and intercropping with *A. histrix* could probably be due to incorporation of residues resulting in high SOC. Increase in soil organic matter level might have resulted in increase in soil fertility, nutrient supply, porosity, permeability and thus, soil productivity [17]. The findings obtained are consistent with that of other workers in the same savanna agroecological zone of Nigeria [18].

Striga shoots per m^{-2} and per plot, and *Striga* reaction score generally were reduced by and varied between N fertilization and *A. histrix* intercropping with maize in this study. This clearly demonstrated that alternate plants of *A. histrix* could cause a reduction in *Striga* emergence, similar to application of N at 60 – 120 kg N ha^{-1}. Furthermore, same hill intercropping of *A. histrix* also produced a reduction in *Striga* shoots in this study. These findings might be attributed to *A. histrix* acting as a trap or catch crop and the shading effect from *A. histrix* canopy. In addition to shading out *Striga* in intercropping systems, the *A. histrix* has also shown to stimulate the germination of *Striga* without acting as host, just like cowpea and soybean [6]; [14]; [9] and [19].

Striga shoots were generally low with application of 90 kg N ha^{-1} at 9 WAS, 90 kg N ha^{-1} and alternate hill planting at 12 WAS in 2012; 60 kg N ha^{-1} , 90 kg N ha^{-1} and alternate hill planting at 9 WAS, 60 kg N ha^{-1} was the case at 12 WAS in 2013. These demonstrate that alternate plants of *A. histrix* could cause a reduction in *Striga* emergence similar to application of N at 60 – 90 kg N.This is in agreement with the findings of other workers. Usually large amounts of nitrogen are required to reduce *Striga* density [20]. However, improved growth and vigour due to N fertilization might have helped the maize crop to reduce *Striga* parasitism. [21] indicated higher *Striga* emergence without nitrogen compared with all nitrogen rates evaluated with sorghum. Early application of compound fertilizers might have depressed the germination of *Striga* seeds hence the delay in emergence [22]. Similarly, [19]; [23] and [24] observed that adequate urea and cereal legume rotation, have been reported to be effective in reducing *Striga* emergence and damage on maize and sorghum.

Grain yield without inorganic N fertilizer was significantly lower than that of the other inorganic N levels. Similar responses to inorganic N fertilizer have been reported in the study area by [25]. The high yield obtained in the study area might be attributed to adequate moisture and other optimum growth factors obtained in this study [26].

VI. CONCLUSION

Intercropping maize with *A. histrix* has the potential of reducing *Striga* parasitism with respect to *Striga* shoots per m^{-2} and plot, *Striga*reation score and enhancing maize grain yield. Both intercropping and N fertilization improved the soil organic matter and hence, reduced *Striga* infestation for good crop growth. Incorporation of the *A. histrix* residues substantially reduced *Striga* infestation. Maize intercropping with *A. histrix*was as good as N fertilization, with respect to plant height, days to 50 % tasseling, number of cob per plot, cob length, 100 grain weight, stover and maize grain yields. There was response to inorganic N fertilizer application, suggesting the need for N application to maize for optimum grain yield. Nitrogen rate of 60 kg ha^{-1} was optimum for maize yield.

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Table 2: Initial soil properties before land preparation in 2012

Parameter	Value
Sand (g kg^{-1})	795
Silt (g kg^{-1})	89
Clay (g kg^{-1})	116
Textural class	Loamy sand
pH (H_2O) (g kg^{-1})	6.7
pH (in $CaCl_2$) (g kg^{-1})	5.5
Organic Carbon (g kg^{-1})	3.3
Total Nitrogen (g kg^{-1})	1.8
Available Phosphorus(mg kg^{-1})	18
Na+ (cmol kg^{-1})	0.19
K+ (cmol kg^{-1})	0.09
Mg++ (cmol kg^{-1})	0.98
Ca++ (cmol kg^{-1})	4.96
Exchangeable acidity(cmol kg^{-1})	0.11
ECEC (cmol kg^{-1})	6.32
Base saturation (%)	98.0

Table 3: Effects of intercropping and nitrogen fertilization on maize plant height at 3, 6 and 9 WAS in 2012 and 2013 rainy seasons

	Maize plant height (cm)					
	2012			2013		
Treatment	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS
0 kg N ha^{-1}	53a	90c	164bc	41f	63c	164d
60 kg N ha^{-1}	58a	138a	197a	43e	73b	215b
90 kg N ha^{-1}	58a	106b	175b	47c	88a	220b
120 kg N ha^{-1}	57a	127ab	184ab	51a	79ab	230b
Same Hill	48b	90c	153c	49b	88a	277a
Alternate Hill	50a	86c	150c	45d	74b	187c
SE±	1.66	5.42	5.19	2.41	2.41	8.81

Means in the same column with different letter(s) are significantly different from each other at $P < 0.05$ using Duncan Multiple Range Test (DMRT)

WAS – Weeks after sowing

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Table 4: Effects of intercropping and nitrogen fertilization on some growth and yield components of maize

Treatment	Days to 50% tasselling		Number of cobs $plot^{-1}$		Cob length (cm)	
	2012	2013	2012	2013	2012	2013
0 kg N ha^{-1}	56a	56a	26c	77c	7c	13b
60 kg N ha^{-1}	51b	51b	68a	85b	12ab	16a
90 kg N ha^{-1}	49b	51b	56ab	106a	10bc	15ab
120 kg N ha^{-1}	49b	49b	67a	64bc	13a	14ab
Same Hill	54ab	49b	31c	88b	10bc	14ab
Alternate Hill	49b	49b	48b	97ab	9bc	16a
SE±	0.80	0.80	5.10	5.80	0.60	0.50

Means in the column with different letter(s) are significantly different from each other at P < 0.05 using Duncan Multiple Range Test (DMRT)

Table 5: Effects of intercropping and nitrogen fertilization on Striga shoots per m^{-2} at 9 and 12 WAS in 2012 and 2013 rainy seasons

	Striga shoots m^{-2}			
	2012		2013	
Treatment	9 WAS	12WAS	9 WAS	12WAS
0 kg N ha^{-1}	3a	6a	6a	8ab
60 kg N ha^{-1}	2ab	5ab	0b	4b
90 kg N ha^{-1}	1b	1b	2ab	11a
120 kg N ha^{-1}	0c	2ab	1b	6b
Same Hill	1b	2ab	2ab	12a
Alternate Hill	1b	1b	1b	8ab
SE±	0.30	0.70	0.50	1.20

Means in the same column with different letter(s) are significantly different from each other at P < 0.05 using Duncan Multiple Range Test (DMRT)

WAS – Weeks after sowing

Table 6: Effects of intercropping and nitrogen fertilization on Striga reaction score on maize at 9 and 12 WAS in 2012 and 2013 rainy seasons

	Striga reaction score			
	2012		2013	
Treatment	9 WAS	12WAS	9 WAS	12 WAS
0 kg N ha^{-1}	17a	3a	5a	7a
60 kg N ha^{-1}	1b	2b	0c	3b
90 kg N ha^{-1}	1b	1b	1bc	6a
120 kg N ha^{-1}	1b	1b	1bc	4b
Same Hill	1b	2b	2bc	6a
Alternate Hill	1b	2b	3b	6a
SE±	0.08	0.19	0.40	0.40

Means in the same column with different letter(s) are significantly different from each other at P < 0.05 using Duncan Multiple Range Test (DMRT)

WAS – Weeks after sowing

Table 7: Effects of intercropping and nitrogen fertilization on Strigashoots growing with maize plant at 9 and 12 WAS in 2012 and 2013 rainy seasons

	Striga shoots per maize plant			
	2012		2013	
Treatment	9 WAS	12WAS	9 WAS	12 WAS
0 kg N ha^{-1}	7a	15a	3a	3
60 kg N ha^{-1}	2b	1b	0c	3
90 kg N ha^{-1}	1b	1b	2ab	4
120 kg N ha^{-1}	3ab	3b	1bc	3
Same Hill	0b	2b	2ab	4
Alternate Hill	0b	1b	1bc	3
SE±	0.81	1.88	0.33	0.25

Means in the same column with different letter(s) are significantly different from each other at P < 0.05 using Duncan Multiple Range Test (DMRT)

WAS – Weeks after sowing

Table 8: Effects of intercropping and nitrogen fertilization on maize yields and yield attributes in 2012 and 2013 rainy seasons

	100 grain weight (g)		Stover yield (kg ha^{-1})		Grain yield (kg ha^{-1})	
Treatment	2012	2013	2012	2013	2012	2013
0 kg N ha^{-1}	20b	23b	1272c	1137e	306c	2222d
60 kg N ha^{-1}	27a	29a	2519ab	6946bc	759a	3505a
90 kg N ha^{-1}	24a	26ab	1882b	5194d	628ab	3131bc
120 kg N ha^{-1}	23a	26ab	2719a	7313b	539ab	2587cd
Same Hill	22a	28a	1653bc	5994c	412bc	2616c
Alternate Hill	23a	28a	1811b	8665a	552ab	3295b
SE±	1.40	0.60	154.20	162.20	57.10	1.60

Means in the column with different letter(s) are significantly different from each other at P < 0.05 using Duncan Multiple Range Test (DMRT)

WAS – Weeks after sowing

Antibacterial Activity *Rhizophora stylosa* and *Avicennia marina* of Mangrove Fruit Extraction on *Vibriosis* of Mangrove Crab Larvae (*Scylla Serrata* Forsskal)

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Abstract— *The stability of mangrove crabs (Scylla serrata Forsska^{0}l) production were still constrained, especially the high mortality in the larval stage caused by vibriosis infection in the form of vibrio bacterial attack, so natural extracts as antibacterial such as R.stylosa and A.marina were needed. The purpose of this study was to assess the antibacterial activity R.Stylosa and A.marina of mangrove fruit extracts through in-vitro as the cause vibriosis of mangrove crab larvae. (Scylla serrata F). On fruit sample and extraction of active ingredients R.Stylosa and A.marina fruit were the initial stages of the study, then continued with bacterial isolation, soaked calculation of% and antibacterial activity test for antibacterial on vibrio bacteria. The results of the soaked calculation of% R.stylosa at the concentration of 2 mg / disk / 50 µl, the highest obtained in metanol was 12.92% and A.marina was 8.61% in metanol; The results of antibacterial activity based on inhibition zone area, for the highest R.stylosa in solvent metanol (11.40 mm) , in V.harveyi bacteria, then followed by 7.18 mm in V. alginolyticus bacteria, then 7.03 mm in V.paraemolyticus bacteria, where as the results of antibacterial activity based on inhibition zone area, for the highest A.marina in the Chloroform solvent (21.09mm), in V.harveyi bacteria, then followed 19.08mm in V. paraemolyticus bacteria, and 11.80mm in V.alginolyticus bacteria. Obstacle zones obtained categorized as moderate to very high (> 11- <15mm = moderate; height = 15-20 mm; and very high => 20mm) based on the description at Zainuddin (2006) so that they met the requirements to be applied through in-vivo.*

Keywords— ***R.stylosa, A.marina, Antibacterial, Vibriosis, Scylla Serrata***.

I. INTRODUCTION

One of the roles of mangroves is as an antibacterial active ingredient, because mangrove plants, such as *R.stylosa* and *A.marina* contain antibacterial compounds such as *alkaloids, flavonoids, phenols, terpenoids, steroids and saponins*. This class of compounds is the ingredient of modern medicines (Janah, 2017; Pratama, 2014; and Eryanti, 1999), so it is expected to be used for testing the production of antibiotics against *Vibrio* sp bacteria in tackling *vibriosis* in crab larvae that are of economic importance in aquaculture, this is interesting to study because ecologically there is a strong interaction between mangrove crabs as cultivants and mangroves as habitats, and educationally this research is expected to contribute in order to help increase productivity in the fishing industry sector, especially in crab cultivation.

The increasing demand for mangrove crabs stimulates farmers to cultivate mangrove crabs, both in hatcheries and enlargement in ponds associated with the mangrove environment. The limited population of mangrove crabs and the amount that is affected by the season and the high cost of feeding is one of the obstacles in the maintenance of crabs (Lateef *et.al*., 2008). The main obstacle in aquaculture activities is diseases in biota (Hatmanti, 2003). Lavilla and Pena (2004) state that bacterial infections attack all crab stages, both larvae and adult crabs. Jithendran *et.al*. (2010) stated that *Vibrio harveyi* 10^5 - 10^7 CFU /ml pathogenic in the mangrove crab zoea stage. Irianto (2007) explains that *Vibrio* sp. is a primary pathogen in marine and brackish culture.

According to Ashofa and Prayitno (2014), *Vibrio* sp. also a secondary pathogen, meaning *Vibrio* sp.infect after the attack of other diseases such as protozoa or other diseases. Furthermore, it was added that the maintenance of mangrove crabs (*Scylla serrata Forsskal*) still often decreased production due to the presence of *vibriosis* in the form of an attack of vibrio bacterial infection. The mortality of mangrove crab larvae has been stated by many researchers, one of the causes is bacterial vibrio infection (Putri and Prayitno, 2015). Various types of Vibrio bacteria can cause 100% mortal in mangrove crabs, especially in the larval stage to adult size (Taplur *et al*. 2011).

This research aimed to create a natural antibacterial formula in the form of *R.Stylosa* and *A.marina* mangrove fruit extracts for disease prevention in mangrove crab larvae which is expected to contribute to increased production, environmentally friendly and sustainable. While the specific purpose of this study is to examine the antibacterial activity of *R.stylosa* and *A.marina* mangrove fruit extracts in vitro against vibrio bacteria that cause vibriosis in mangrove crab larvae (*S.serrata F*). The specific target to be achieved in this research is the determination of % soaked and antibacterial activity in In-*vitro R.stylosa* and *A.marina* mangrove fruit extracts by maceration or immersion in multilevel solvents based on their level of polarity (n-hexane, chloroform, metanol, and water) to overcome the problem of *vibriosis* in the cultivation of mangrove crabs, especially in the larval stage.

II. METHODS AND MATERIAL

Sample Preparation

R.stylosa and *A.marina* mangroves were collected from the area around the coast of Kuri Caddi, Maros, South Sulawesi. About 8 kg of *R.stylosa* and *A.marina* mangroves then in scaled wet weight, collected in a fresh state then dried at a temperature of less than 40°C by using sunlight. After drying the mangroves were scaled again and obtained a dry weight of 4 kg each *R.stylosa* and *A.marina* blended until smooth, to get the weight of powder each 300g *R.stylosa* and *A.marina*

Mangrove Fruit Extraction

Extraction was carried out using multilevel maceration method on two samples of simplicia powder (derived from mangrove fruit derivatives of *R.stylosa* and *A. marina* species). The extraction process was carried out by kinetic maceration method (assisted with stirrer) for 24 hours at room temperature for each solvent. The solvents used were successively starting from non-polar (n-hexane), semi-polar (chloroform), and polar (methanol and water) solvents. A total of 300g of simplicia was divided 50g each into 6 erlenmeyer flasks, then each of the erlenmeyers contained with simplicia was soaked with 300ml of solvent (1: 6) and extracted on a magnetic stirrer. This extraction was carried out for 24 hours and repeated for 3 times. After being extracted with n-hexane solvent, the simplicia pulp was dried before being macerated with chloroform solvent, until the water solvent.After the extraction process was done , the organic solvent was evaporated by vacuum using Rotavor. For water solvents, a freeze dryer was carried out until the extract was obtained. The results of the thick extract were weighed and stored at cold temperatures until they would be used for testing and to calculate the extract a soaked stuff. This extraction method refered to the extraction method Zainuddin (2006).

To calculate the extract yield used the formula:

$$\%\ \text{Yield} = \frac{\text{Extract weight}}{\text{Weight of powder biomass}} \times 100\%$$

The extraction procedure of *R.stylosa* and *A.marina* mangroves by using multilevel solvents (n-hexane, chloroform, metnaol, and water) based on polarity can be seen in the following figure:

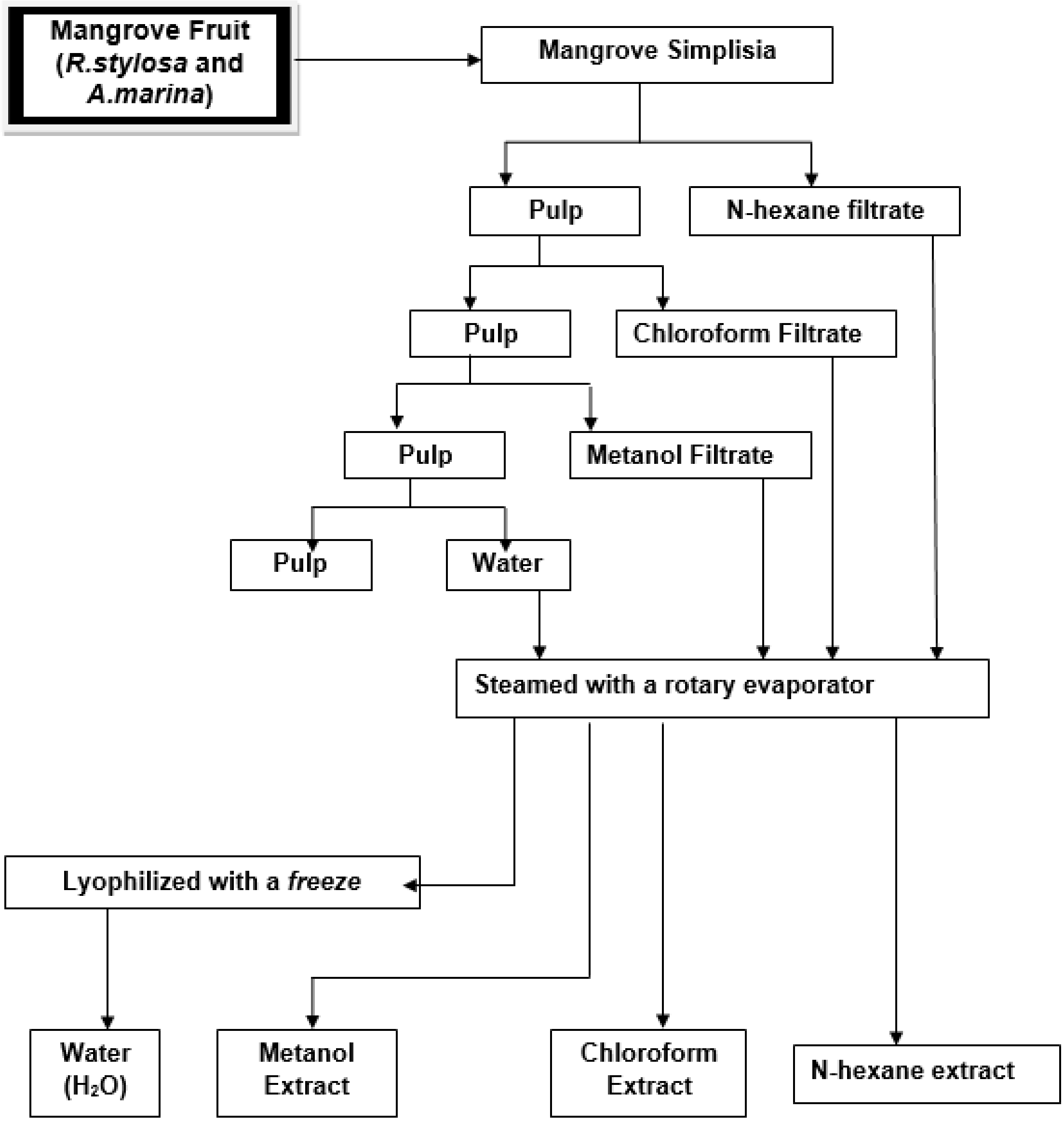

Fig.1: Mangrove Fruit Extraction Procedure

Isolation of *vibrio* spp

The results of vibriosis bacterial isolates were obtained from the results of the bacterial culture of Takalar Brackish Aquaculture Research Center, then pure culture and isolated in the laboratory of Parasites and Fish Diseases Hasanuddin University (Isolation of bacteria from the media of crab larvae maintenance was carried out by taking 1 mL of media water then diluted with 9 mL of solution physiological saline (0.85% NaCl) and then 0.1 mL are inoculated on TCBSA (Thiosul phate Cetoate Bile Sucrose Agar) plates, incubated for 48 hours.The bacteria that grow on petri dishes are isolated and purified based on the shape and color of the colonies on TSA media (Tryoptic Soy Agar) slant, incubated for 4 hours, propagated to NB (Nutrient Broth) and used for inhibition zone test).

Antibacterial Activity Testing

Antibacterial activity testing was carried out at the Fish Parasite and Disease Laboratory of the Faculty of Marine and Fisheries, Hasanuddin University, using disk diffusion method (Zainuddin, 2006). The four extract solvents (n-hexane, chloroform, methanol, and water) were weighed at a concentration of 2 mg / disk / 50 µl, then put into an ependorf tube and dissolved with each solvent. Then homogeneous using vortex and ready to be tested. Vibriosis pathogenic bacterial isolates were cultured again in an oblique TSA medium, then incubated for 24 hours. As a positive control ciprofloxacin was used. The negative control used is the solvent used for extraction (n-hexane, chloroform, methanol and water).

The making of a microbial suspension test was carried out by taking 1 ose needle of pure culture bacteria,

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then put it in a test tube containing 2 ml of 0.9% physiological NaCL solution, then divortexed and put as much as 200 µl into six bottles containing 20 mL of warm TSA media and flattened with a circular motion so that the bacteria evenly distributed. After that, the agar medium in a still liquid bottle is poured into a Petri dish and allowed to condense.

Bacterial inhibitory activity is indicated by the presence of inhibition zones (clear zones / halo zones) around the paper disc. The diameter of the bacterial growth inhibition zone is measured in mm and made a quantitative measure for the size of the inhibitory zone (Figure 2) and (Table 1).

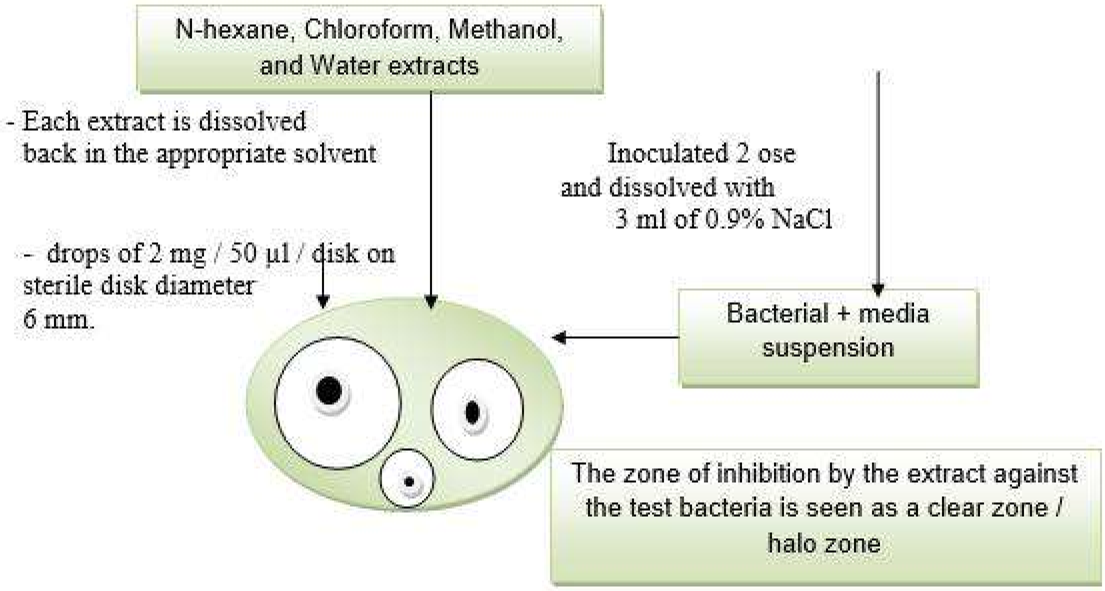

Fig.2: Inhibition Zone Test Procedure

Table 1. Inhibition power levels based on measurements of inhibition zone diameters

No	Inhibitory Zone Diameter	Information
1	>20 mm	Very High
2	15 – 20 mm	High
3	>11 - <15 mm	Medium
4	≤10 mm	Low

III. RESULTS AND DISCUSSION

Percentage of Yield

The yield is the ratio of the amount of extract obtained from an ingredient to the initial weight of the ingredients, the results of the calculation of % extract of *R.stylosa* and *A.marina* are presented in Table 2.

Tabel 2.The percentage yield of R.stylosa and A.marinaextracts with multilevel solvents.

No	Sample	Powder weight (bs) (g)	Ekstract	Extract weight (be) (g)	%yield
01.	*Avicennia marina*	300	n-hexane	1,916	0,64
			Chloroform	3,125	1,04
			Methanol	25,824	8,61
			Water	1,545	0,52
02.	*Rhizophora stylosa*	300	n-heksan	4,200	1,40
			Clorofrom	1,912	0,64
			Methanol	38,774	12,92
			Water	2,124	0,71

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The calculation result of R.stylosa% at a concentration of 2 mg / disk / 50 µl, the highest was obtained in methanol is 12.92% and A.marina as much is 8.61% in methanol as solvent. The high percentage of rendeman obtained in polar methanol solvents is because methanol as a polar solvent has an alcohol functional group in the form of a hydroxyl group that has a high boiling point and low molecular weight which has high solubility in water, thus causing the solubility of the extract to be high. The higher yield yield shows that more bioactive compounds are contained in an ingredient (Rohmansyah 2011).

Anti-bacterial Activity of *R.stylosa* Extract

The antibacterial activity of R.stylosa fruit extracts based on the average-diameter inhibition zone of various *R.stylosa* extract solvents against the bacteria *V. alginolyticus*, *V.harveyii* and *V. parahaemolyticus* are presented in Table 3

Table 3. Average diameter of inhibition zones of various solvents of R.stylosa extract against bacteria V.alginolyticus, V.harveyii and V.parahaemolyticus

Solvent Extract	Inhibit zone against - (mm)		
	V. alginolyticus	*V. harveyii*	*V. parahaemolyticus*
n-heksana	6.00± 0.20[a]	6.00±0.10[a]	6.00±0.05[a]
Cloroform	6.00± 0.10[a]	7.06±0.28[a]	6.93±0.39[a]
Metanol	7.18± 0.35[a]	11.40±6.71[b]	7.03±0.57[a]
Water	6.00± 0.25[a]	6.00± 0.10[a]	6.00±0.15[a]

Note: The average value followed by different letters means that it is significantly different in the Tukey test of 0.01 level (P <0.05).

Tukey test results (0.01) in Table 3 show that the methanol extract solvent showed the highest inhibitory zone diameter of 11.40 mm, but it was not significantly different from other solvents. The results of the average inhibition zone diameter (Table 4) of the 4 extracts tested showed that the highest inhibition zone diameter was obtained in methanol extract (11.40mm) against V.harveyi bacteria which were categorized as moderate inhibition levels (> 11- < 15mm), followed by methanol extract (7.18mm) against V. alginolyticus bacteria, and methanol extract (7.03mm) against V.pharaemolyticus bacteria which are categorized in the level of weak inhibition (≤10 mm) according to what was stated Zainuddin, (2006). This can be explained that the polar methanol solvent has the highest inhibitory zone capability, because it has an alcohol functional group in the form of a hydroxyl group that has a high boiling point and high water solubility (due to the hydrogen bonding between alcohol and water) so it has the ability explore the active ingredient extract is greater than other solvents.

Antibacterial Activity of *A.marina* Extract

The antibacterial activity of A. marina fruit extracts based on the average-diameter inhibition zones of various A. marina extract solvents against the bacteria *V. alginolyticus*, *V.harveyii* and *V. parahaemolyticus* is presented in Table 4.

Table 4. Average diameter of inhibition zones of various solvents of A.marina extract against bacteria V.alginolyticus, V.harveyii and V. parahaemolyticus.

Solvent Extract	Inhibit zone against- (mm)		
	V. alginolyticus	*V. harveyii*	*V.parahaemolyticus*
n-heksana	6.00±0.20[b]	6.00±0.15[b]	6.88±0.5[b]
Cloroform	11.8±1.87[a]	21.09±3.40[a]	19.08±1.24[a]
Methanol	6.00±0.20[b]	6.81± 0.26[b]	6.00± 0.36[b]
Water	6.00±0.10[b]	6.00 + 0.10[b]	6.00± 0.15[b]

Note: The average value followed by different letters means that it is significantly different in the Tukey test of 0.01 level (P <0.05)

The Tukey test results in Table 4 show that the chloroform extract solvent showed the best diameter of the inhibitory zone, significantly different from the other solvents. The results of the average inhibition zone diameter (Table 4) of the 4 extracts tested showed that the highest inhibition zone diameter was obtained in chloroform extract (21.09 mm) against *V.harveyi* bacteria, which were categorized in very high inhibitory levels (>

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20 mm), then followed by chlorofom extract (19.08 mm) against V. *pharaemolyticus* bacteria, which are categorized in high levels of inhibition (15-20 mm) and chlorofom extract (11.8 mm) against *V. alginolyticus* bacteria categorized in the level of moderate inhibition (> 11- <15mm) as stated by Zainuddin, (2006). Although the average inhibition zone of the above solvent is lower than the positive control solvent (Ciprofloxacin) with a inhibitory zone value of 16.39 mm, because Ciprofloxacin is a pure compound while the extract is still an impure compound because there are many other compounds contained therein, but its use is not recommended because it can make bacteria become resistant (invulnerable) as stated by Roza and Johnny, 1999).

A marina extract is one of the antibiotics that can be used in overcoming vibriosis in fish, shrimp, and crabs that have economic value in aquaculture efforts. This can be seen in Table 4, where the inhibition zone diameter in *A. marina* is extracted with chloroform showing a wider inhibition zone diameter than extraction with n-hexane, methanol and water solvents. Alam (2000) states that mangrove extract can suppress the growth rate of Vibrio harveyi.

Furthermore, the antibacterial activity of various extracts of A. marina and R.stylosa against V. algynoliticus (A), V.harveyii (B) and V. badaemolyticus (C) bacteria can be seen in Figure 3.

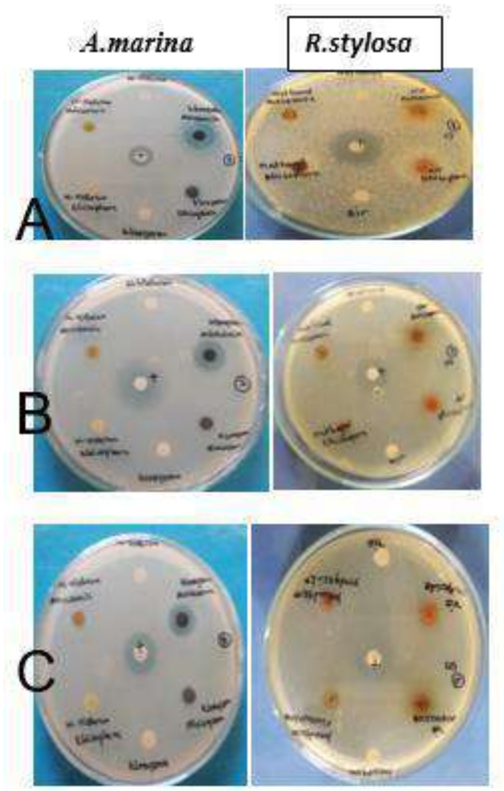

Fig.3. Antibacterial activity of various extracts of A.marina and R.stylosa against V. algynoliticus (A), V.harveyii (B) and V. parahaemolyticus (C) bacteria

IV. CONCLUSION

Polar methanol and chloroform extracts on *Rhizopora stylosa* and *Avicennia marina*are the finest solvent category in inhibition zone tests compared to other treatments (Indicators of high inhibition zone diameter and high% of extraction) so that it can be recommended for *In-vivo* application testing.

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About the use of Longitudinal data Analysis in Forage Legumes Breeding: A Review

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***Abstract*— *Forage breeding is more complex than that practiced in other plant species. In addition to assessing the effect of superior genotypes through animal performance, there is a need to evaluate genetic materials over time, which requires the use of appropriate tools and statistical methods so that all effects of the environment are captured and analyzed due to the perennial character of these species. Another significant factor with regard to forage legumes is the analysis in pure or mixed stands, which may facilitate the conduction of trials in the first case and improve the adaptive ability evaluation of species with associated plant and the environment effects in the second case. In this context, the interaction of the genotype with the environment, which differs for the temperate and tropical legume species, is discussed from the point of view of the longitudinal data analysis by application of the mixed model methodology, also considering the employment of mixed pastures in the tropical region of the globe.*

Keywords*— *Genotype x environment interaction, measures over time, mixed pasture, perennial species, tropical and temperate legumes.

I. INTRODUCTION

The Fabaceae family, or commonly known as legume, comprises from 650 to 750 plant genera, with 18,000 to 19,000 species among grain, pasture, and agroforestry species, and it is second in importance to human activities, behind only grasses species (Graham and Vance, 2003). In addition to being source of protein, lipids and carbohydrates in food and feed, legumes perform a crucial role in different ecosystems by biological nitrogen fixation, ensuring the maintenance of biological activity and the cycling of nutrients, thus improving soil and pasture quality (Miranda *et al*., 2010; Boelt *et al*., 2015).

Perennial legumes are considered an essential component for the maintenance of sustainable agroforestry and production systems (Annicchiarico *et al*., 2015). By the other hand, especially in Brazil, the lack of diversity due to the massive presence of few forage varieties, mainly apomictic grasses, makes the pastures dangerously susceptible to pests and diseases, which has the potential to devastate massive areas (Araújo *et al*., 2008). In this sense, less than 1% of total pastures area in Brazil is composed of forage legumes, which fails to generate significant benefits such as the contribution of nitrogen in soil and source of high quality protein in animal nutrition (Simeão *et al*., 2015). Another significant benefit is the regeneration of degraded pastures; prevent the increase of agricultural frontier, mainly in the Amazon region (Assis *et al*., 2008). Otherwise, in temperate regions, legumes are widely used and studied, mainly for their economic and environmental benefits (Valle *et al*., 2009; Annicchiarico *et al*., 2015).

In the current context, where there is a human population rising, a greater demand for animal and non-animal products and a reduction of pasture and cropping areas, the genetic improvement of forages is the most sustainable option for increasing production due to its technical and economic implications (Araújo *et al*., 2008; Simeão *et al*., 2015). However, in contrast to conventional breeding programs, agronomic performance is only one among the several factors analyzed in forage breeding where the focus stays on animal performance. Thus, knowledge of the complex environment x plant interaction becomes essential for success in the selection of interest genetic materials.

II. TROPICAL FORAGE SPECIES BREEDING

The genetic improvement of forages in Brazil is a recent activity, intensified only in the last decades, but with the development of highly adapted and productive cultivars (Jank *et al*., 2011). In general, forage species breeding programs aim to increase yields of dry matter and seeds, resistance to biotic and abiotic stresses, persistence and nutritional quality (Hayes *et al*., 2013; Resende *et al*., 2008).

The structure of these breeding programs is basically composed of three phases, which can vary from six to eleven years (Assis, 2009). In the initial phase, the goal is to obtain new genotypes; second phase focuses in selection; and the final phase aims the recommendation for release of superior genetic materials. All over the program, the number of genotypes under evaluation decreases, starting from a considerable quantity of highly divergent genetic materials to a reduced number of higher yields for the characteristics of interest (Jank *et al*., 2014).

In general, the improvement of the initial genetic materials, mainly of grasses, is practiced by the recurrent selection methods based on the phenotype (Resende *et al*., 2014). Experimental evaluations and selection practices tend to vary according to the type of progeny and estimation methods, which should consider, among other things, the species and its reproductive system, available germplasm, growing environment and type of cultivar to be released (Annicchiarico *et al*., 2015; Hayes *et al*., 2013).

In the 1980s and 1990s, the introduction of forage cultivars in Brazil occurred through the agronomic evaluation and selection of superior clonal accesses validated in grazing trials (Simeão *et al*., 2015). The breeding methods for tropical legumes were those used in annual autogamous and alogamus species, although most tropical legumes were perennial with mixed breeding systems. In fact, this demonstrated some effectiveness, but failed to explore strategies and characteristics important to perennial species, such as persistence (Resende *et al*., 2008). In addition, significant failures were related to agronomic characteristics, such as lack of disease resistance and low seed production; and in the market chain, as a lack of seed harvest systems and distribution of these seeds, resulted in a low rate of adoption of forage legumes by Brazilians producers (Resende *et al*., 2008; Shelton *et al*., 2005).

On the other hand, there are cases of success, mainly in the western region of the Brazilian Amazon, that use mixed pasture with forage peanut (*Arachis pintoi*) and tropical kudzu (*Pueraria phaseoloides*), and in the central region of the country, employng the common stylo cultivar Campo Grande (*Stylosanthes capitata* and *S. macrocephala*) (Shelton *et al*., 2015). In Brazil's South region, because of the edaphoclimatic characteristics, there is a small but growing use of temperate forages such as alfalfa and clover (red and white) in the animal production system (Montardo *et al*., 2003; Peres Netto *et al*., 2011; Schneider *et al*., 2011).

2.1 Use and importance of forage legumes

Forage legumes are suitable for multiple purposes, such as increasing the sustainability of production systems which is the most required due to their relative tolerance to abiotic stresses, persistence, vigor and longevity in several systems, and the easy establishment (Annicchiarico *et al*., 2015; Shelton *et al*., 2005). They also provide high-quality feed for animals, nectar, seeds, green manure and soil cover, making them an critical component of the production of wool, milk and meat under pasture in the world and bringing increases up to 50% of animal productivity (Barcellos *et al*., 2008; Boelt *et al*., 2015).

Although many perennial leguminous species offer potential for use as forage, few are in fact employed (Valle *et al*., 2009). However, only in the last few years, with the increasing concern about environment and sustainability of production systems, forage legumes have been prominent in animal production, mainly in temperate regions of the globe (Andrade *et al*., 2015; Batello *et al*., 2008). Alfalfa (*Medicago sativa* and *M. falcata*) is considered the most widely used legume species, distributed in about 30 million ha in the Northern Hemisphere and South America and expanding its area in recent years to Australia and China (Annicchiarico *et al*., 2015). White clover (*Trifolium repens*) is preferred in some regions of temperate climate and more intensive grazing, mainly in Western Europe, United States and South America, while red clover (*T. pratense*) is the predominant species used in Northern Europe. Besides, white clover is widely managed in mixed pastures in several countries, while alfalfa and red clover are managed under mowing regime and rotation grazing (Annicchiarico *et al*., 2015; Batello *et al*., 2008).

In Brazil, tropical forage legumes are predominantly used in consortium with grasses of African origin (*Panicum*, *Brachiaria* and *Pennisetum*) (Valle *et al*., 2009). Initially, most of the cultivars managed were developed and commercialized by Australia and, due to their wide distribution through natural pastures and cultivated areas, mostly from South America, they were poorly studied, resulting in a large amount of unexplored genetic material (Araújo *et al*., 2008; Valle *et al*., 2009).

The forage peanut (*Arachis pintoi* and *A. repens*) and the common stylo (*Stylosanthes guianensis*, *S. scabra*, *S. hamata*, *S. humilis*, *S. capitata*, *S. macrocephala*) are the herbaceous species mostly used in Brazil, and less frequently used species of the genus *Desmodium*, *Centrosema*, *Neonotonia* and *Pueraria*, this is more pronounced in the Western Amazon; besides shrubs species like *Cajanus*, *Leucaena* and *Cratylia* (Barcellos *et al*., 2008; Valle *et al*., 2009). Although the main legume forage species are native to Brazil, there is a reduced rate of adoption by the producers, resulting in insignificant area of cultivation in relation to grasses, mainly of the genus *Brachiaria*. On the other hand, the economic importance of these legume species has demonstrated considerable economic value in the animal production of Asian and African countries (Valle *et al*., 2009). In Brazil, the mixed pasture of grasses and common stylo cultivar Campo Grande, a seeds physical mixture of 80% of *S. capitata* and 20% of *S. macrocephala*, extends for about 1.7 million ha; thus far 140,000 ha of pasture are mixed with forage peanuts and 148,000 ha with tropical kuzdu, only in the State of Acre, which comprises the largest area of these mixed pastures in the country (Embrapa, 2013; Valle *et al*., 2009; Shelton *et al*., 2005).

2.2 Forage Legume breeding

The employment of temperate species of forage legume is much more prior than the use of tropical legumes. Originating in the Mediterranean region, some of these species went through domestication even before the Christian era, with records of its use in Europe from the time of Roman domination to the renaissance and with large-scale systematic selection for over a century ago (Annicchiarico *et al*., 2015; Batello *et al*., 2008). On the other hand, the interest in tropical forage legumes raised in the 1930s in Australia, where increases were observed in the rates of animal production in native pastures due to introduction of common stylo species, which was studied and later transformed into technology and exported to the other tropical regions (Rao *et al*., 2015). From the 1960s, there was more active interest in the introduction of legumes adapted to animal production systems in tropical regions, which led to the creation of collections of germplasm collected mainly in Latin America and the Caribbean (Resende *et al*., 2008).

Temperate forage legumes are predominantly alogamus and suffer severe inbreeding depression (Annicchiarico *et al*., 2015). The majority of the tropical ones have mixed system of reproduction, tending to autogamy (Jank *et al*., 2011; Simeão *et al*., 2015). These conditions imply in different population structures and, consequently, in variation between and within families and populations, these conditions also changing the selection strategies, that must be chosen according to the predominant mechanism of reproduction of each species (Annicchiarico, 2002; Garcia *et al*., 2013; Hayes *et al*., 2013; Pereira *et al*., 2003).

Initially, selection for most temperate and tropical legumes was carried out by massal selection, from a broad genetic base, focused primarily on disease resistance and grazing tolerance, and less emphasis on progeny tests and diallel crosses (Annicchiarico *et al*., 2015; Resende *et al*., 2008). Massal selection has the advantage of facilitating the development of cultivars resistant to multiple pests and diseases and also minimizes inbreeding depression that may occur during recurrent selection cycles, but limits the concentration of favorable alleles during the exclusion of undesirable alleles and restricts quantitative inheritance gains (Annicchiarico *et al*., 2015; Simeão *et al*., 2015).

Currently, natural variability has already been widely explored for temperate species, while breeding by selection of ecotypes that occur directly in nature is still used for tropical species, since the genetic variability of the germplasm collections is little studied (Araújo *et al*., 2008; Simeão *et al*., 2017). This unequal development is also observed in the application of molecular techniques, routinely used in temperate species and recently applied in tropical ones, with lacking of fundamental studies such as establishment of DNA extraction protocols and choice of molecular markers (Araújo *et al*., 2008; Valle *et al*., 2009).

2.2.1 Criteria and methods of selection

A selection cycle in temperate and tropical forage breeding typically requires 3 to 5 years, with evaluation of individuals or families over several harvests (or crops) to measure the selection criteria (Simeão *et al*., 2015). These criteria are usually based on yield (dry matter and seeds) and resistance to pests and diseases; persistence capacity (survival, precocity, establishment and competition); and quality (nutrient contents, digestibility and palatability), which are directly related to each other and to the objectives of breeding (Resende *et al*., 2008). During this period, there may be a need to modify the breeding method, part of the strategies to better exploit the intrinsic characteristics of the forage species, such as vegetative propagation, perennial cycle, gene exchange with other species, in order to increase the efficiency of the program (Annicchiarico, 2002; Pereira *et al*., 2003).

For temperate legumes, Annicchiarico *et al*. (2015) claim that greater gains are obtained through the employment of breeding schemes that use hybrid selection or pure lines, aimed at the development of synthetic varieties, with commercial seed production by several generations of open-pollinated progenies after the parental selection. Parents can be obtained by evaluation of clones or progenies of full-siblings or half-siblings, constitute a step of considerable importance to determine the genetic potential, genetic basis, and the degree of endogamy reached by the following generations (Annicchiarico *et al*., 2015; Pereira *et al*., 2001).

The constitution of synthetic varieties, an inter-population selection method, provides more possibilities of genetic base amplification and favorable alleles maintenance and it is originated from the crossing of lineages or clones of successive generations planted in bulk, that is, with the seeds harvested together and sampled for planting (Pereira *et al*., 2001). For high-heritability characters in alfalfa, Pereira *et al*. (2001) point resistance gains by intrapopulational methods, in individuals (such as maternal selection, clonal lines and progeny tests) and within populations.

Most of the characteristics of interest in temperate legumes, as well as in tropical ones, retains quantitative heritage. In this case, the additive genetic variation assumes significant role in the gains by recurrent phenotypic selection, although the non-additive genetic variation (or dominance genetic variation, ignoring the epistasis) is considerable for dry matter yield in alfalfa (Annicchiarico *et al*., 2015; Hayes *et al*., 2013). In this aspect, the presence of non-additive variance in high magnitude, as observed for dry matter production characteristics in *S. capitata* open-pollinated progenies, can be translated into high heterosis, and should be very carefully investigated to increase the gains (Resende *et al*., 2008). In addition, adaptation ability is a critical factor for many productive characteristics of temperate legumes and an approach to improve the performance of already used fodder is by hybridizing elite populations with locally adapted and resistant ecotypes (Annicchiarico *et al*., 2011; Oliveira *et al*., 2013).

Among the selection criteria for temperate legumes, the target characters are those related to production, dry matter and seeds; resistance, mainly to drought and soil acidity; and compatibility with grasses (Annicchiarico *et al*., 2015). In this aspect, correlations with morphophysiological characteristics can be explored in the identification and indirect selection of superior genetic material, such as leaf senescence related to drought tolerance or flowering for alfalfa seed production and aerial morphological characteristics related to competitive ability in white clover, without the need for higher cost techniques, such as molecular markers (Annicchiarico, 2003; Annicchiarico *et al*., 2011; 2015).

Currently, for the main tropical species, the obtaining of divergent genetic materials and the selection of superior individuals practice the techniques of hybridization and generations advance for forage peanuts, and the recurrent selection among and within families for stylo (Assis; Valentim, 2009a; Andrade *et al*., 2015). In Brazil, promising hybrid lines are also being evaluated (Assis *et al*., 2018) and in Australia, recurrent selection was used with genetic markers to identify recombinant natural crossbreeding plants in stylo, but the genealogical method was widely used in several countries for forage and seed yield in species of the genus (Pereira *et al*., 2001). This method is equally interesting for forage peanut that originated from a base population representative of genetic variability, obtained by inter or intraspecific hybridization, as a result of natural or artificial recombination (Assis; Valentim, 2009b).

Resistance to anthracnose is one of the selection criteria demands for stylo cultivars, and for forage peanut is sought also seed production, rapid establishment and production of dry matter and tolerance to drought (Andrade *et al*., 2015; Assis; Valentim, 2009a; Resende *et al*., 2008).

2.2.2 Selection in pure or mixed stands

The benefits of grass and legume pasture mixed have been widely sought in world livestock production (Annicchiarico *et al*., 2015; Barcellos *et al*., 2008). The white clover and perennial ryegrass (*Lolium perenne*) mixed pasture, because of its characteristics suitable to form productive and resilient systems, is an example of success in many temperate regions, becoming the most important mixed pasture in the world (Andrade, 2013). However, the mixed pasture technology did not achieve the same success in the tropics showed few adoption cases, mainly in Brazil (Shelton *et al*., 2005; Simeão *et al*, 2015).

Among the causes for this lack of interest in mixed pasture cultivation remain the failures of forage breeding programs, which in the traditional selection process do not consider the key characteristics for good performance of the botanical families involved, such as plant architecture and persistence (Andrade, 2013; Simeão *et al*., 2015). In addition, the lack of seed production for mixed pasture implementation increases the costs of adoption because making the propagation process predominantly by seedlings, even when the legume has the desirable characteristics, as in the case of forage peanuts (Andrade *et al*., 2015; Resende *et al*., 2008).

According to Andrade (2013), there have never been programs to improve tropical grasses aiming to obtaining germplasm compatible with legumes. Thus, the selection of the superior legume genetic materials is carried out on pure stands and, later, its ability to association with commercial grasses is tested, often producing unsatisfactory results. In this sense, the efficiency of selection in pure stands can be questioned, since the species will be utilized together and the effect of a possible interaction between cultivars, as well as their behavior against grazing stress, are neglected (Andrade, 2013; Andrade *et al*., 2015). In addition, many aspects of the competitive ability of the legume, whether broad or relative response to the type of associated grass, have not yet been fully elucidated for tropical legumes, as observed for white clover varieties, for example, with a consistent response to competition ability with several grasses (Andrade *et al*., 2015; Annicchiarico, 2003).

The complexity of forage breeding to use in mixed pastures is greater than the breeding for use in pure stands, which generally does not provide information about the behavior of forage in a mixed pasture (Andrade, 2013). Moreover, the competitive ability of the species in pure and mixed stands can be variable, since the yield in mixed pastures is attributed to the adaptive capacity and the intrinsic characteristics of each species, such as physiological needs of legumes plants belonging to C3 photosynthetic group and grasses, belonging to C4 group, which would be evaluated more efficiently together. (Annicchiarico, 2003; Assis *et al*., 2008; Volaire *et al*., 2013). On the other hand, satisfactorily established correlations among interest characters associated, such as length and density of stolons and lengthening of the petiole associated with the ability to competition in white clover, can be used as initial selection criteria in monoculture (Annicchiarico, 2003). In addition, the evaluation performed in pure stands can be less expensive than in mixed stand, since it does not require the botanical components separation (Andrade *et al*., 2015).

In this sense, the initial selection can be directed to the search of characters aimed at increasing the persistence and compatibility between species, which today are more known and discussed characteristics, however that needs the analysis of a particular set of species or cultivars, according to their intrinsic characteristics (Andrade, 2013; Andrade *et al*., 2015).

According to Andrade (2013), the persistence of legumes in pasture depends on two mechanisms: those that guarantee the perennial or maintenance of the population, as plant longevity and production of seeds or stolons and rhizomes; and those that regulate their adaptation to grazing, such as growth points or greater regrowth capacity. Compatibility is defined by several factors, such as palatability; mechanisms for population maintenance; tolerance to defoliation and trampling; morphological plasticity; response to nutritional limitations; tolerance to drought or water excess; competition for light and space; root system pattern; and the habit of growth. This last one, according to the author, is the most important and decisive factor, in which prostrate leguminous species have advantages over upright or volatile ones due to the initial defoliation of grasses and consequent increase of light entrance, besides of keeping restricted the animal access to its regrowth points, a more photosynthetically active part of the plant, allowing its rapid recomposition.

III. LONGITUDINAL DATA ANALYSIS METHODS

According to Resende *et al*. (2008), because of perennial or semi-perennial characteristics, the forage species present several aspects that differentiate their genetic improvement from the genetic improvement practiced in the annual species, such as generation overlap, sexual reproduction with variation in self-fertilization rates, asexual reproduction and expression of characteristics over several years, but with annual behavior regarding the reproductive cycle. These factors lead to the utilization of selected individuals for several years, which demands greater accuracy and precision in selection methods, use of repeated evaluations over the years, importance of individual over the average of groups for selection purpose, and reduction of survival rate, which causes unbalance of experiments (Resende, 2002). In addition, the estimation methods in perennial plants breeding should consider a coefficient of genetic determination, as well as possible heterogeneity and non-independence of residual variances among the cultivars or genotypes, because of their perennial character, as a result of repeated measures carried out throughout the evaluations (Resende and Duarte, 2007).

Repeated measures are evaluations performed with interest factor several times, and when these measures are generated over time, they are called longitudinal data. In these cases, the researcher's interest lies in the whole data set and not only in evaluations individually, since they do not contemplate the effects of the treatments over time and their interactions among measurements, besides the effects within the evaluated plot itself. (De Faveri *et al*., 2015; Freitas *et al*., 2008; Littel *et al*., 2000; Resende *et al*., 2008). These measures, because they originate from the same sample, are not independent, showing possible autocorrelation patterns, that is, serial correlations; and taken non-randomly at intervals of time, which promotes the need for specific analysis methods (Onofri *et al*., 2010; Piepho and Eckl, 2014).

In the context of genetic improvement, data analyzes were initially based on the analysis of variance (ANOVA), a method developed by Fisher at beginning of the 20th century, which divides the total variation of data into sources due to genotype, environments (in cases where

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there is more than one evaluation site), harvests, also called crops or cuts, and all interactions between these sources, as well, the errors within the test (Smith *et al*., 2005). Because of the computational facility, the momentum methods, where the average squares of each component or source of variation are equated to their respective mathematical expectations to estimate the components of variance, are still widely used (Coelho and Barbin, 2006; Freitas *et al*., 2008). However, this approach leads to assumptions that should not be ignored, under threat of biased estimates of effects: normality, homogeneity of variances, and independence of sample errors, which are generally not observed in field trials, especially for perennial species (Onofri *et al*., 2010; Resende, 2002). In the absence of compliance with these requirements, artifacts such as adjustments in degrees of freedom and data transformation can be employed, but are not always effective solutions (Freitas *et al*., 2008; 2011).

Onofri *et al*. (2010) state that, even if used properly and solving most of statistical problems in a simple way in agriculture, the application of ANOVA, although not technically incorrect, may be inefficient in cases of unbalanced trials in various environments or longitudinal data. For the longitudinal data case, a possibility of analysis would be by the average of subsamples or individually for each measurement, but feasible only in balanced cases and lead to loss of variation information; or analysis of the entire data set with distinction of two error levels for the experimental units allocated to the plots, which generally correspond to the genotypes, and to the observation units allocated to the subplots, generally for measures over time (Freitas *et al*., 2011; Onofri *et al*., 2010). In the case of measures over time, the use of the scheme in split-plot must necessarily satisfy the condition of sphericity, that is, the variances of the difference between pairs of errors are all equal (Freitas *et al*., 2008; Huynh and Feldt, 1970).

On the other hand, an efficient solution to analyze these data is the methodology based on mixed models, which considers fixed components in the model, except the general average, and random components, except the error, and uses procedures considered optimal to estimate the genetic parameters and predict the genotypic values, with adjustment of the variance and covariance structure of errors (Littell *et al*., 2000; 2006; Piepho Möhring, 2006; Resende, 2002).

Although the definition of fixed and random components of the model is controversial and Resende and Duarte (2007) affirm that the relevance of the method lies in the choice of the most accurate estimators and predictors, since the number of observations influences the definitions of fixed and random components, in a simplified way in genetic improvement, the fixed components contemplate the measures over time and environmental effects, with the measurements allocated in what would be the subplots of the ANOVA. The random components are the genotype effects and their interactions, allocated in the equivalent of the plots, and go through adjustments of functions, obtaining regression parameters, as well residue and component of variance for each parameter (Onofri *et al*., 2010). In this way, the method offers two advantages: the experimental design is reflected by the analysis, with all levels of errors; and the adjustment of several structures of variances and covariance for the serial patterns, generally with decreasing correlations due to the increase of distances among them, improving the estimations (Littell *et al*., 2000; Piepho *et al*., 2008).

In the data analysis by mixed models, in spite of e several methods available for estimation of the components of variance, the most used approach is the frequentist based on the likelihood methods, mainly by the Restricted Maximum Likelihood (REML), which is based on maximization of the likelihood function independent of fixed effects and considering its degrees of freedom (Patterson; Thompson, 1971; Resende, 2002). The prediction of value method is based on the Best Linear Unbiased Prediction (BLUP) (Henderson, 1973) and includes: best prediction (BP), available when all parameters of joint data distribution and genetic values (unobservable) are known; best linear prediction (BLP), when the first and second moments (mean and variance) of data are assumed to be know; and better linear unbiased prediction (BLUP), where only the second moments are assumed to be know (Resende, 2002). At this point lies the importance of using reliable estimators, since such components are not in fact known and should be appropriately estimated (Resende and Duarte, 2007).

According to Resende *et al*. (2008), the evaluation of genetic materials has the objectives of inferring about their genotypic values and ordering the materials based on these values. Genotypic values are the true values sought for the genotypes, that is, the actual values of cultivation and use, without the influence of the effects of blocks, plots and environmental effects that, even when evaluated in the same place, are intrinsic to the experiment and integrate the variable phenotypic value of genetic material. (Resende and Duarte, 2007). Thus, the actual interest in the genotype evaluation trials is to estimate their genetic values, as a result of the mixed model approach, and not only the phenotypic values provided by ANOVA.

Under the mixed model approach (REML/BLUP), perennial species with repeated measurements can be evaluated considering these measures as distinct characters, in other words, individual or average of all evaluations; or as a single character, with each approach offering diverse levels of genotype information. Considering as distinct characters, it is possible to evaluate the change in character over time (age), the utilization system of the crop and the weighting of genetic values predicted by harvest, such as the evaluation in different seasons of the year, for example, drought and water; in addition the search for initial selection based only on the first harvest and the verification of homogeneity of genetic and environmental variances in the different harvests, with their respective heritabilities (Resende *et al*., 2008). Likewise, it is possible to determine confidence intervals of predicted genotypic values, which allow inference on multiple comparisons among genotypes; as well, the use of harvest average, but only for balanced cases and with less informative result, without repeatability and interaction genotype x harvest (Resende, 2002).

In the case of a single character, the model of repeatability can be adopted, which contemplates the genotype, block, harvest and their interactions effects, considering equally the permanent effect of plots (genotype x block interaction), essential to eliminate the residual correlation effects among repeated measures, since there is no randomization of plots among harvests (Resende *et al*., 2008). Even with imbalance, this model provides the simultaneous estimation of heritability and individual repeatability, average heritability of genotypes, which provides the accuracy of selection, and genetic correlations through harvests and permanent environment (Resende, 2002). All these parameters are extremely informative and essential to define the most effective strategies for selection and cannot be obtained by ANOVA, another fact that restricts the use of ANOVA for genetic improvement of forage species (Piepho and Möhring, 2006; Resende *et al*., 2008).

Other methods of longitudinal data analysis are still being used in to improve perennial plants, like random regression, which include several approaches such as covariables, spatial and multivariate analysis (Resende *et al*., 2006a; Wang *et al*., 2009; Zamudio *et al*., 2008).

3.1 Selection criteria dependent on longitudinal data

The identification and selection of the superior genetic material and the increase of the gains rates are directly dependent of the statistical methods used for modeling the genetic effect and for predicting the true potential of each genotype, and these methods, in turn, are linked to the objectives of the trial and the plant characters involved (De Faveri *et al*., 2015).

Productivity and resistance are some of the most important selection criteria in perennials species. However, the permanent character of these species brings the need for analysis over time, since environmental influence has great magnitude in the characters of production and brings the aspect of seasonality to pests and diseases incidence, e directly related to the plant resistance capacity (Cilas *et al*., 2011; Pereira *et al*., 2001; Rubiales *et al*., 2015). Measures obtained repeatedly over time allow the determination of the characters repeatability, a significant parameter to predict genotypic and phenotypic values, making an inference about the phenotypic correlation among the repeated measures in the same individual (Resende, 2002). In addition, the joint analysis of these various measures allows selecting materials by genetic values based on their stability and adaptability along the harvests (Resende, 2007).

According to Pereira *et al*. (2001), the ability to adjust to environment and the constant behavior in diverse conditions are characteristics of adaptation and stability of genetic material and are related to its genetic constitution. These characteristics are critical because they are linked to the response to environmental improvement conditions and to the predictability of genotypes, which determine the commercial success of a cultivar (Cilas *et al*., 2011; Resende *et al*., 2008).

In perennial forage species, persistence is another important selection criteria evaluated through precocity and survival capacity, establishment and competition, and, jointly with productivity, is linked to the information of production superiority measured in several harvests (Resende *et al*., 2008). Resende *et al*. (2008) comment that these characters are directly related to each other, since persistence is linked to survival capacity, which depends on longevity, competition capacity and natural resemblance, and this resemblance, in turn, is one of the factors of considerable importance in strategies for management of mixed pastures. In addition, survival capacity, a character often ignored in breeding programs, assumes crucial importance, as reported by Resende *et al*. (2006b) for stylo, influencing the low rate of adoption of the legume in Brazil (Simeão *et al*., 2015).

3.2 Longitudinal data on forage breeding

The employment of longitudinal data on forage breeding is widely diffused for both temperate and tropical species. This is an important way to obtain information from experimental trials that try to detect trends of genotypes over time, since simpler methods, even in well-designed and conducted trials, can compromise the detection and analysis of relevant effects (Annicchiarico, 2002; De Faveri *et al*., 2015; Locascio and Atri, 2011).

The use and analysis of longitudinal data allowed considerable advances in the improvement of temperate forages, allowing the exploration of the adaptive and morphological characteristics of many species, for example obtaining alfalfa genotypes tolerant to salinity and drought and resistant to intensive grazing for the Mediterranean region, as well genotypes with variability for potential use in tropical regions, such as in Southeast Brazil (Annicchiarico *et al*., 2011; Assis *et al*, 2010). White clover genotypes where also observed showing adaptive characteristics for warmer conditions of Brazilian Southern region and distinction and classification of genotypes for several applications in Europe, such as landscaping, besides the traditional grazing and hay (Oliveira *et al*., 2013; Schneider *et al*., 2011).

The competitive capacity of white clover for mixture with grasses was also evaluated, suggesting being a consistent character in the species (Annicchiarico and Proietti, 2010). In addition, the importance of evaluation in mixed stands, as well as the use of selection indexes that incorporate productive and morphological characteristics, has been proven (Annicchiarico, 2003).

The application of longitudinal data has contributed to the methodology and strategies for conducting programs of forages genetic improvement. An example is the understanding that genotype selection in spaced plots for further performance trials in densified plots is less efficient, especially for characters subject to genotype x harvest interaction, such as yield of dry matter and seeds, compared with the selection made directly in the denser plots, which better reproduce the field environment for white clover (Annicchiarico and Piano, 2000). In addition, the incorporation and analysis of the serial and spatial correlation effects among harvests and among trials, as well as the distinction of the evaluation year effect, associated with the external environmental variation and the harvest effect, which represents the formation processes of culture internal income, bring more accurate estimative of parameters (De Faveri *et al*., 2015; Piepho and Eckl, 2014).

For tropical forages, the longitudinal data analysis has allowed the estimation of genetic parameters and prediction of genotypic values of several genotypes of grasses, which enables the identification of superior genetic materials for crossing and selection, identification of genotypes adapted to regional conditions and determination of selection indexes for classification of genetic materials with better forage production throughout the year (Figueiredo *et al*., 2012; Resende *et al*., 2004; Silva *et al*., 2010; Simeão *et al*., 2016). In addition, this analysis allowed to establish the ideal number of measures with high reliability for the characterization of dry matter production in Brachiaria and Panicum species, thus optimizing the evaluation time (Basso *et al*., 2009; Lédo *et al*., 2008; Martuscello *et al*., 2015; Souza Sobrinho *et al*., 2010).

In legumes species, it was possible to detect genetic variability in *S. capitata* genotypes related to anthracnose resistance, a disease that has limited its commercial use, and higher persistence capacity of stylo genotypes in the pasture (Assis *et al*., 2018; Falco *et al*., 2016). In addition, there was the identification of forage peanut ecotypes for use in mixed pastures in Brazilian Cerrado and genotypes with shorter establishment time and lower harvest frequencies (Assis *et al*., 2008; Ferreira *et al*., 2013; Simeão *et al*., 2017; Valentim *et al*., 2003). In evaluations of mixed pastures, forage peanut systems showed similar results to systems with white and red clover related to forage production, nutritive value and control of spontaneous species, demonstrating also potential for higher animal load on pasture in summer season in region South of Brazil (Diehl *et al*., 2013; Olivo *et al*., 2010; 2012).

3.3 Genotype x harvest interaction

In forage breeding, agronomic researches are essential to obtain information about the genotypes behavior and responses to environment, use and management factors. Harvest trials are important for determining yield, regrowth capacity and management systems, as well as adaptability, stability and seasonality of production (Townsend, 2001).

Seasonality in production of tropical forages is common, especially in regions with markedly dry seasons, which limits the production of dry matter (Lédo *et al*., 2008; Souza Sobrinho *et al*., 2011). For temperate forages, in addition to summer drought, the major limiting factor is the low temperature in winter (Porqueddu *et al*., 2005). In these cases, the genotype x harvest interaction tends to be significant and can be a complicating factor in genetic material selection, since the best individuals in one harvest may not demonstrate the same performance in another harvest, which reinforces the importance of repeatability study and the determination of minimum number of measures necessary to predict the real value of genotypes for perennial species (Resende, 2002). The selection without interaction information can be practiced based on the average genotype behavior along the harvests, with inference by the average genotypic values (Resende *et al*., 2008). However, environmental interactions may require definitions of strategies that evolve selection for adaptation and stability goals, which requires the determination of suitable genetic resources, type of variety to be released, breeding form, and specific selection processes (Annicchiarico, 2002).

Adequate treatment of data, with identification of harvest and environmental interactions effects, can help to understand the magnitude and occurrence of environmental interference, as well as to define the appropriate strategy to deal with it, since it mainly affects correlations and heterogeneity of variances and covariances among the measures, besides the loss of plots, consequences of the harvests performed in the same experimental unit over time (Annicchiarico, 2002; Piepho and Eckl, 2014).

According to Resende (2007), amid the several alternatives that predict the effects and modeling the correlation structures among the repeated measures in the context of mixed models, besides dealing with the imbalance of data, are: simplified univariate model of repeatability with and without genotype x harvest interaction; complete multivariate model of unstructured covariance matrix (UN); autoregressive model with heterogeneous variances (ARH); structured anti-dependency model (SAD); banded correlation model (Toepitz structure) with correlations for each interval among harvest; compound symmetry structure (CS); compound symmetry structure with heterogeneous variances (CSH).

Univariate models are unrealistic, considering situations that do not in fact occur in field experiments, that is, harvests with genetic correlation equal to 1 over time, phenotypic correlations, or repeatability, with the same magnitude and homogeneous residual genetic variances (Piepho and Eckl, 2014; Resende, 2007). The multivariate model, although complete and optimal, is computationally costly because it considers each harvest as a distinct variable, requiring large amount of computational time and has difficult adjustment when above three harvests analyses are considered (Resende *et al*., 2008). The CS model is the most used, however, require corrections for high heterogeneities, since homogeneity of variances and covariance among harvests are assumed; the ARH, CSH and SAD models considering also the heterogeneity and the banded model, being more parameterized, should be applied when the correlations of distant measurements are not related to the adjacent measures (Resende, 2007). Thus, Resende *et al*. (2008) recommend for analysis of repeated measures in perennial forages, in case of high heterogeneity of variance among harvests, the use of ARH, SAD and Toeplitz matrices; however, because the measured variable is the same among harvests, the variances tend to be homogeneous, with the CS matrix being more advantageous, being able to be used in heterogeneous data after the data transformation.

IV. FINAL CONSIDERATIONS

The use of mixed models in plant breeding has been increasing and demonstrates advantages over ANOVA (Assis *et al*., 2008; Piepho *et al*., 2008; Resende, 2002; Resende *et al*., 2008). One of them, in addition to obtaining more informative results, is the possibility of modeling the variance and covariance structures to overcome the problem of serial correlation and heterogeneity of variances observed in longitudinal data (De Faveri *et al*., 2015; Piepho and Eckl, 2014). A broad range of available literature explores the forms of model selection and application of this methodology, which, because of the computational facilities available today, make its application viable (Littell *et al*., 2000; 2006; Liu *et al*., 2007; Moser, 2004; Resende and Thompson, 2004). The use of pre-established matrices and data transformations may not be the best option, since each set of data, even containing known patterns, can show singular behaviors and tendencies that must be properly analyzed and modeled, especially the environmental interaction effects (Annicchiarico, 2002; De Faveri *et al*., 2015). In these cases, ignoring or avoiding heterogeneity tends to erroneous or inefficient inferences (Littell *et al*., 2000).

Another significant aspect is how to detect the variation between measures. Resende (2007) point out the tests of Bartlett, Hartley and Levene, but the first one is very sensitive to the lack of normality of errors and the second one does not present entries for values above twelve treatments, so the Levene’s test is replacing the others. According to Huynh and Feldt (1970), the equality of variances for different pairs of treatments is sufficient condition to assume the correlation, or sphericity, among measures, so the Mauchly’s test is a multivariate procedure efficiently applied in random variables with normal distribution.

In this aspect, the adequate analysis of data allows the realization of reliable inferences, enabling the advancement in researches and, consequently, efficient results in development and release of cultivars. Annicchiarico *et al*. (2015) point out the importance of applying the analysis procedures and selection strategies for the genetic variability exploitation of genetic materials that can offer many opportunities for forage breeding. In addition, the use of new strategies and technologies, such as the evaluation in densified and in mixed plots and the use of genomic tools, can improve the selection gain in temperate forages, which has shown limited progress in dry matter and seed yields (Annicchiarico *et al*., 2015; Annicchiarico; Piano, 2010; Grinberg *et al*., 2016).

Regarding tropical forages, which present genetic improvement considered recent, the use of reliable and adequate statistical tools can help explore the genetic materials variability through the analysis of data and promote the selection of genetic material in a more consistent way, especially considering restricted situations of evaluations and genotype x harvest interaction in the search for more adapted genotypes (Resende *et al*., 2006; Simeão *et al*., 2016; 2017).

The decrease of the area available for animal production, as well as the demand for more efficient and sustainable productive systems, will be decisive in the adoption of mixed forage systems technologies, mainly due to the benefits that mixed pastures confer to the producer, as a reduction in the consumption of inputs and increased productivity (Barcellos *et al*., 2008; Simeão *et al*., 2015; Porqueddu *et al*., 2005).In this context, the low adoption of legumes in tropical pastures tends to be gradually overcome by the release of new, more adapted and productive cultivars, coming from methodologies and strategies increasingly modern and efficiently applied and that seeks new ways of detecting and analyzing genetic variability (Annicchiarico and Piano, 2010; Simeão *et al*., 2015).

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Breeding and testing single-cross maize hybrid QT55 in provinces in the North, South Central and Central Highlands of Vietnam

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***Abstract*— *In many places around the world, population growth and climate change have been posing huge challenges to agriculture. There are increasing demands for food products in both quantity and quality. As a result, it is essential to develop new hybrid maize varieties with high yield, quality and resistance. In this study, single-cross maize hybrid QT55 was created from a combination of two maize hybrids (D4 x D54). This hybrid maize was tested in some provinces in the North, South Central and Central Highlands of Vietnam. Study results show that in comparison with control maize cultivars, QT55 was a medium early single-cross maize hybrid (medium growth time) with the yields from 69.44 to 75.38 quintals ha^{-1} and ranged from 60 to 100.2 quintals ha^{-1} during intensive farming. Additionally, QT55 demonstrated higher resistance to stalk borer and other diseases such as the banded leaf, sheath blight and stalk rot. It is less likely to fall, cold tolerant and drought tolerant are better. Single-cross maize hybrid QT55 was best planted in Spring and Autumn-Winter crops (in Northern provinces) and Winter-Spring, Summer-Autumn crops (in South Central and Central Highlands).*

***Keywords*— single-cross maize hybrid QT55, breeding, testing, medium early, high yield, drought tolerance.**

I. INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crops, ranking second after wheat based on production (Hallauer and Carena, 2009; Dowswell, 2019). Maize plays a significant role in providing human foods, animal feed, the raw material for the processing industry and biofuels (Shiferaw *et al.*, 2011; Hochman and Zilberman, 2018; Loy and Lundy, 2019). The crop contains a huge amount of cellulose, vitamins, minerals and antioxidants (Ai and Jane, 2016). It does not only provide essential nutrients for human health but also contributes to preventing cancers (Jayaram *et al.*, 2015). In addition, maize is easily cultivated under various climatic conditions, offering great financial support to farmer households (Becerril and Abdulai, 2010; Mathenge *et al.*, 2014). As a result, maize has been widely cultivated in many countries around the world.

In Vietnam, maize has been cultivated in seven agro-ecological regions. In 2018, the cultivated area of maize in Vietnam was recorded to reach 1039 thousand hectares with the mean yield of 47.2 quintals ha^{-1} and the output of 4905.9 thousand tons (General Statistics Office of Vietnam, 2018). However, maize cultivation in Vietnam has still failed to meet the domestic consumption demand, leading to annual import of millions of tons of maize for animal feed processing. Statistics show that 10.18 million tons of maize were imported into Vietnam in 2018 (Ministry of Industry and Trade of the Socialist Republic of Vietnam, 2018).

Provinces in the North, South Central and Central Highlands of Vietnam are agriculture-oriented, in which maize is an important crop. The constraints and challenges in maize cultivation faced by farmer households in these regions are mainly the cultivation in riparian zones, narrow areas, medium-qualified and poorly fertile soil, mostly drought soil with water deficiency happening in 70% of the total cultivated area. The majority of currently cultivated maize varieties are imported hybrid maize cultivars (accounting for over 60%) at high prices. Farmer households can hardly take control of the crop seeds. There is a lack of high-qualified medium early hybrid maize cultivars through domestic seeding selection as well as suitable cultivation techniques for each cultivar, leading to the fact that some maize cultivars are suffering from pests and diseases at the serious rate and tending to have degenerated. This is also one of the main reasons why Vietnamese commercial maize production is less competitive than that of other countries in the world. Under the pressure of rapid population growth and urbanization, the cultivation area has been decreasing (Wang, 2019). Therefore, the demand for maize can be met when crop yield improves. Additionally, climate change also adversely affects crop growth and development (Calzadilla *et al.*, 2013). Development of new hybrid maize varieties with high yield, high quality and good resistance is a common and inevitable trend of the world (Dass *et al.*, 2009; Schroeder *et al.*, 2013; Abate *et al.*, 2015). This study, therefore, focuses on breeding a new hybrid maize with medium length of growing time, high and stable yield, high resistance to pests and diseases, less likelihood to fall, good drought stress tolerance, which can be suitably planted in major crops of provinces in the North, South Central and Central Highlands of Vietnam.

II. MATERIALS AND METHODS

2.1 Research materials

Single-cross maize hybrid QT55 was created from the hybrid combination D4 (III115144) x D54 (BOD22). The maternal line D4 (III115144) is originated from tropical region and selected as pour line by self-pollination method. Paternal line D54 (BOD22) is originated from tropical region and selected as pour line by self-pollination method.

Control cultivars: DK9001, CP.333, DK6919, CP888 (basic testing); DK9001, CP888, LVN10, LVN99, CP999, NK67 (production testing); D1, LCH9 (drought experiment). These control varieties are widely cultivated in localities where experiments were carried out.

2.2 Research venue and time

Tests of self-pollination, maintenance and evaluation of combining abilities among maize lines were conducted at the Center for plant evaluation and seed testing and plant products in Tu Liem, Hanoi. Breeder testing was conducted in Thanh Hoa, Vinh Phuc and Binh Dinh. Basic testing in Hanoi, Hai Duong, Thai Binh, Vinh Phuc, Bac Giang, Thanh Hoa, Nghe An, Quang Nam, Quang Ngai, Ninh Thuan and Đăk Lăk. Production testing in Son La, Tuyen Quang, Hoa Binh, Phu Tho, Vinh Phuc, Bac Ninh, Thanh Hoa, Nghe An, Binh Dinh and Đăk Lăk. Experiments were carried out from Autumn-Winter crop, 2012 to Spring crop, 2018.

Experiments on drought tolerance of maternal lines (D4), paternal line (D54) and single-cross maize hybrid QT55 were conducted at the Center for plant evaluation and seed testing and plant products in Tu Liem, Hanoi in Spring crop, 2019 (from February 2019 to April 2019).

2.3 Research methods

2.3.1 Conducting self-pollination, maintenance and evaluating combining abilities among maize lines

Self-pollinated parental lines of QT55 were selected as pure lines by traditional self-fertilization method, together with self-pollination by full-sib, half-sib selection methods.

Evaluation of combining abilities covered general combining ability (GCA) and specific combining ability (SCA) among 8 pure-line maize cultivars in diallel crossing as mentioned in Experimental method 4 by Griffing (1956).

2.3.2 Testing new hybrid maize cultivar in different ecological regions

Breeder testing and basic testing of Single-cross maize hybrid QT55 were conducted in accordance with "National technical regulation on testing for Value of Cultivation and Use of Maize varieties" – QCVN 01-56:2011/BNNPTNT by Ministry of Agriculture and Rural Development (2011).

Production testing of single-cross maize hybrid QT55 in experimental ecological regions was carried out based on the process of local hybrid maize cultivation in those localities. The experiments were arranged in a sequential manner, not repeated with control cultivars included. The testing area was 1000 m^2/cultivar/location/crop with a plant population density of 57-64 thousand plants ha^{-1} and fertilizer rate of (10 tons of completely decomposed manure or 2 tons of micro-organic fertilizer + 160 kg N + 90 kg P_2O_5 + 110 kg K_2O) ha^{-1}.

2.3.3 Evaluating drought tolerance

Drought tolerance of maternal lines (D4), paternal lines (D54) and single-cross maize hybrid QT55 were evaluated at the stage of seedlings with 5 - 6 leaves in covered net houses by CIMMYT (1985) method.

2.4 Statistical analysis

Combining ability (including GCA and SCA) of maize cultivars was analyzed based on the dry grain yield of hybrid combination thanks to IRRISTAT 5.0/ Linetest/ Dialen 2 software. Yield data gained from breeder testing and basic testing was statistically processed with IRRISTAT 5.0 and Excel 3.2. In production testing, maize was harvested in randomized-block design by statistical method, and the mean yield value was calculated with Excel 3.2 software.

III. RESULTS AND DISCUSSION

3.1 Conducting self-pollination, maintenance and evaluating combining abilities among maize lines

Analyses of the general combining ability (GCA) (gi) and the variance of specific combining ability (SCA) (σ^2sij) among 8 pure lines of maize in 3 diallel cross experiments conducted in 2012 Autumn-Winter crop, 2013 Spring crop and 2013 Autumn-Winter crop in Hoang Hoa, Thanh Hoa, Vietnam are presented in Table 1.

Table 1. Values of GCA (gi) and variance of SCA (σ^2sij) among pure lines of maize in 3 diallel cross experiments conducted in Hoang Hoa, Thanh Hoa, Vietnam[1]

No.	Maize line	General combining ability (gi)	Variance of specific combining ability (σ^2sij)
1	D4	+ 10.69	+ 12.048
2	D6	+ 7.26	+ 34.503
3	D8	+ 9.03	+ 27.340
4	D54	+ 18.65	+ 49.209
5	D100	+ 17.63	+ 28.809
6	D1	- 16.81	+ 37.726
7	D25	- 22.67	+ 83.209
8	D61	- 21.76	+ 51.205

[1]The mean value gained from 2012 Autumn-Winter crop, 2013 Spring crop and 2013 Autumn-Winter crop.

Maize lines with high value of GCA include D54 (gi: +18.65), D100 (gi: +17.63), followed by D4 (gi: +10.69), D8 (gi: +9.03) and D6 (gi: +7.26).

Maize lines with the highest variance of SCA include D25 (σ^2sij: +83.209), D61 (σ^2sij: +51.205) and D54 (σ^2sij: +49.209). Maize lines with medium variance of SCA include D1(σ^2sij: +37.726), D6 (σ^2sij: +34.503), D8 (σ^2sij: +27.340) and D4 (σ^2sij: +12.048).

The two pure lines with high value of GCA and high variance of SCA are D4 (gi: +10.69 and σ^2sij: +12.048) and D54 (gi: +18.65 and σ^2sij: +49.209). This single hybrid combination D4//D54 generates a new single-cross maize hybrid named QT55, which is put to the breeder testing in different ecological regions.

3.2 Agronomic characteristics of the maternal line (D4) and paternal line (D54)

Maternal line D4 took 123-125 days to reach harvest (Spring crop), 101-103 days (Autumn-Winter crop), paternal line D54 took 124-126 days (Spring crop), 103-105 days (Autumn-Winter crop). The mean plant height of D4 line reached 132.2 cm with the mean cob insertion height of 79.4 cm, lower than those of D54 line with the mean plant height of 149 cm and cob insertion height of 86 cm. The cob length of D54 line was 14.6 cm, longer than that of D4 line (13.1 cm). Both D4 and D54 lines had 12-16 rows per cob; The average dry grain yield of D4 line reached 30.8 quintals ha^{-1} and that of D54 line was 30 quintals ha^{-1}. Both lines showed good resistance against stalk borer and diseases (banded leaf, sheath blight, stalk rot). The plant bodies of both lines were firm, less likely to fall, drought-resistant (Table 2).

Table 2. Agronomic characteristics of the maternal line (D4) and paternal line (D54) in 2013 Spring crop and 2014 Autumn-Winter crop in Hoang Hoa, Thanh Hoa, Vietnam

No.	Criteria[1]	Maternal line D4 (III115144)	Paternal line D54 (BOD22)
1	Length of growing period (day)		
1.1	2013 Spring crop		
	Sowing to Tasseling	74-76	75-77
	Sowing to Physiological Maturity	123-125	124-126
1.2	2013 Autumn-Winter crop		
	Sowing to Tasseling	53-55	55-57
	Sowing to Physiological Maturity	101-103	103-105
2	Plant height (cm)	132.2 ± 5	149.0 ± 9
3	Cob insertion height (cm)	79.4 ± 2	86.0 ± 3
4	Cob length(cm)	13.1 ± 1	14.6 ± 2
5	Number of rows per cob	12-16	12-16
6	Number of grains per row	22.3	21.0
7	1000-grain weight (g)	270.4 ± 2	279.2 ± 2
8	Mean yield (quintal ha^{-1})	30.8	30.0
9	Protein(%)	11.90	11.32
10	Stalk borer (rating scale 1-5)	1-2	1
11	Banded leaf (rating scale 0-5)	1-2	0
12	Sheath blight (%)	3	5
13	Stalk rot (rating scale 1-5)	1-2	1-2
14	Number of roots collapsed plants (%)	3	3
15	Drought tolerance (rating scale 1-5)	2	1

[1]Assessed based on QCVN 01-56:2011/BNNPTNT.

3.3 Breeder testing on single-cross maize hybrid QT55

In two Spring crops and one Autumn-Winter crop, the yield of QT55 was recorded at the range from 62.4 to 85.1 quintals ha^{-1}, significantly higher than that of the control cultivars DK9901 and CP.333 at the significance level of 95%. The highest yield in Spring crops was in the range from 69.5 to 85.1 quintals ha^{-1}. The mean yield was 75.38 quintals ha^{-1}, surpassing that of the control varieties (DK9901, CP.333) with the difference of 9.66 quintals ha^{-1} (Table 3).

Table 3. Yield of single-cross maize hybrid QT55 in experimental places within Breeder Testing

Crop	Location	Yield (quintal ha^{-1})		CV (%)	$LSD_{0,05}$
		QT55	DK9901 (control)		
2013 Autumn -Winter	Hoang Hoa, Thanh Hoa	64.0	57.8	6.0	6.3
	Binh Xuyen, Vinh Phuc	62.4	56.2	7.8	4.8
2014 Spring	Hoang Hoa, Thanh Hoa	69.5	64.2	8.2	4.9
	An Nhon, Binh Dinh	85.1	72.0	8.0	10.5
2017 Spring	Hoang Hoa, Thanh Hoa	81.9	67.1*	7.4	3.5
	Thieu Hoa, Thanh Hoa	82.1	73.2	5.8	2.6
	Cam Thuy, Thanh Hoa	82.7	69.6	6.8	4.2
	Mean value	***75.38***	***65.72***		

Note: (*) CP.333.

3.4 Basic testing on single-cross maize hybrid QT55

3.4.1 Agronomic characteristics of single-cross maize hybrid QT55

QT55 is a medium early cultivar, similar to DK9901 line. They took 118-120 days to reach harvest in Spring crop and 108-110 days in Autumn-Winter crop (The Red River Delta - Northern midland and mountainous region), 111-113 days in Autumn-Winter crop and 117-119 days in Spring crop (North Central of Vietnam), 102-104 days in Winter-Spring crop and 95-96 days in Summer-Autumn crop (South Central of Vietnam), 95-96 days in Summer-Autumn crop and 115-117 days in Winter-Spring crop (Central Highlands of Vietnam). QT55 plant height varied from 176.3 to 231.3 cm, with the mean plant height of 203.8 cm, which was 5.4 cm higher than that of the control cultivar DK9901. The cob insertion height ranged from 76.9 to 131.7 cm, surpassing that of cultivar DK9901 with the average difference of 6.4 cm. The cob length was recorded at the range from 17.6 to 18.9 cm, and the mean cob length, which was 1.6 cm longer than that of cultivar DK9901, reached 18.2 cm. QT55 line had from 12 to 18 rows per cob with the mean number of 15 rows per cob, higher than those of control cultivar DK9901 (12-16 rows per cob with the mean number of 13.6 rows per cob). The average 1000-grain weight of QT55 was 306.5 grams and higher than that of the control cultivar DK9901 (270.8 grams). The grain percentage per cob in QT55 was from 54.3% to 81.3% with the mean value of 67.8%, roughly equivalent to that of cultivar DK9901 (67.5%) (Table 4).

Table 4. Some agronomic characteristics of QT55 in experimental places within basic testing

No.	Criteria[1]	Variety	
		QT55	DK9901 (control)
1	Length of growing period (day)		
	- Red River Delta - Northern midland and mountainous region		
	2015 Spring crop	118-120	115-117
	2015 Autumn-Winter crop	108-110	105-107
	- North Central		
	2017 Autumn-Winter crop	111-113	109-111
	2018 Spring crop	117-119	117-119
	- South Central		
	2015-2016 Winter-Spring crop	102-104	100-103
	2016 Summer-Autumn crop	95-96	95-97
	- Central Highlands		
	2015 Summer-Autumn crop	95-96	94-96
	2015-2016 Winter-Spring crop	115-117	113-115
2	Plant height (cm)	203.8 ± 27.5	198.4 ± 24.1
3	Cob insertion height (cm)	104.3 ± 27.4	97.9 ± 19.1
4	Cob length (cm)	18.2 ± 0.65	16.6 ± 0.85
5	Number of rows per cob	12-18	12-16
6	Number of grains per row	34.4 ± 3.1	36.2 ± 2.2
7	1000-grain weight (gam)	306.5 ± 5.5	270.8 ± 3.5
8	Gain percentage per cob (%)	67.8 ± 13.5	67.5 ± 14.7

[1]Assessed based on QCVN 01-56:2011/BNNPTNT.

Sources: Center for plant evaluation and seed testing and plant products in Vietnam, Center for plant evaluation and seed testing and plant products in Central Vietnam, Center for plant evaluation and seed testing and plant products in Highlands Vietnam.

*Table 5. Pest and disease tolerance and resistance to unfavorable conditions of QT55**

No.	Criteria[1]	Variety	
		QT55	DK9901 (control)
1	Stalk borer (rating scale 1-5)	1-2	1-2
2	Corn earworm (rating scale 1-5)	1-2	1-3
3	Corn leaf aphid (rating scale 1-5)	1	1-3
4	Sheath blight (%)	9.5	7.4
5	Banded leaf (rating scale 1-5)	0-2	0-3
6	Stalk rot (%)	0	0
7	Number of roots collapsed plants (%)	8.8	3.4
8	Number of stem broken plants (%)	1	1
9	Drought tolerance (rating scale 1-5)	1	1
10	Cold tolerance (rating scale 1-5)	1-2	1

**Mean values were taken from basic testing.*

[1]Assessed based on QCVN 01-56:2011/BNNPTNT.

Sources: Center for plant evaluation and seed testing and plant products in Vietnam, Center for plant evaluation and seed testing and plant products in Central Vietnam, Center for plant evaluation and seed testing and plant products in Highlands Vietnam.

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3.4.2 Pest and disease tolerance of single-cross maize hybrid QT55

Table 5 shows that QT55 was rarely infected with the stalk borer (rating scale 1-2), corn earworm (rating scale 1-2) and corn leaf aphid (1 point). The same results were found in testing on DK9901. QT55 was seldom infected with banded leaf (rating scale 0-2) as well as sheath blight (9.5%); stalk rot was not detected in QT55 (0 points). The corn stalk was strong and good at anti-falling (8.8% of the number of roots collapsed plants and 1% of the number of stem broken plants); fairly drought tolerant and which was cold-resistant, equivalent to DK9901.

3.4.3 Yield of single-cross maize hybrid QT55

The yield of single-cross maize hybrid after basic testing conducted in the Red River Delta and Northern midland and Mountainous region was presented in Table 6. In 2014 Winter crop, the yield of QT55 in 3 testing locations ranged from 48.55 quintals ha^{-1} to 84.22 quintals ha^{-1}. The average number was 63.55 quintals ha^{-1}, which was higher than the one of DK9901 at 2.77 quintals ha^{-1} (4.6%). In 2015 Spring crop, the yield of QT55 in 4 testing locations ranged from 58.50 to 82.73 quintals ha^{-1}, the average number (68.71 quintals ha^{-1}) was higher than the figure of DK9901, which reached only 1.56 quintals ha^{-1} (2.3%). In 2015 Winter crop, the yield of QT55 recorded in 5 testing locations ranged from 50.42 to 67.27 quintals ha^{-1} with an average of 59.72 quintals ha^{-1}, which was similar to the ones found in DK9901 (60.23 quintals ha^{-1}). After 3 basic testing cases in the Red River Delta and Northern midland and mountainous region, QT55 had average yield at 63.67 quintals ha^{-1}, which was 1.6% higher than the results recorded in the control variety, DK9901.

The yield of single-cross maize hybrid after basic testing conducted in the North Central of Vietnam was showed in Table 6. In 2014 Winter crop, the yield of QT55 in 2 testing locations ranged from 59.87 to 63.72 quintals ha^{-1}. The average number was 61.79 quintals ha^{-1}, which was higher than the one of DK9901 at 0.91 quintals ha^{-1} (1.5%). In 2015 Spring crop, the yield of QT55 in 2 testing locations ranged from 60.95 to 67.87 quintals ha^{-1}, the average number (64.91 quintals ha^{-1}) was 1.85 quintals ha^{-1} higher than the figure of DK9901 (2.9% higher). In 2017 Winter crop, the yield of QT55 recorded in 2 testing locations ranged from 56.82 to 58.80 quintals ha^{-1} with an average of 57.81 quintals ha^{-1}, which was 2.48 quintals ha^{-1} higher than the ones found in DK9901 (4.5%). In 2018 Spring crop, the yield of QT55 in 2 testing locations was from 62.83 to 71.29 quintals ha^{-1} with the average of 67.06 quintals ha^{-1}, which was similar to the ones of DK6919 (68.13 quintals ha^{-1}). After 4 basic testing cases in the North Central of Vietnam, QT55 achieved average yield at 62.89 quintals ha^{-1}, which was 1.7% higher than the results recorded in the control varieties (~1.04 quintals ha^{-1}).

Table 6. Yield of QT55 in basic testing locations in different ecological regions in Vietnam

Crop	Location	Yield (quintal ha^{-1})		CV (%)	$LSD_{0.05}$
		QT55	DK9901 (control)		
Red River Delta-Northern midland and mountainous region of Vietnam					
2014 Winter	Ha Noi	57.87	56.87	5.0	4.53
	Hai Duong	48.55	59.79	11.6	10.87
	Thai Binh	84.22	65.69	7.4	8.59
2015 Spring	Ha Noi	58.50	65.40	8.4	9.12
	Hai Duong	72.86	75.19	5.5	6.98
	Thai Binh	82.73	67.71	9.7	11.9
	Vinh Phuc	60.76	60.33	4.9	4.83
2015 Winter	Ha Noi	63.39	58.71	5.6	5.66
	Hai Duong	52.31	58.95	5.0	4.78
	Thai Binh	65.23	65.19	6.7	7.41
	Vinh Phuc	50.42	51.92	4.8	4.48
	Bac Giang	67.27	66.42	9.6	10.63
Mean value		*63.67*	*62.68*		
North Central of Vietnam					
2014 Winter	Thanh Hoa	59.87	57.80	4.1	4.26
	Nghe An	63.72	63.97	6.1	6.81
2015 Spring	Thanh Hoa	68.87	73.17	9.1	10.49
	Nghe An	60.95	52.95	6.5	6.16

2017 Winter	Thanh Hoa	58.80	55.10	3.6	3.01
	Nghe An	56.82	55.57	4.5	5.03
2018 Spring	Thanh Hoa	62.83	60.00 *	4.0	4.70
	Nghe An	71.29	76.25 *	5.0	8.75
Mean value		*62.89*	*61.85*		
South Cetral of Vietnam					
2014-2015 Winter-Spring	Quang Nam	78.2	71.7 **	4.3	5.51
	Quang Ngai	82.6	84.3 **	5.6	7.78
	Ninh Thuan	68.4	65.5 **	6.2	7.12
2015 Summer-Autumn	Quang Nam	54.5	53.5 **	3.9	3.85
	Quang Ngai	80.3	82.9 **	6.6	8.42
	Ninh Thuan	61.1	73.5 **	5.7	6.75
2015-2016 Winter-Spring	Quang Nam	65.1	73.1 **	3.6	4.65
	Quang Ngai	84.5	75.8 **	4.8	6.90
	Ninh Thuan	60.6	62.2 **	7.4	7.96
Mean value		*70.58*	*71.38*		
Central Highlands of Vietnam					
2015 Summer-Autumn	Buon Ma Thuot	84.01	80.30 ***	4.3	5.83
	Krông Păk	74.97	73.90 ***	6.7	8.54
	Krông Bông	80.76	79.12 ***	5.7	7.86
2015 Autumn-Winter	Buon Ma Thuot	80.32	80.14 ***	3.9	5.71
2015-2016 Winter-Spring	Buon Ma Thuot	83.04	75.90 ***	5.3	7.89
Mean value		*80.62*	*77.87*		
Mean value of 5 regions		***69.44***	***68.44***		

Note: (*) DK6919; (**) CP.333; (***) CP888.

Sources: Center for plant evaluation and seed testing and plant products in Vietnam.

Table 6 depicts the yield of QT55 after basic testing in South Central of Vietnam. In 2014-2015 Winter-Spring crop, the yield of QT55 in 3 testing locations ranged from 68.40 quintals ha^{-1} to 82.60 quintals ha^{-1}. The average number was 76.40 quintals ha^{-1}, which was higher than the one of CP.333 at 2.60 quintals ha^{-1} (1.5%). In 2015 Summer-Autumn crop, the yield of QT55 in 3 testing locations ranged from 54.4 to 80.30 quintals ha^{-1}, the average number (65.3 quintals ha^{-1}) was lower than the figure of CP.333 at 4.66 quintals ha^{-1}. In 2017 Winter-Spring crop, the yield of QT55 recorded in 3 testing locations ranged from 60.6 to 84.5 quintals ha^{-1} with an average of 70.06 quintals ha^{-1}, which was similar to the ones of CP.333 (70.36 quintals ha^{-1}). After 3 basic testing cases in the South Central of Vietnam, QT55 achieved an average yield at 70.58 quintals ha^{-1}, which was nearly the same as the results recorded in CP.333 (71.38 quintals ha^{-1}).

The yield of QT55 after basic testing in Central Highlands is also described in Table 6. In 2015 Summer-Autumn crop, the yield of QT55 in 3 testing locations ranged from 74.97 to 84.01 quintals ha^{-1}, the average number (79.91 quintals ha^{-1}) was 2.14 quintals ha^{-1} higher than the figure of CP888 (2.8%). In 2015 Autumn-Winter crop, the yield of QT55 reached 80.32 quintals ha^{-1}, which was similar to the ones of CP888 (80.14 quintals ha^{-1}). In 2015-2016 Winter-Spring crop, the yield of QT55 was 82.03 quintals ha^{-1}. This yield was 7.14 quintals ha^{-1} higher than the yield of CP888 (9.4%). After 3 basic testing cases in Central Highlands, QT55 achieved an average yield at 80.62 quintals ha^{-1}, which was higher than the results recorded in CP888. The higher amount was 3.16 quintals ha^{-1} (3.5%).

3.5 Production testing on single-cross maize hybrid QT55

The results of testing on QT55's production in the Red River Delta and Northern midland and mountainous region is shown in Table 7. QT55 had medium length of growing period (which was longer than DK9901 from 2 to 5 days and similar to LVN99). This variety was a healthy plant that was less infected with the stalk borer and corn earworm as well as other diseases such as the banded leaf, sheath blight and stalk rot. The corn stalk was strong and good at anti-falling; fairly drought tolerant and cold resistant. This plant could be grown in various conditions. The yield of QT55 ranged from 60.9 to 72.4 quintals ha^{-1} with an average of 65.46 quintals ha^{-1}. This productivity was higher than control varieties including DK9901, LVN99 and LVN10 from 0.8 to 18.9%.

Table 7 also describes the production testing of QT55 in North Central of Vietnam. It can be seen that QT55 had medium length of growing period (which was longer than DK9901 from 1 to 4 days). The plant grew well, achieved medium height and was able to create earn corn at medium speed. The ears were long and beautiful with yellow and orange and half tough kennels, which were popular among consumers. QT55 was less infected with the stalk borer and corn earworm as well as other diseases such as the banded leaf, sheath blight and stalk rot. The corn stalk was strong and good at anti-falling; fairly drought tolerant and cold resistant. This variety could be grown in various conditions and was the most suitable for main crop during the year such as Spring crop and Autumn-Winter crop as well as different types of soil in North Central of Vietnam. The average yield of QT55 was 76 quintals ha^{-1} (ranging from 60.0 to 100.2 quintals ha^{-1}), which was higher than the control variety (DK9901) from 10 to 15.4%.

The production testing of QT55 in South Central of Vietnam is presented in Table 7. This variety had medium length of growing period (which was longer than DK9901 from 2 to 7 days). The plant grew well, achieved medium height and was able to create earn corn at medium speed. The ears appeared to belong and beautiful with yellow and orange and half tough kennels. The yield of QT55 ranged from 80 to 85.1 quintals ha^{-1} (82.55 quintals ha^{-1} on average), which was higher than the control variety (DK9901) from 10.8 to 18.19%. It was less infected with the stalk borer and corn earworm as well as other diseases such as the banded leaf, sheath blight and stalk rot. The corn stalk was strong and good at anti-falling; fairly drought tolerant and cold resistant. This variety could be grown in various conditions and types of soil. It is suitable for intensive farming.

Table 7. Results of production testing on single-cross maize hybrid QT55 in different ecological regions in Vietnam

Crop	**Location**	**Length of growing period (day)**		**Yield (quintal ha^{-1})**		**Comparing to control variety (%)**
		QT55	**DK9901 (control)**	**QT55**	**DK9901 (control)**	
Red River Delta-Northern midland and mountainous region of Vietnam						
2015 Spring	Tam Nong, Phu Tho	131	127	60.9	54.02	+ 12.7
2015 Spring-Summer	Mai Son, Son La	114	102 *	72.4	60.8 *	+ 18.9
2015 Winter	Tam Duong, Vinh Phuc	122	117	62.94	58.25	+ 8.1
2016 Spring	Son Duong, Tuyen Quang	110	110 **	67.5	61.11 **	+ 10.4
	Lac Son, Hoa Binh	120	120	63.5	63.0	+ 0.8
2016 Winter	Yen Lac, Vinh Phuc	116	115	64.5	61.6	+ 4.7
	Thanh Thuy, Phu Tho	118	116	66.5	61.6	+ 7.9
Mean value				*65.46*	*60.05*	*+ 9.0*
North Cetral of Vietnam						
2015 Spring	Yen Thanh, Nghe An	120	116	65.2	56.9	+ 14.5
2015 Winter	Hoang Hoa, Thanh Hoa	100	105	60.0	54.0	+ 11.1
	Yen Thanh, Nghe An	108	110	68.5	62.0	+ 10.5
2016 Spring	Nghi Loc, Nghe An	118	122 ***	64.7	56.9 ***	+ 13.7
2018 Spring	Hoang Hoa, Thanh Hoa	115	115	90.4	79.3	+ 14.0
	Thieu Hoa, Thanh Hoa	119	117	100.2	89.8	+ 12.0
	Cam Thuy, Thanh Hoa	116	115	83.0	75.5	+ 10.0
Mean value				*76.0*	*67.7*	*+ 12.3*
South Cetral of Vietnam						
2013-2014 Winter-Spring	An Nhon, Binh Dinh	123	125	85.1	72.0	+ 18.19
2014-2015 Winter-Spring	An Nhon, Binh Dinh	112	105	80.0	72.2	+ 10.8
Mean value				*82.55*	*72.1*	*+ 14.49*
Central Highlands of Vietnam						
2015-2016 Winter-Spring	Eatu, Đăk Lăk	117	115 ****	82.85	78.12 ****	+ 6.1
2016 Autumn-Winter	Eatu, Đăk Lăk	110	108 *****	73.84	70.97 *****	+ 4.0
Mean value				*78.35*	*74.54*	*+ 5.09*
Mean value of 5 regions		***100-131***	***105-127***	***75.59***	***68.60***	***+ 10.2***

Note: (*) LVN10; (**) LVN99; (***) CP999; (****) CP888; (*****) NK67.

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Table 7 depicts the production testing of QT55 in the Central Highlands of Vietnam. It had the same medium length of the growing period as the control varieties (CP888 and NK67). QT55 was less infected with the stalk borer and corn earworm as well as other diseases such as the banded leaf, sheath blight and stalk rot. The corn stalk was strong and good at anti-falling; fairly drought tolerant and cold resistant. The yield was recorded at 78.35 quintals ha^{-1} on average (ranging from 73.84 to 82.85 quintals ha^{-1}). This quantity was 6.1% and 4% higher than that of CP888 and NK67 respectively.

In short, production testing of QT55 had been conducted during 13 crops (from 2013-2014 Winter-Spring crop to 2018 Spring crop) in 18 different locations of 5 ecological regions including Red River Delta, Northern midland and mountainous region, North Central, South Central and Central Highlands of Vietnam. The yield of dried kennel ranged from 60.0 to 100.2 quintals ha^{-1}, 75.59 quintals ha^{-1} on average, which was 10.2% higher than that of control varieties.

3.6 Evaluation drought tolerance of the parental lines and single-cross maize hybrid QT55

3.6.1 Maize growth criteria during drought experiments

Underwater stress during the period from the 3-leaf to 6-leaf stage, QT55 was 39 cm in height, which was 0.7 cm higher than LCH9 – a drought-tolerant variety; its root length was 49.8 cm, which was 11.5 cm longer than LCH9; the number of roots found in QT55 is 3 roots less than that of LCH9 (Table 8).

From 3-leaf to 6-leaf stage, D54 (paternal line) was 42.9 cm in height, which was 12.8 cm higher than D1; its root length was 51.9 cm in length, which was 13.2 cm longer than D1; the number of roots was also higher than that of D1 at 11.2 roots. Meanwhile, D4 (maternal line)' height was 31.7 cm, which was 1.6 cm higher than D1; its root length was 47.1 cm (8.4 cm higher than D1) and the number of roots was 5.2 (2.9 roots less than D1) (Table 8).

Table 8. Height, root length and the number of roots of QT55 lines/ varieties

No.	Line/ variety	Height (cm)		Root length (cm)		Number of roots (root)	
		Without watering	With watering	Without watering	With watering	Without watering	With watering
1	D1	30.1 ± 3.8	44.8 ± 2.6	38.7 ± 9.6	54.2 ± 6.5	8.1 ± 1.7	11.9 ± 2.2
2	D4	31.7 ± 2.4	35.9 ± 4.1	47.1 ± 8.6	55.2 ± 9.4	5.2 ± 0.8	7.2 ± 1.4
3	D54	42.9 ± 4.6	46.7 ± 9.1	51.9 ± 10.7	65.9 ± 12.3	11.2 ± 2.4	11.8 ± 3.5
4	QT55	39.0 ± 3.8	47.0 ± 9.5	49.8 ± 8.1	57.6 ± 13.4	8.6 ± 1.9	11.8 ± 3.4
5	LCH9	38.3 ± 3.2	46.2 ± 9.4	38.3 ± 6.9	78.1 ± 16.5	11.6 ± 1.6	8.5 ± 3.2

3.6.2 QT55's recovery after re-watering at 5-6-leaf stage

QT55's drought tolerance (rating scale 2-3) was similar to that of the drought-tolerant variety LCH9 (rating scale 2). After wilting at the 6-leaf stage and after 2 days re-watering, QT55 (rating scale 2) had the same recovery after re-watering as LCH9 (rating scale 2) (Table 9).

Table 9. Recovery after re-watering of lines/varieties QT55 at the 5-6-leaf stage

No.	Line/variety	Drought tolerance (Rating scale 1-5)	Recovery after 2 days re-watering (Rating scale 1-5)
1	D1	3-4	4
2	D4	2-3	3
3	D54	2	2
4	QT55	2-3	2
5	LCH9	3	2

The paternal line, D54 (rating scale 2) was drought tolerant better than D1 (rating scale 3-4). After wilting at 6-leaf stage and after 2 days re-watering, D54 (rating scale 2) was able to recover better than D1 (rating scale 3-4). The maternal line, D4 (rating scale 2-3) was also better at drought tolerance than D1 (rating scale 3-4). After wilting at 6-leaf stage and after 2 days re-watering, D4 (rating scale 3) showed better performance in recovery than D1 (rating scale 4) (Table 9).

3.6.3 Weight of dry matter of QT55 lines/ varieties during drought experiments

Underwater stress from 3-leaf stage to 5-6-leaf stage, QT55's weight of dry matter was 0.510 grams/plant, which was higher than LCH9 (0.419 grams/plant) significance level of 95% (Table 10).

Table 10. Weight of dry matter of QT55 lines/varieties during drought experiment in net houses

No.	Line/variety	Weight of dry matter (gram/plant)	
		Without watering	With watering
1	D1	0.167	0.351
2	D4	0.233	0.346
3	D54	0.466	0.507
4	QT55	0.510	0.552
5	LCH9	0.419	0.497
	CV %	*10.2*	*7.5*
	$LSD_{0.05}$	*0.101*	*0.093*

At 5-6 leaf stage, the weight of dry matter of paternal line, D54, and the maternal line, D4, was 0.466 grams/plant and 0.233 grams/plant respectively, which were higher than D1 at 0.167 grams/plant with a significance level of 95% (Table 10).

IV. CONCLUSIONS

The final result of the study was a single cross maize hybrid, QT55 with medium length of growing period. This variety was 203.8 cm high on average while the average corn insertion height was 104.3 cm. It was a healthy plant which able to grow well in a good shape, the leaves covered all the cob; the grain percentage per cob was 67.8%; 1000-Grain Weight was 306.5 grams on average. The yields (basic testing) in the Red River Delta and Northern midland and mountainous region, North Central, South Central and Central Highlands of Vietnam were 63.67 quintals ha^{-1}, 62.89 quintals ha^{-1}, 70.58 quintals ha^{-1} and 80.62 quintals ha^{-1} respectively. The average yields (production testing) in the Red River Delta and Northern midland and mountainous region reached 65.46 quintals ha^{-1}, which was 9% higher than the control variety; the figures recorded in North Central, South Central and Central Highlands of Vietnam were 76 quintals ha^{-1}, 82.55 quintals ha^{-1} and 78.35 quintals ha^{-1}, which were 12.3%, 14.49% and 5.09% higher than the control variety respectively. QT55 was fairly good at drought tolerance, less infected with the stalk borer as well as other diseases such as the banded leaf, sheath blight and stalk rot. The variety was also good at anti-falling and suitable for different crops in provinces in the North, South Central as well as the Central Highlands of Vietnam.

AUTHOR CONTRIBUTIONS

LQT (Le Quy Tuong) and LVN conceived the idea and designed the experiments. LQT (Le Quy Tuong), LVN, LQT (Le Quy Tung) and NTK implemented the experiments. LQT (Le Quy Tuong) and BBT analyzed the research data. LQT (Le Quy Tuong) prepared the draft of the paper. BBT wrote and edited the manuscript. All authors agreed with the final version of the manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Efficacy of Different Glyphosate rates of Application on Weed Infestation in Citrus Orchards

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***Abstract*— *Citrus weeding trial was conducted during the 2019 growing season. The aimof this study is to investigate the effect of three glyphosate rates of application on weed infestation in citrus orchards. Dominant weed botanical families belong to: Asteraceae, Amaranthaceae, Caryophyllaceae,Solanaceae, Poaceae and Primulaceae.Results showed that glyphosate applied at 1080 g/hectareand 720 g/hectare provided good weed control. Glyphosate rates of application at 1080 g/hectare and 720 g/hectare recorded respectively 88.07% and 81% of weed density reduction compared to weed density in the control plots and 93.36% and 77.41% of weed dry biomass reduction compared to weed dry biomass in the control plots.Glyphosate rates of application at 1080 g/hectarerecorded 95% of visual weed control notation compared to weed infestation in the control plots.Glyphosate applied at 360 g/hectare showed very low efficacy and is not recommended in chemical weed control program in citrus orchards.*

***Keywords*— Weed infestation, citrus, glyphosate, efficacy, density, biomass, Larache, Morocco.**

I. INTRODUCTION

Citrus is one of the important fruit trees grown in Morocco (Walali&*al*., 2003). This crop plays a socio-economic role with an area of 125,000 hectares and a production average of 2 million tons per year (ASPAM, 2019). It contributes substantially to the improvement of the income of farmers and generates significant effects on job creation. Exports of citrus, represent an important source of foreign currency. Several biotic constraints limit their productivity including pests, diseases (viral and Cryptogamic), nematodes and weeds (Mokrini&*al*., 2018). In fact, weeds compete for growth factors such water, nutrients and light and reduce crop yield and quality (Onyegbule &*al*., 2014; Tucker & Singh 1993). The most common weeds in Moroccan citrus orchards belong to the following botanical families: *Poaceae, Asteraceae, Fabaceae, Brassicaceae* and *Boraginaceae* (Wahbi & Taleb, 1995; Hilali, 1995; Taleb &*al*., 1996; Bensellam &*al*., 1997; Talibi, 1999). There are various weed management practices that can reduce weed infestation in citrus orchards such cultivating, Mowing, Chemical weed Control, Biological Control and use of allelopathic plants (Tucker & Singh 1993). However, weed management with chemical control through herbicides is a cheaper and most effective practice against weed infestation especially when combined with other control measures (Bensellam & Bouhache, 2007). Glyphosate is a nonselective herbicide that kills mono and dicotyledonous plants of annual or perennial cycles. Glyphosate block the biosynthesis of aromatic amino acids produced through the shikimate pathway phenylalanine, tyrosine and tryptophan (Gravena and *al*., 2012; Index phytosanitaire Maroc, 2017). This herbicide is largely used worldwide due to its large spectrum efficacy against weed and cheaper cost. However, good chemical weed control by applying glyphosate is dependent on the nature of the dominant weed flora and the rates of application (Bensellam & Bouhache, 2007). Therefore,this study aims to evaluate theefficacy of three glyphosate rates of application to determine the rate of application that allows thebestweed control in citrus orchards in Larache Morocco region.

II. MATERIAL AND METHODS

A weeding trial was conducted at the Larache INRA Research Station Morocco during 2019 growing season. The average annual rainfall is about 700 mm concentrated for almost all between October 15th and April 15th. The soil texture is sandy. The experimental design is a random block with tree repetitions. The size of the elementary plot is 5m x 5m. The age of citrus plantation is three years. Each block consists of four elementary plots: three treatments in addition to a non-weed control. The treatments are carried out on March 15, 2019 with

Backpack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200L. Treatments consist on three glyphosate rates of application (Table 1). Observations were made on May 08, 2019. Observations concerned Visual rating of efficacy on a scale ranging from 0 to 100% (where 0% is ineffective while 100% is a total destruction of weeds), Percentage of weed density reduction: *Weed density reduction percentage= [weed density in control plots – weed density in treated plots] x 100 / [weed density in control plots]*, Calculation of the density at the experimental level of the plot was made by a quardatof 1m x 1m. Percentage of dry biomass reduction: *Weed dry biomass reduction percentage= [weed dry biomass weight in control plots – weed dry biomass weight in treated plots] x 100 / [weed dry biomass weight in control plots]*. Calculation of dry weed biomass were made by collecting weeds in each plot using a quardatof 1m x 1m. Samples were dried in a drying oven at 75 ° C for 48 hours. Then, dry plant material in each plot were weighed with a precision balance. Statistical analyzes are performed with SPSS software version 21.

Table 1: Applied herbicides in experimental site

Herbicide treatments	Glyphosate rates of application (g/hectare)
Treatment 1	360 g/hectare
Treatment 2	720 g/hectare
Treatment 3	1080 g/hectare

III. RESULTS AND DISCUSSION

1. Weed flora Infestation

Dominant weed botanical families in the experimental are: *Asteraceae* (33.3%),*Amaranthaceae* (22.2%),*Caryophyllaceae* (11.1%), *Solanaceae* (11.1%), *Poaceae* (11.1%), and*Primulaceae* (11.1%). Dominant weed species are: *Erigeron Canadensis*, *Chamaemelummixtum*, *Sonchusoleraceus*, *Chenopodiumopulifolium and Beta macrocarpa Cerastiumglomeratum* (Table 2).

Table 2: Weed flora in experimental site

Scientific Name	Common Name
Erigeron canadensis L.	CANADIAN HORSEWEED
Sloanum nigrum L.	EUROPEAN BLACK NIGHTSHADE
Anagallis arvensis L.	SCARLET PIMPERNEL
Beta macrocarpa Guss	BEET
Bromus rigidus Rhoth	RIPGUT BROME
Cerastium glomeratum Thuill.	STICKY MOUSE-EAR CHICKWEED
Chenopodium opulifolium Schrad.	SEAPORT GOOSEFOOT
Sonchus oleraceus L.	SOWTHISTLE
Chamaemelum mixtum (L.) All.	CHAMAEMELUM MIXTUM

1. Effect on visual efficacy rating

Statistical analysis revealed a very highly significant difference between treatments (table 3). Plots treated with 1080 g/hectare of glyphosate showed the best efficacy recording 95% of visual weed control notation compared to weed infestation in the control plots. Glyphosate Rate of application at 720 g/hectare showed also pretty good efficacy recording 83.67%. Glyphosate applied at 360 g/hectare showed moderate efficacy recording 63.33%.

Table 3: Effect on visual efficacy rating

Glyphosate rates of application	Visual efficacy rating(%)
1080 g/hectare	95 a
720 g/hectare	83.67 b
360 g/hectare	63.33 c
Pα = 0.05	*< 0.000*

Significant differences within the same column and means followed by the same letter do not differ at Pα≤0.05 according to Tukey's test.

2. Effecton weed density reduction

Statistical analysis revealed a very highly significant difference between treatments (table 4). Plots treated with 1080 g/hectare and 720 g/hectare of glyphosate showed the best efficacy recording respectively 88.07% and 81% of weed density reduction compared to weed density in the control plots. Glyphosate Rate of application at 360 g/hectare showed low weed density reduction recording 56.79%.

Table 4: Effect on weed density reduction

Glyphosate rates of application	Weed density reduction (%)
1080 g/hectare	88.07 a
720 g/hectare	81ab
360 g/hectare	56.79 b
Pα = 0.05	*0.001*

Significant differences within the same column and means followed by the same letter do not differ at Pα≤0.05 according to Tukey's test.

3. Effecton weed dry biomass reduction

Statistical analysis revealed a very highly significant difference between treatments (table 5). Plots treated with 1080 g/hectare and 720 g/hectare of glyphosate showed the best efficacy recording respectively 93.36% and 77.41% of weed dry biomass reduction compared to weed dry biomass in the control plots. Glyphosate Rate of application at 360 g/hectare sowed very low weed dry biomass reduction recording only32.44%.

Table 5: Effect on weed dry biomass reduction

Glyphosate rates of application	Weed dry biomass reduction (%)
1080 g/hectare	93.36 a
720 g/hectare	77.41 a
360 g/hectare	32.44 b
Pα = 0.05	*0.001*

Significant differences within the same column and means followed by the same letter do not differ at Pα≤0.05 according to Tukey's test.

In fact, some authors reported that glyphosate applied at 2160 g/hectare on citrus orchards in Gharb region in Morocco showed just 64.89% on weed dry biomass reduction compared to weed dry biomass in the control plots (Bensellam &Bouhache 2007). In our trial, half of this glyphosate rate of application has shown very good weed dry biomass reduction (93.36%). This can be explained by the nature of the weed species since weed infestation in Larache region is different fromthat of Gharb region. Therefore, it is important to test rates of application in different region before any recommendation to avoid low weed control (underdose) or the waste of herbicides (overdose).

IV. CONCLUSION

This study has shown that glyphosate rates of application at 1080 g/hectare and 720 g/hectare showed good weed control in citrus orchards in terms of dry biomass reduction, weed density reduction and visual weed efficacy notation. Glyphosate applied at 360 g/hectare is not recommended in chemical weed control program in citrus orchards in Larache region of Morocco.

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Utilization of Sludge Waste as Fertilizer for Chili Plants: Observed from Technical, Economical Aspects and Farmers' Perceptions

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Abstract— *PT. X was an industrial company that engaged in chicken slaughterhouse and meat processing and its derivatives, with a continuous production process that produced a variety of waste ranging from Liquid, Solid, and others. Moreover, for the type of liquid waste produced by PT. X, was treated with a Wastewater Treatment Plant which was one of the facilities in PT. X. The second stage was to make a comparison between Sludge, chicken manure, and rice husk. Furthermore, there was a variation of the ratio: the first 1: 1: 1 and the second 2: 1: 1 where two were the number of sludge. Application of fertilizers was carried out on chili plants. From the test results, it showed that there was an increase in productivity between 30% - 42.8% in chili plants. Therefore, the cost of fertilizing in one crop of chili with compost processed by Sludge IPAl of PT. X was equal to Rp. 1,500 per stem in a single planting period. As for the NPK Mutiara fertilizer, the cost incurred for fertilizing in a single chili planting period was Rp. 4,050, - per stem of chili plants. While the result of the questionnaire towards the attitudes of farmers showed sufficient value, hence, the fertilizer processed by IPAL sludge had a good chance to be accepted by the community, especially chili farmers.*

Keywords— Chili Plants, Compost, NPK fertilizer, Sludge, WWTP.

I. INTRODUCTION

Industrial estates in Indonesia began to multiply and spread in almost all regions. According to data from the Ministry of Industry Performance Achievement (Kemenperin) 2015 - 2017 showed that in the period of 2015 - 2017 successfully built and operated three new industrial zones on Java Island and seven new industrial zones outside of Java and predicted for the next 2 years will growing 6 new industrial areas outside Java in 2019. With the development of the industrial areas in Indonesia, it will surely be followed by the problems that arise from these industrial activities.

The condition of sludge was organic and very smelly. If it was left to stand for days, it would result in smelly and sour odour and could create a very disturbing environment around the factory. The analysis showed that the sludge contained organic N, P and C elements, as well as Ca, Mg, K, Cu, Mn, Zn and Fe elements which were nutrients needed by plants. However, the C / N ratio of the sludge produced was low; thus, it needed to be mixed with organic material which has a high C content for its utilization to the soil. Husk was a by-product of rice harvest which had high C levels therefore it could be used as a mixture (bulking agent) in the composting process.

II. LITERATURE REVIEW

Waste was basically a material that was excerted from human activities or natural processes that have no or no economic value. It often had negative economic value because the disposal management of it required a relatively large cost. Based on the source, waste was divided into three: natural waste, domestic waste and industrial waste (Murtadho and Said, 1988). Organic sludge originateded from primary and secondary settling tank The sludge from the primary settling tank, called the primary sludge, was a solid precipitate which flown along with the wastewater, while the sludge from the secondary settling tank, called the secondary sludge, was a residual microbial precipitated that was discharged from the Wastewater Treatment Plant. The condition where there was no oxygen in wastewater, could take place optimally at temperatures of 35-500 C with a pH value of 7.0 to 6.0 that occured during the denitrification process and served to convert nitrates into nitrogen gas (Dawson and Murphy, 1972). On the other hand, composting was a process of decomposition and stabilization of organic matter by microorganisms in a controlled environment with the final result in the form of humus and compost (Simamora and Salundik, 2006). Chili plants (Capsicum frutescens L.) was one of the horticultural crops of

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vegetables which had small fruits with a spicy flavor. Chili plants (Capsicum frutescens L.) had several regional names, such as (in the area of Java) *chili japlak*, *mengkreng, cengis, ceplik, or cempling.*

III. METHOD OF THE STUDY

Equipment: Mixing materials (containers), Mixer, Gloves, Scales, Sieves, Fertilizer containers.

Materials: Waste sludge (IPAL Sludge), Rice husk. Chicken manure

How to do:

1. Taking a sludge sample

   Samples (dried sludge) were taken from WWTP at PT X
2. Sludge sample preparation

   The sludge sample was dried on plastic and allowed it to dry. Then, crushed and sieved in a 100 mesh sieve, then weighed as much as 9 kg.

Manufacturing the Fertilizer

1. Preparing tools and materials
2. Making a ratio of 1: 1: 1 and 2: 1: 1
3. The process of mixing ingredients
4. Four weeks of composting process
5. Compost was ready to use

IV. DISCUSSION

The content or characteristics of WWTP sludge by PT. X after conducting the analysis

Table.1: Sludge Characteristic of IPAL by PT. X

Characteristic	Result
Explosive	Not Explosive
Flammable	Not Flammable
Reactive	Negative
Corrosive (pH $\leq$2.5 or pH $\geq$12.5)	5,58

Source: Laboratory Analysis

Table.2.: Sludge Characteristic of IPAL by PT. X compared to Standard Indonesian Compost

Parameter	Unit	Compost Quality Standard		Initial Sludge Concentration
		Minimum	Maximum	
Water Content	(%)	-	50	20,41
Particle Unit		0,55	25	20
pH		6,80	7,49	7,02
Nitrogen	(%)	0,40	*	0,60
Carbon	(%)	9,80	32	20,25
Phosfor (P_2O_5)	(%)	0,10	-	1,52
C/N Rasio		10	20	33,75
Calium (K_2O)	(%)	0,20	*	1,46
Arsen	mg/kg	*	13	< 0,002
Cadnium (Cd)	mg/kg	*	3	< 0,008
Mercury (Hg)	mg/kg	*	0,8	< 0,002
Lead (Pb)	mg/kg	*	150	2,1
Zinc (Zn)	mg/kg	*	500	41,36
Iron (Fe)	(%)	*	2,00	<0,002
Manganese (Mn)	(%)	*	0,10	< 0,002

Source: Laboratory Analysis

Note: * The value is greater than the maximum unit

Quality standard according to SNI 19-7030-2004

Table.3: Sludge Characteristic of IPAL by PT. X Compared to Sample A dan Sample B

Parameter	**Unit**	**Compost Quality Standard**		**Consentration**	
		Minimum	**Maximum**	**Sample A**	**Sample B**
Water Content	(%)	-	50	20,15	7,18
Particle Unit		0,55	25	20	15
pH		6,80	7,49	7,40	7,08
Nitrogen	(%)	0,40	*	1,20	0,76
Carbon	(%)	9,80	32	22,25	12,51
Phosfor (P_2O_5)	(%)	0,10	-	0,71	0,72
C/N Rasio		10	20	26,70	16,42
Calium (K_2O)	(%)	0,20	*	0,51	0,46
Arsen	mg/kg	*	13	< 0,002	< 0,002
Cadnium (Cd)	mg/kg	*	3	< 0,008	< 0,008
Mercury (Hg)	mg/kg	*	0,8	< 0,002	< 0,002
Lead (Pb)	mg/kg	*	150	1,98	1,5
Zinc (Zn)	mg/kg	*	500	40,98	40,11
Iron (Fe)	(%)	*	2,00	< 0,002	< 0,002
Manganese (Mn)	(%)	*	0,10	< 0,002	< 0,002

Source: Laboratory Analysis
Note: * The value is greater than the maximum unit
Quality standard according to SNI 19-7030-2004
Sample A with ratio 1 : 1 : 1
Sample B with ratio 2 : 1 : 1

From these results, it could be seen that compost made with a ratio of 1: 1: 1 did not meet the quality standards for Indonesian compost, because the value of the C/N ratio was still above the applicable quality standard. According to Kusumawati, the 2015 ratio of high C/N values showed that compost had not been decomposed completely or in other words compost was not yet ripe. Moreover, high C/N ratio could be caused by several factors, one of which was composting time and compost made.

From the results of the laboratory tests, it could be concluded that the research would be continued only for the variation of the ratio between sludge: chicken manure: rice husk 2: 1: 1. Because the laboratory test for 1: 1: 1 variation could not fulfill the Indonesian compost standard according to SNI 19-7030-2004. Thus, even if the variation was applied, the results could not be mass produced because they did not meet the required standards.

Sludge produced by Compost had a brownish black color characteristic and had a slightly soft texture due to the mixture of chicken manure which was still wet as a mixture in the compost making process.

Application of composting was conducted when the chili plants began to blossom. Before that process, the treatment of chili plants was only done in the form of watering plants every day and cleaning the area around the plant and not to be disturbed by weeds or pests that could interfere with the productivity of chili plants. The composting process was done by making a dose of 100 grams of fertilizer sprinkled on them and buried them with the soil. This was because fertilizers did not easily evaporate and dissolve in rain water. The use of this fertilizer was used only once for 21 days during the productivity period of chili. Because the application of compost which was too much could disturb the balance of nutrients in the soil. (Musnamar, E.I., 2006)

For testing, it was done by comparing the effectiveness of compost fertilizer with the one that had been circulating in the market for the type of fertilizer in chili plants. In this experiment, compost was compared with NPK Mutiara fertilizer. From the test result, it showed that there was an increase in productivity between 30% - 42.8% in chili plants with the treatment of adding compost from the results of the utilization of WWTP sludge by PT. X. For the results from both types of fertilizers could be seen in the table below:

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Table.4: Results of Chili Plant with Two Types of Fertilizers

No.	Planting Area	Chili Results (Unit)	
		Compost Fertilizer (IPAL Sludge)	NPK Mutiara Fertilizer
1.	Area 1	130 unit	100 unit
2.	Area 2	150 unit	105 unit
3.	Area 3	125 unit	90 unit

Source: Research result

Analysis of economic aspects was carried out to determine the difference in costs incurred by farmers using NPK Mutiara fertilizer and compost fertilizer from the utilization of WWTP sludge by PT. X, shown in the table below:

Table.5: Comparison of Planting Costs and Planting Results Between NPK Mutiara and Compost Fertilizer on Chili Plants Per Hectar of Land

Fertilizer Type	Planting Area	Planting Cost (Rupiah)	Harvesting Yield (Rupiah)	Deviation Profit (Rupiah)
NPK Mutiara	Area 1	Rp. 40.500.000,-	Rp. 50.000.000,-	Rp. 9.500.000,-
	Area 2	Rp. 40.500.000,-	Rp. 52.500.000,-	Rp. 12.000.000,-
	Area 3	Rp. 40.500.000,-	Rp. 45.000.000,-	Rp. 4.500.000,-
	Average Cost	Rp. 40.500.000,-	Rp. 49.166.700,-	Rp. 8.666.700,-
Compost by IPAL sludge	Area 1	Rp. 21.000.000,-	Rp. 65.000.000,-	Rp. 44.000.000,-
	Area 2	Rp. 21.000.000,-	Rp. 75.000.000,-	Rp. 54.000.000,-
	Area 3	Rp. 21.000.000,-	Rp. 62.500.000,-	Rp. 41.500.000,-
	Average Cost	Rp. 21.000.000,-	Rp. 67.500.000,-	Rp. 46.500.000,-
Deviation of NPK Mutiara & Compost Fertilizer		**Rp. 19.500.000,-**	**Rp. 18.333.300,-**	**Rp. 37.833.300,-**

Source: Research result

While the results of the questionnaire towards the attitudes of farmers showed sufficient value, it meant that the fertilizer processed by IPAL sludge had a good chance to be accepted by the community in this case chili farmers. Unsatisfactory results required additional seed inoculation with Rhizobium and phosphobacterin that significantly increased nitrogen and potassium levels (Dutta and Bandyopadhyay, 2009).

Application of a combination of bio-phosphate and phosphorus chemical fertilizers could be a practical and useful method for increasing corn yields and reducing environmental pollution (Khatoon et al., 2011). The use of organic fertilizer of 300 kg / ha was a strategy to protect the environment from threats posed by organic waste (Arshad et al., 2008). Fertilizers using biogas residues provided higher yields than NPK and biogas residues which increased soil microbial activity (Abubaker et al., 2012). Bio-organic fertilizer which was a combination of manure compost with antagonistic microorganisms, as well as organic fertilizer was able to prevent plants from wilting and susceptible to disease (Qiu et al., 2012).

Field studies were conducted at Egerton University with two seasons for comparison. In first season, bioslurry fertilizer increased carrot yields 8.8% and 23.5% in season 2. Total dissolved solid of plant roots was 12.7% higher in season 1 and 13.2% in season 2 compared to controls. In conclusion, this study recommended 7.8 t/ha of bioslurry fertilizer to improve yield and quality of carrots (Jeptoo et al., 2013). Bio slurry from the anaerobic process could be used in fish ponds to produce plankton to feed fish, and could be applied to arable land and fertility fields, while biochar from pyrolysis was better used to improve soil on arable land (Orskov et al., 2012).

V. CONCLUSION

1. From the results of the analysis that had been carried out on the WWTP sludge by PT. X, it showed that the value for macro N component was 0.60%, P was 1.52%, K was 20.25%, and C/N ratio was 33.75. Whereas the C/N ratio value exceeded the compost quality standard according to SNI 19-7030-2004 which rangef from 10-20. It was caused by the

nitrogen value (N) which was too small when compared to the carbon value (C).

2. From the results of the analysis that had been conducted on compost produced by WWTP sludge by PT. X, it showed that the variation of compost with ratio of 2: 1: 1: 1 was the most effective while for the ratio of 1: 1: 1 could not meet the quality standards for compost, because the C/N ratio value of 26.70 was still above the quality standard compost according to SNI 19-7030-2004 which ranged from 10-20.
3. Observing from the study of technical aspects, that the highest yield of chilli productivity was in chilli plants with additional treatment of compost fertilizer from WWTP sludge by PT.X, with an increase of between 30% - 42.8% of chili crop yields with the addition of NPK Mutiara fertilizer treatment with the highest yield of 150 treatments, the addition of compost to area 2.
4. Observing from the economic aspects of the study, it showed that for the use of NPK Mutiara fertilizers, the average cost of fertilizing per 1 Ha of area was Rp. 40,500,000, - and the average yield of Rp. 49,166,700. As for compost, the average cost of fertilizing per 1 hectare of land was Rp. 21.00,000 and the average yield of Rp. 67,500,000.
5. Observing from the aspects of farmers' perceptions on compost produced by WWTP sludge by PT. X, for the level of knowledge of farmers about compost was in the less category (0-15). Meanwhile, the attitude of the farmers regarding compost processed by WWTP sludge was in the sufficient category (8-14).

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Effect of Cowpea Seeding Density on Growth Parameters and Grain Yield of Maize in a real Crop Situation in Northern Côte d'Ivoire.

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Abstract*— Soil depletion and degradation as well as climate variability are responsible for the decrease in agricultural yields and the poverty of the rural population in northern Côte d'Ivoire.The present study was conducted in a participatory manner with two (2) food producer groups from the villages of Kolokaha and Sohouo (Korhogo Department) to determine the density of semi cowpea seeding that maximizes the growth and yield of maize.In this perspective, three densities of cowpea tested in this system of association with pure maize culture during two growing seasons with two improved maize varieties and a local variety.This is the T0 treatment: pure corn culture; T1_SNL: corn + semi-cowpea in interbedded line; T2_SNLDI: corn + semi-cowpea in double line; T3_SNQ: corn + semi-cowpea staggered.The results show that improved varieties of maize produce more and grow faster than the local variety. At each of two study sites, there was no marked effect of cowpea seeding density on plant height and grain yield per unit area.Although the three association modalities are efficient, SNL and SNLDI association models, which are confirmed as the most competitive, can preferably be recommended in a rural environment. However, the study of the use of cowpea with corn could be considered to allow a better use of the soil resources and consequently an improvement of the productivity of the associated crops.

***Keywords*— Association, cowpea, maize, semi density, soil.**

I. INTRODUCTION

Soil depletion and degradation as well as climate variability are responsible for decrease in agricultural yields and worsening poverty in northern Côte d'Ivoire. With the strong land and demographic pressure observed in this zone, farmers are forced to practice continuous cultivation and to make the most of available land (N'guessan et al., 2019, N'goran et al., 2018), as is the case in the cotton zone of Burkina Faso reported by Coulibaly et al., (2012), Barro et al., (2016) and Ouattara et al., (2016). Today, farmers are worried about the fatigue of their soils, say that the land does not produce as before. In the cotton and maize cropping systems that predominate in the dense area of Korhogo Department, the use of mineral fertilizers alone does not maintain soil fertility.In this zone, legumes occupy only a marginal part in cropping systems, whereas they can play a very important role, whether grown in rotation or in association. Several studies conducted on legumes indicate that they can help improve soil fertility through the symbiotic fixation of nitrogen in the air (Gbakatchetche et al., 2010, Barro et al., 2016 and Ouattara et al. 2016, Kouassi et al., 2017), to produce quality feed for animals (Zoundi et al., 2006, Bambara et al., 2008 and Ouattara et al., 2016) and to provide income for agricultural exploitations.With the strong land and demographic pressure observed in recent years in the northern part of Côte d'Ivoire, the use of soil restoration techniques with tree legumes is becoming problematic. The use of herbaceous legumes thus becomes an alternative for improving soil fertility. Of these, cowpea is the best choice because it is one of the main sources of protein and food for the rural and urban populations of the area as well as for livestock.To do this, the research question that arises is the corn-legume combination mode that can reduce competition between crops and promote yield improvement. Therefore, this study was undertaken to help determine the seedling density of cowpea that optimizes growth parameters and grain yield of corn in the corn-cowpea association system.

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II. MATERIAL AND METHOD

Study site

The study was conducted in the villages of Kolokaha and Sohouo located in the sub-prefectures of Sinematiali and Sohouo in the Korhogo department respectively (***Figure 1***). These two villages are mainly populated by Senoufo natives whose main activity is agriculture and livestock. The general pattern of the region is a tabular set of ferruginous cuirasses with gentle breaks caused by garlands of hills and hillocks with rounded reliefs set on plateaus of medium height (Avenard et al., 1971).According to Beaudou and Sayol, (1980), the geological substratum consists of calc-alkaline granites of the Precambrian. The soil cover of this region is characterized by the very large predominance of ferrallitic soils (Avenard et al., 1971). At the climatic level, the savanna district is bathed in a two-season tropical Sudanian climate, a dry season from November to April and a rainy season from May to October.

Plant material

The plant material used consisted of three varieties of maize seed with or without local cowpea seed purchased from the Korhogo market (***Figure 2***). Corn seeds included two improved varieties, namely the Komsaya and EV 87 varieties and the local variety supplied by the farmers. The seeds of the Komsaya variety are characterized by yellow-orange grains of the dentate horn type. They have a crop cycle that ranges from 85 to 90 days with a potential yield of 8 to 9.5 t / ha for an optimal density of 60 000 plants / ha.This seed is suitable for areas receiving an annual rainfall ranging from 800 to 900 mm / year. The seeds of the selected variety EV 87 are composed of yellow-toothed grains characterized by a crop cycle that ranges from 80 to 95 days with a potential yield of 3 to 5 t / ha and an optimum density of 42. 500 plants / ha. It is suitable for areas receiving an annual rainfall of about 1000 mm.

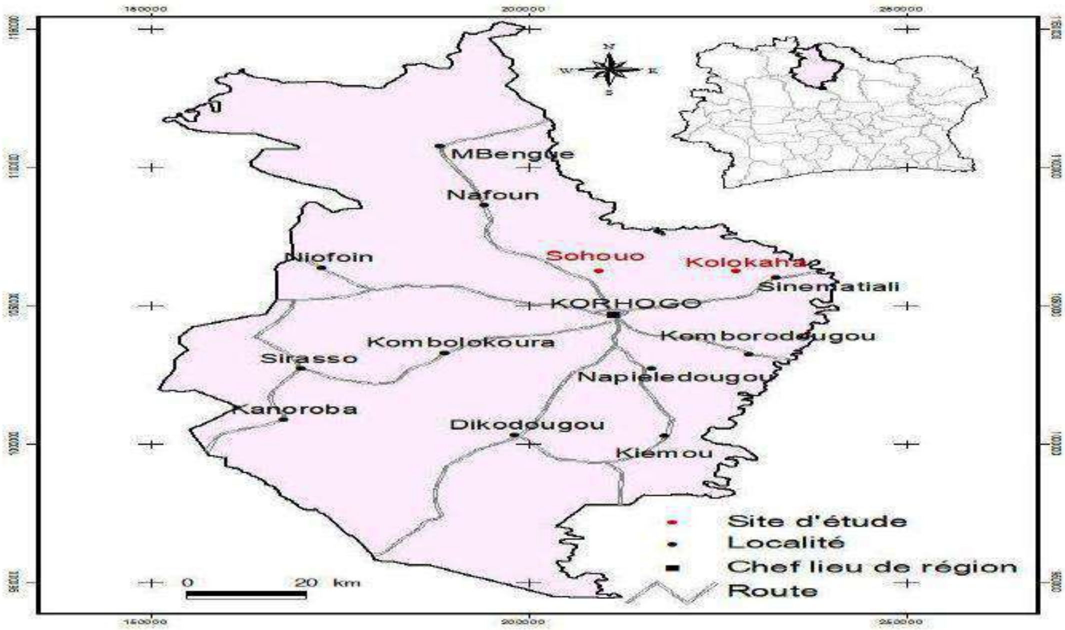

Fig.1: Map showing the location of the study areas.

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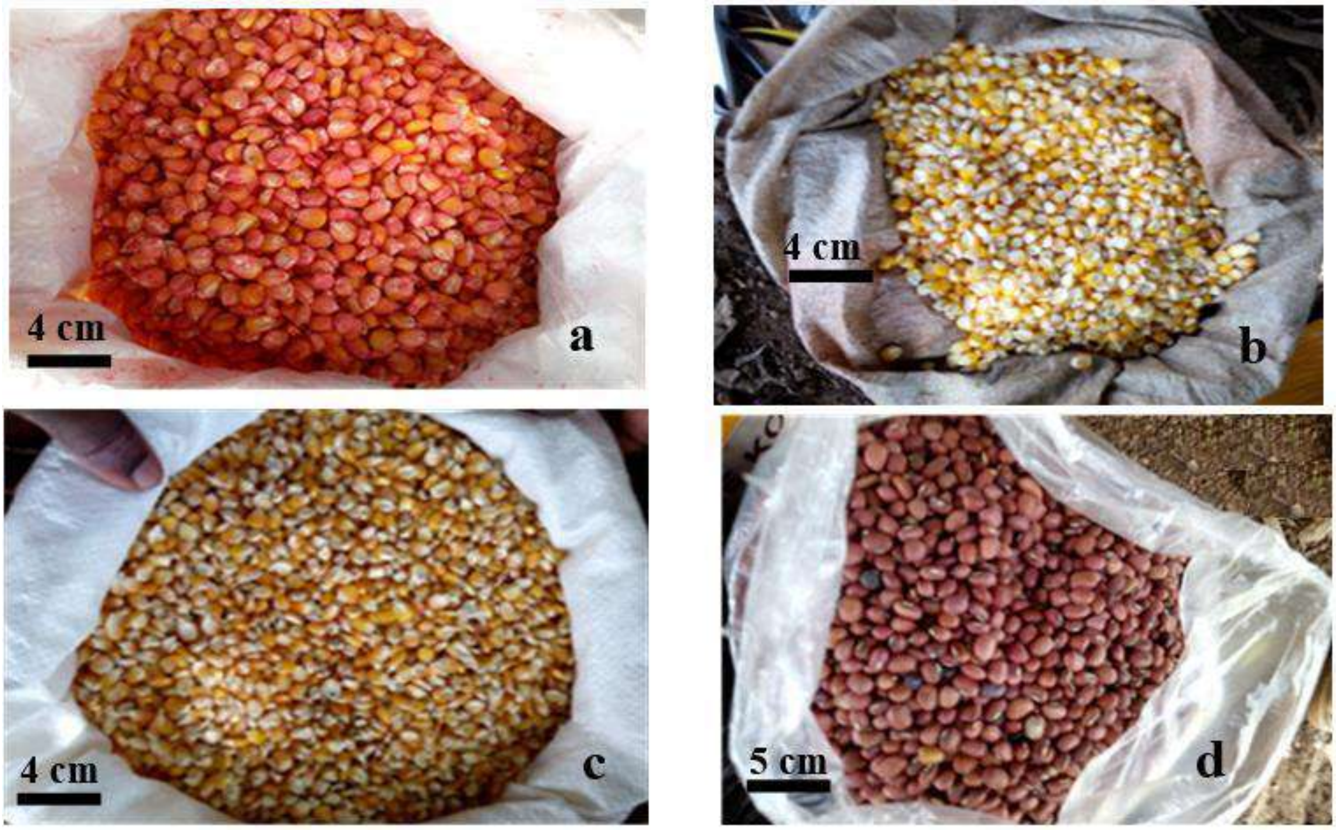

Fig.2: Morphological aspect of maize and cowpea grain seeds (a: Komsaya maize variety, b: Maize local variety, c: EV87 maize seed, d: cowpea seed)

According to the farmers, the seeds of the local variety can produce between 02 to 03 t / ha. Regarding cowpea, the seed is characterized by a cycle of 75 days. Its potential grain yield is 1.5 t / ha and is suitable for areas with annual rainfall ranging from 400 to 800 mm of water.

Establishment and operation of demonstration plots

Out of the nine villages benefiting from the project, the two groups of Kolokaha and Sohouo have a total of 50 direct beneficiaries, distributed among 35 members in Kolokaha (70%), including 03 men (8.42%) and 32 women (91%). , 43%) and 15 people in Sohouo (30%) with 02 men (13.33%) and 13 women (86.67%). In each of these villages, the members of the target groups were volunteers and the choice of the plot dedicated to the project and its location were done by the farmers themselves.They were trained in the proposed new technologies and participated fully in all the phases (semi, weeding, fertilizer spreading, harvesting, etc.) of the field work. In addition to agricultural inputs (improved maize seed, NPK fertilizer, urea, herbicides, insecticide), land preparation costs (clearing, plowing, spraying, herbicide pre-treatment of the plowed plot, etc.) were borne by the farmer project. On each of the demonstration plots, plowing followed by ridging was carried out using a bovine traction plow.The demonstration plot was then grided into 3 blocks and each block consists of 3 sub-blocks subdivided into 4 elementary parcels of 30 m2 measuring 6 m long and 5 m wide. Each of the sub-blocks within a block is dedicated to one of the three varieties of corn. The spacing between the elementary parcels within the block is 2 m and one block to another is 3 m. The operation of semi was done manually by the women of the two groups following spacings of 0.80 m in line and 0.30 m between the pockets.On each elementary plot, we had 13 lines and on each line, 15 poquets. two to three seeds were sown per poquet. Thus, each elemental plot of 30 m2 included 195 plants per unit of surface on all three blocks. In the association system, maize and cowpea were placed in the elementary plots of each block and under blocks according to the schematic combination mode in **Figure 3**:

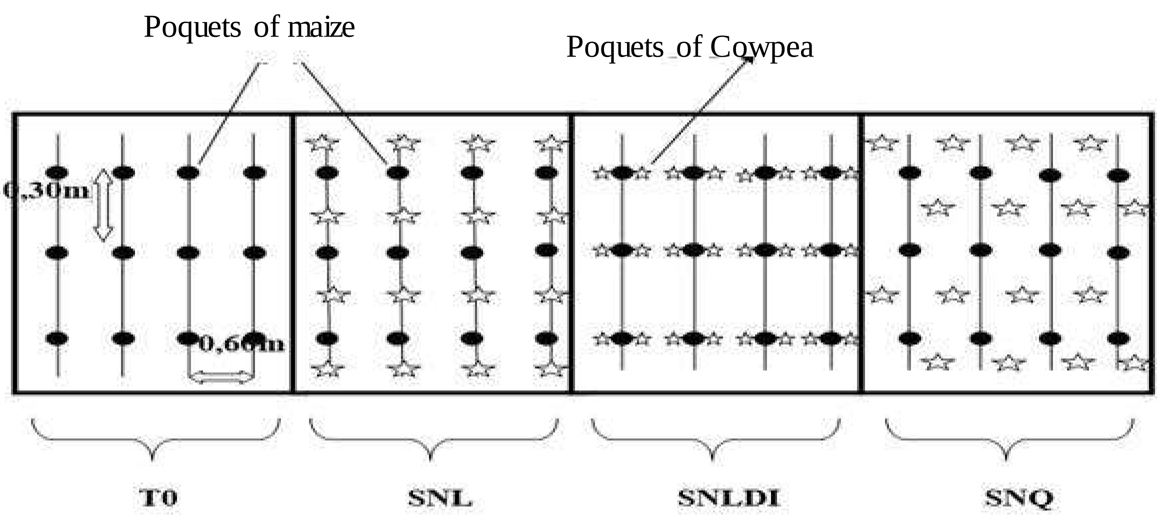

Fig.3: Maize and cowpea semi points in the association system

- **T0**: *maize seed in pure culture*
- **T1-SNL**: *corn-semi-cowpea seed interposed*
- **T2-SNLDI**: *semi-cowpea corn seed in double interbedded line*
- **T3-SNQ**: *semi-stale corn seed staggered*

There were 16 semi points when cowpea is sown in intercalated line (SNL) and quinconce (SNQ), or 16 cowpea plants per line for a density of 208 plants per elementary plot. In addition, when cowpea is sown in a double interspersed line (SNLDI), there were 32 plants on each line equivalent to a density of 416 plants/30m2. All of these plots benefited from fertilizer inputs and insecticide treatments. The study was conducted during two growing cycles covering the growing seasons of 2017 and 2018. During these two seasons, the semi intervened on the demonstration plots of the two villages in the periods from August 12 to 16, 2017 and July 10-15, 2018.

Agronomic data collection

On each of the two demonstration plots, monitoring of the height growth and development of maize plants on the elementary plots was carried out in a participatory manner with the members of the beneficiary groups for 02 months. During this period, observations were made every 15 days from the 30th day after semi (JAS); i.e. at the 30th; 45th and 60th JAS out of 12 plants randomly selected by elementary plot equivalent to 36 plants per treatment.Growth and development parameters described by Mbaye et al. (2014) and Barro et al. (2016) in the case of similar studies, were used to characterize the vegetative behavior of plants from the three maize seeds. During the culture phase, the variables measured were the height of the plants, the number of leaves produced per plant, the circumference of the collar stems at 10 cm from the soil, and the grain yield per unit area.

Statistical analysis

Comparison of the averages of the agronomic parameters tested for seedling density, variety and measurement dates was achieved by variance analysis (ANOVA) at the 5% probability threshold. When a significant difference is noted between the factors considered for a given trait, the test of the smallest significant difference (ppds) HSD of TUKEY was performed. All these statistical tests were carried out using STATISTICA 7.1 software. In addition, the evaluation of association performance was carried out by calculating the Surface Equivalent Rate (TSE) or Land Equivalent Ratio (LER) for each component of the association. When the value of the LER is greater than or equal to 1, the combination is more advantageous than pure cultivation. Otherwise, when the value of the LER is less than 1, the association is less advantageous than pure cultivation (Ghosh, 2004). This method is based on the formula of Mead and Willey (1980) described as following::

LERm= $\frac{YLm}{YSm}$

YLm : maize yield in combination,
YSm : corn yield in pure culture,
LERm : LER of maize.

III. RESULTS

Effects of the corn variety and the study site on plant growth parameters over the two growing seasons.

Tables 1 and 2 show, respectively, the average height, number of leaves produced and circumference at the

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collar during the growth of plants from the three maize varieties during the 2017 and 2018 crop seasons. These tables show that the variety of maize has significantly affected (p -0.0001) all of these parameters 30; 45 and 60 JAS regardless of the growing season.The results also show that the average values of these parameters increase over time and with variety, highlighting significant differences (P -0.0001) from 30 JAS. At the Kolokaha demonstration site, there was no significant effect of the maize variety on the number of leaves produced and the circumference at the collar of the corn plants 30; 45 and 60 JAS whatever the growing season. On the contrary, during the two growing seasons, there was a significant difference in the height of maize plants from 30 JAS. In fact, during this period, plant height is significantly higher in the Komsaya (season 1: 74.28 cm; season 2: 75.02 cm) compared to EV87 (season 1: 65.229 cm) and local (season 1: 60.625 cm; saiso n 2: 61,231 cm) which, moreover, have statistically identical values. However, although there is no significant difference, there is a slight increase in plant height in the EV87 variety compared to the local variety regardless of the growing season. This trend of evolution of plant height is the same after 45 and 60 JAS. In Sohouo, the plants behave in the same way for this variable regardless of the variety and the growing season 30 JAS. On this site, the difference between plant height occurs from 45 JAS up to 60 JAS. On these dates, the height of the plants is higher than the improved Komsaya variety compared to the other two varieties during the 2017 and 2018 growing seasons.The results also reveal that in Sohouo, the variety of maize did not significantly influence the circumference at the collar of corn plants 30; 45 and 60 JAS. In addition, data from Tables 1 and 2 show that maize plants grow faster on the Kolokaha demonstration plot compared to those grown in Sohouo regardless of variety and growing season.

Influence of cowpea seeding density and study site on corn plant growth and development parameters during both growing cycles

Tables 3 and 4 show, respectively, the average values of the growth and development parameters of maize plants based on seeding density. These tables show that cowpea seeding density had no significant effect on height, number of leaves produced and plant collar circumference regardless of date of measurement, study site and growing season.Nevertheless, on the Kolokaha demonstration plot and during the first growing cycle, there were 30 JAS, a trend of stunting of maize plants of 0.4% and 1.02%, respectively in low (SNL) and high (SNLDI) cowpea compared to a non-significant 3.08% increase in SNQ treatments compared to pure-grown maize plants.From this date, the sNL maize plants begin a slight growth in height with a non-significant increase of 3.48% and catch up with those of SNQ 45 JAS treatments up to 60 JAS compared to the reference treatment.

Table 1: Corn plant growth and development data 30 and 45 days after semi depending on variety and study site

Cycles	Var/Site	Measurement dates (days)					
		30			45		
		H	NF	DC	H	NF	DC
1	**Varkom_Kol**	74,28 ± 13,46^{a}	9,33 ± 1,47^{a}	1,21±0,21^{bc}	192,292 ± 30,20^{a}	11,514 ± 1,12^{ab}	2,65 ± 0,63^{ab}
	VarEV87_Kol	65,23 ± 12,32^{b}	9,38 ± 1.33^{a}	1,17±0,20^{c}	169,395 ± 36,56^{b}	10,972 ± 1,48^{b}	2,49 ± 0,59^{b}
	VarLoc_Kol	60,63±10,52^{bc}	8,99 ± 1.48^{a}	1,21±0,017^{bc}	164,222 ± 32,19^{b}	11,597 ± 1,28^{a}	2,59 ± 0,62^{ab}
	Varkom_Soh	57,17 ± 11,93^{cde}	7,80 ± 1,31^{bc}	1,25±0,23^{ab}	111,715 ± 25,18^{e}	8,569 ± 1,51^{cd}	2,20 ± 0,40^{cd}
	VarEV87_Soh	57,06 ± 15,86^{cde}	7,67 ± 1,39^{bc}	1,23 ± 0,23^{abc}	104,889 ± 25,82^{ef}	8,176 ± 1,36^{de}	2,19 ± 0,39^{cd}
	VarLoc_Soh	52,88 ± 15,92^{e}	7,14 ± 1,29^{d}	1,19 ± 0,20^{bc}	94,882 ± 22,84^{f}	7,993 ± 1,83^{e}	2,12 ± 0,34^{d}
2	**Varkom_Kol**	75,02 ± 13,60^{a}	9,43 ± 1,49^{a}	1,22 ± 0,22^{abc}	196,17 ± 30,85^{a}	11,51 ± 1,12^{a}	2,80 ± 0,46^{a}
	VarLoc_Kol	61,23 ± 10,63^{bc}	9,08 ± 1 ,50^{a}	1,22 ± 0,22^{bc}	167,53 ± 32,81^{b}	11,60± 1,28^{a}	2,788 ± 0,51^{b}
	Varkom_Soh	58,31 ± 12,17^{cd}	7,95 ± 1.34^{b}	1,30 ± 0,18^{a}	145,230 ± 32,73^{c}	8,912 ± 1,57^{c}	2,357 ± 0,32^{c}
	VarLoc_Soh	53,93 ± 16,24^{de}	7,28 ± 1,31^{cd}	1,24 ± 0,20^{abc}	123,347 ± 29,69^{d}	8,313 ± 1,91^{de}	2,255 ± 0,36^{cd}
	ANOVA						
	F	48,078***	62,833***	4,161***	183,423***	168,922***	47,656***
	P	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001

In the same column, the averages followed by the same letter are not significantly different to P -0.0001. ***H** : height ;**NF** : number of leaves produced per plant ; **DC** : circumference at the collar ; **Var:** variety; **Varkom**: Komsaya variety; **VarEV87**: variety EV87; **VarLo**c: Local variety; **Kol**: Kolokaha, **Soh**: Sohouo.*

Table 2: Corn plant growth and development data 60 days after semi depending on variety and study site.

Cycles	Var/Sites	Measurement dates (days)		
		60		
		H	NF	DC
1	**Varkom_Kol**	232,673±36,54^{a}	16,12 ± 1,56^{b}	3,232 ± 0,53^{ab}
	VarEV87_Kol	204,969±44,24^{b}	15,361 ± 2,07^{c}	3,122 ± 0,50^{b}
	VarLoc_Kol	198,709±38,95^{b}	16,236 ± 1,79^{ab}	3,217 ± 0,59^{ab}
	Varkom_Soh	117,301 ± 26,44^{d}	9,426 ± 1,51^{ef}	2,37 ± 0,31^{de}
	VarEV87_Soh	112,751 ± 30,66^{d}	9,067 ± 1,35^{f}	2,332 ± 0,41^{e}
	VarLoc_Soh	99,626 ± 23,98^{de}	8,792 ± 1,83^{f}	2,27 ± 0,35^{e}
2	**Varkom_Kol**	241,980 ± 38,00^{a}	16,764 ± 1,62^{ab}	3,362 ± 0,56^{a}
	VarLoc_Kol	206,657 ± 40,51^{b}	16,886 ± 1,86^{a}	3,345 ± 0,61^{a}
	Varkom_Soh	131,377 ± 29,61^{c}	10,558 ± 1,86^{d}	2,640 ± 0,36^{c}
	VarLoc_Soh	111,581 ± 26,86^{e}	9,847 ± 2,26^{e}	2,526 ± 0,40^{cd}
	ANOVA			
	F	385,848***	555,877***	132,133***
	P	<0,0001	<0,0001	<0,0001

*In the same column, the averages followed by the same letter are not significantly different to P -0.0001. **H**: height ;**NF**: number of leaves produced per plant ; **DC**: circumference at the collar ; **Var:** variety; **Varkom**: Komsaya variety; **VarEV87**: variety EV87; **VarLo**c: Local variety; **Kol**:*

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Table 3: Corn plant growth and development data based on cowpea seeding density and study site during the two 30 - and 45 JAS growing cycles

Cycles	DS/Sites	Measurement dates (days)					
		30			45		
		H	NF	DC	H	NF	DC
1	TSN_Kol	66,435 ± 11,92[ab]	9,624 ± 1,49[a]	1,193 ± 0,28[bc]	173,407 ± 35,82[ab]	11,370 ± 1,28[ab]	2,651 ± 0,72[bc]
	SNL_Kol	66,167 ± 12,11[ab]	9,380 ± 1,37[ab]	1,235 ± 0,19[abc]	179,444 ± 36,85[ab]	11,556 ± 1,28[ab]	2,745 ± 0,60[abc]
	SNLDI_Kol	65,759 ± 13,16[ab]	9,065 ± 1,26[ab]	1,164 ± 0,18[c]	169,806 ± 31,61[b]	11,083 ± 1,22[b]	2,586 ± 0,54[cd]
	SNQ_Kol	68,481 ± 16,01[ab]	8,806 ± 1,49[b]	1,194 ± 0,19[bc]	178,556 ± 35,89[ab]	11,435 ± 1,44[ab]	2,653 ± 0,57[bc]
	TSN_Soh	58,324 ± 18,10[cde]	7,565 ± 1,33[c]	1,235 ± 0,23[abc]	106,167 ± 31,07[e]	8,667 ± 1,84[cd]	2,246 ± 0,40[e]
	SNL_Soh	55,963 ± 14,92[de]	7,370 ± 1,19[c]	1,215 ± 0,19[abc]	102,454 ± 23,66[e]	8,176 ± 1,32[d]	2,210 ± 0,35[e]
	SNLDI_Soh	54,935 ± 12,98[de]	7,648 ± 1,43[c]	1,220 ± 0,20[abc]	107,787 ± 30,17[e]	8,194 ± 1,70[d]	2,218 ± 0,40[e]
	SNQ_Soh	53,583 ± 12,28[e]	7,565 ± 1,47[c]	1,226 ± 0,19[abc]	102,231 ± 20,78[e]	8,037 ± 1,41[d]	2,230 ± 0,39[e]
2	TSN_Kol	68,287 ± 12,66[ab]	9,777 ± 1,51[a]	1,228 ± 0,28[abc]	179,917 ± 38,02[ab]	11,673 ± ±1,09[ab]	2,811 ± 0,64[ab]
	SNL_Kol	64,836 ± 12,44[abc]	9,300 ± 1,42[ab]	1,265 ± 0,19[abc]	187,453 ± 33,76[a]	12,056 ± 1,17[a]	2,895 ± 0,44[a]
	SNLDI_Kol	68,371 ± 13,45[ab]	9,244 ± 1,30[ab]	1,163 ± 0,18[c]	175,270 ± 33,11[ab]	11,801 ± 1,18[ab]	2,745 ± 0,40[abc]
	SNQ_Kol	71,009 ± 16,64[a]	8,697 ± 1,59[b]	1,229 ± 0,17[abc]	184,648 ± 33,88[ab]	11,957 ± 1,28[a]	2,812 ± 0,40[ab]
	TSN_Soh	61,186 ± 17,85[bcd]	7,777 ± 1,30[c]	1,311 ± 0,20[a]	145,311 ± 39,56[c]	9,216 ± 1,98[c]	2,384 ± 0,36[de]
	SNL_Soh	54,839 ± 13,21[de]	7,466 ± 1,17[c]	1,226 ± 0,18[abc]	125,919 ± 27,04[d]	8,566 ± 1,47[cd]	2,384 ± 0,32[e]
	SNLDI_Soh	54,768 ± 12,65[de]	7,508 ± 1,47[c]	1,260 ± 0,19[abc]	135,525 ± 33,36[cd]	8,392 ± 1,92[cd]	2,291 ± 0,35[e]
	SNQ_Soh	53,692 ± 12,65[de]	7,721 ± 1,51[c]	1,277 ± 0,19[ab]	130,397 ± 28,28[cd]	8,277 ± 1,53[d]	2,321 ± 0,34[e]
	ANOVA						
	F	17,778***	38,045***	3,12***	99,501***	112,603***	32,814***
	P	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001

In the same column, the averages followed by the same letter are not significantly different to P -0.0001. ***H** : height ;**NF** : number of leaves produced per plant ; **DC** : circumference at the collar ; **Var:** variety; **Varkom**: Komsaya variety; **VarEV87**: variety EV87; **VarLo**c: Local variety; **Kol**: Kolokaha, **Soh**: Sohouo.*

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Table 4: Corn plant growth and development data based on cowpea semi density and study site during the two crop cycles at 60 JAS

Cycles	DS/Sites	Measurement dates (days)		
		60		
		H	NF	DC
1	TSN_Kol	209,823 ± 43,34^{bc}	15,919 ± 1,79^{cd}	3,181 ± 0,71^{bc}
	SNL_Kol	217,128 ± 44,59^{abc}	16,178 ± 1,80^{bcd}	3,294 ± 0,49^{abc}
	SNLDI_Kol	205,465 ± 38,25^{c}	15,517 ± 1,71^{d}	3,103 ± 0,45^{c}
	SNQ_Kol	216,052 ± 43,43^{abc}	16,009 ± 2,06^{cd}	3,183 ± 0,46^{bc}
	TSN_Soh	111,475 ± 32,62^{e}	9,533 ± 1,84^{fgh}	2,336 ± 0,40^{ef}
	SNL_Soh	107,576 ± 24,84^{e}	8,994 ± 1,32^{gh}	2,298 ± 0,34^{f}
	SNLDI_Soh	113,176 ± 31,68^{de}	9,014 ± 1,70^{gh}	2,306 ± 0,36^{f}
	SNQ_Soh	107,343 ± 21,82^{e}	8,841 ± 1,41^{h}	2,319 ± 0,34^{ef}
2	TSN_Kol	221,968 ± 46,87^{abc}	16,663 ± 1,58^{abc}	3,373 ± 0,77^{ab}
	SNL_Kol	231,266 ± 41,65^{a}	17,209 ± 1,70^{a}	3,474 ± 0,53^{a}
	SNLDI_Kol	216,235 ± 40,81^{abc}	16,360 ± 1,72^{abcd}	3,193 ± 0,48^{bc}
	SNQ_Kol	227,805 ± 41,82^{ab}	17,068 ± 1,86^{ab}	3,375 ± 0,48^{ab}
	TSN_Soh	131,451 ± 35,78^{d}	10,917 ± 2,35^{e}	2,670 ± 0,40^{d}
	SNL_Soh	113,909 ± 24,46^{de}	10,147 ± 1,74^{ef}	2,496 ± 0,36^{def}
	SNLDI_Soh	122,598 ± 30,18^{de}	9,942 ± 2,28^{efg}	2,566 ± 0,39^{de}
	SNQ_Soh	117,959 ± 25,58^{de}	9,805 ± 1,81^{fg}	2,600 ± 0,38^{d}
	ANOVA			
	F	195,458***	332,944***	80,777***
	P	<0,0001	<0,0001	<0,0001

*In the same column, the averages followed by the same letter are not significantly different to P -0.0001. **H** : height ;**NF** : number of leaves produced per plant ; **DC** : circumference at the collar ; **Var:** variety; **Varkom**: Komsaya variety; **VarEV87**: variety EV87; **VarLoc**: Local variety; **Kol**: Kolokaha, **Soh**: Sohouo.*

On the contrary, during the 2018 growing season, there is a trend of SNL and SNQ corn plants growing faster in heights of 4.19% and 2.63% respectively, and a slight growth delay of 2.58% in high density of cowpea semi (SNLDI) compared to pure-grown corn plants (NSTs).The same is true in Sohouo, where the overall trend in maize plants was recorded on all three measurement dates, respectively of SNL, SNLDI and SNQ treatments compared to pure-grown plants (NSTs) regardless of the growing season and the study site. Analysis of the data in Tables 3 and 4 also reveals a significant inter-site difference between the growth and development of maize plants. These tables show that the corn plants at the Kolokaha demonstration site have significantly, the highest average collar circumference values and move higher up on all measurement dates than those grown at Sohouo whatever the growing season.
+

Influence of the variety on corn grain yield during the first growing season.

Analysis of histograms in Figure 6 reveals a marked effect of variety on corn grain yield per unit area during the first growing season. The results indicate that in Kolokaha, grain yield per unit of surface area is significantly higher in the Komsaya variety (6.67 kg/30 m2) compared to EV 87 (4.02 kg/30 m2) and local (3.21 kg/30 m2) varieties, which, on the other hand, have statistically of the same production although the EV 87 variety has a slight performance compared to the local variety.This trend in corn yield is identical to that observed in Sohouo although no significant difference was found for this variable between variety. In fact, maize grain production is significantly higher in the Komsaya variety (0.67 kg / 30 m2) followed by the EV87 and local varieties with 0.40 kg / 30 m2 and 0.32 kg / 30 m2 respectively. In addition, Figure 6 shows that corn yield per unit area is significantly higher at Kolokaha than at Sohouo, whatever the variety.

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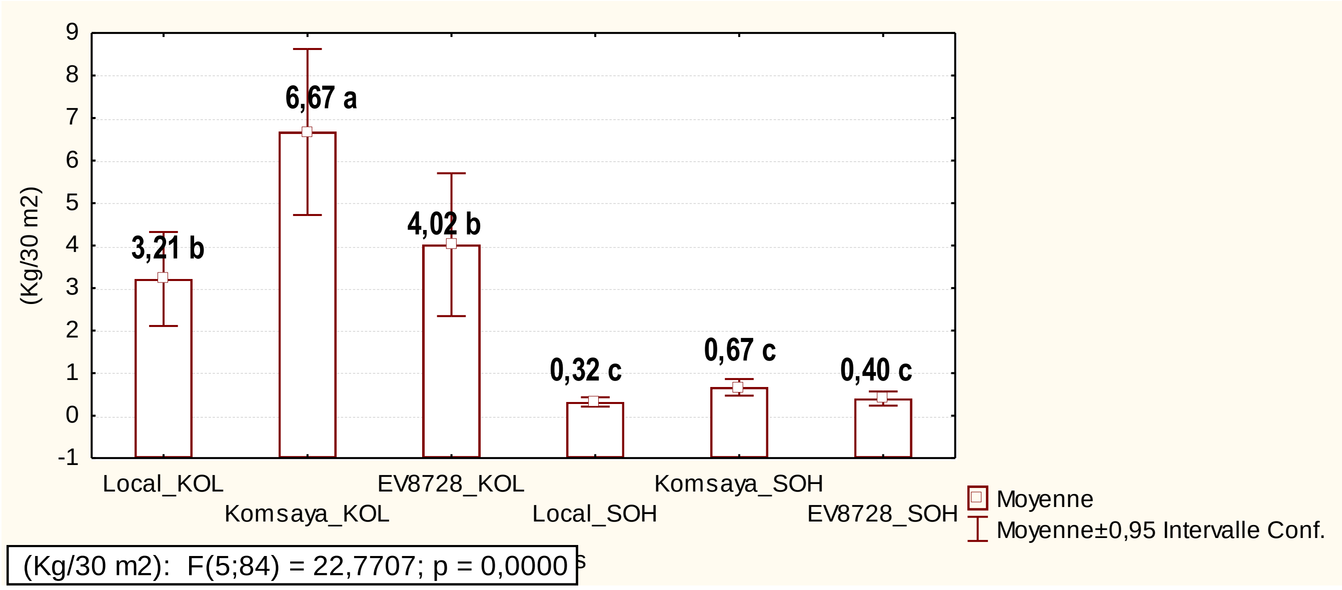

Fig.6: Evolution of maize grain yield during the first growing season

Influence of cowpea seeding density on corn grain yield during the two growing seasons

The results of Table 5 reveal that cowpea seeding density had no significant effect on corn grain yield produced per unit area regardless of the study site and growing season. However, in 2017, there was a downward trend in corn grain yield at each of the two demonstration sites with the seeding density of cowpea in elementary plots grown with improved Komsaya and EV87 against an increase in this parameter at the level of those grown with the local variety. In Kolokaha, the yield decline was 19.24%; 52.17% and 31.52%, respectively, in the SNL, SNLDI and SNQ elementary plots of the improved Komsaya variety and 52.82%; 55.98% and 74.28% at the elementary plots of the EV87 variety compared to pure-grown maize plots. On the Sohouo parcel, the trend decline in yield was 19.41%; 54.37% and 34.95%, respectively, in the SNL, SNLDI and SNQ elementary plots of the improved Komsaya variety and 53.75%; 53.75% and 71.25% in corresponding elementary plots grown with EV87.

Table 5: Corn grain yield per unit area based on density and the study site

Settings	Demonstration plots			
	Kolokaha		Sohouo	
	2017	2018	**2017**	2018
T0_Improved seed_Kom	9,2±5,30^{a}	8,15 ± 3,27^{b}	0,103±0,018^{a}	3,32± 1,81^{a}
T1 _SNL_Improved seed _Kom	7,43±2,18^{a}	8,82 ± 3,37^{b}	0,083±0,018^{a}	3,18± 1,40^{a}
T2_SNDL_Improved seed _Kom	4,40±1,85^{a}	8,45 ± 2,24^{b}	0,047±0,018^{a}	3,68± 2,42^{a}
T3 _SNQ_Improved seed _Kom	6,30±2,00^{a}	6,50 ± 4,09^{ab}	0,067±0,018^{a}	3,47± 2,89^{a}
T0_ Local seed	2,97±2,63^{a}	3,77 ± 1,05^{a}	0,033±0,018^{a}	2,83± 1,42^{a}
T1 _SNL_ Local seed	4,50±0,46^{a}	5,13 ± 1,43^{a}	0,047±0,018^{a}	3,08± 0,96^{a}
T2_SNDL_ Local seed	3,70±3,04^{a}	4,62 ± 3,95^{a}	0,040±0,018^{a}	4,53± 2,26^{a}
T3_SNQ_ Local seed	3,03±0,45^{a}	4,10 ± 1,95^{a}	0,033±0,018^{a}	2,47± 0,67^{a}
T0_Improved seed _EV87	7,27±5,17^{a}		0,08±0,018^{a}	
T1 _SNL_Improved seed _EV87	3,43±1,25^{a}		0,037±0,018^{a}	
T2_SNDL_Improved seed_EV87	3,20±1,67^{a}		0,037±0,018^{a}	
T3 _SNQ_Improved seed _EV87	1,87±0,40^{a}		0,023±0,018^{a}	
ANOVA				
F	2,06	3,07	1,83	0,65
P	0,067	0,01	0,10	0,71

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In the same column, the averages followed by the same letter are not significantly different at P <0.05. F: frequency; P: probability.

On the other hand, during the 2018 crop season, there was a non-significant increase in corn grain yields in elementary plots in cowpea-associated crops in both demonstration plots compared to pure-grown plots for each of the two varieties. In Kolokaha, apart from the SNQ elementary plots of the Komsaya maize variety, where there was a downward trend of 20.24%, yield growth was 8.22% and 3.68% respectively in the SNL and SNLDI elementary plots with improved variety and 36.07%; 22.28% and 8.75%, respectively, in the SNL, SNLDI and SNQ elementary plots corresponding to the local variety compared to pure-grown plots.Thus, on the Kolokaha plot, there was a slight performance of corn grain yield in the SNL elementary plots followed by SNLDI for each maize variety compared to the pure-grown elementary plots. In Sohouo, during the 2018 crop season, there was a trend decline in yield of 3.92% and 13.07% respectively in the elementary SNL plots of the improved Komsaya and SNQ variety of the local variety in contrast to a non-increase yield of 11.18% and 4.53% at the SNLDI and SNQ elementary plots of the improved Komsaya variety and 8.83% and 60.07% at the SNL and SNDL parcels of the local variety. In Sohouo, the SNLDI association modality was more efficient regardless of the variety of maize, followed by SNL and SNQ treatments respectively with the local and improved varieties.

LER values of different cowpea seeding densities

Table 6 shows the LER values obtained from the different seeding densities of the cowpea. During the 2017 growing season, LER values are below 1 when corn seeds of improved varieties are associated with cowpea and greater than 1 in this system of association with the local variety regardless of the study site. On the contrary, during the 2018 crop season, it was observed that LER values are above 1 regardless of the seeding density and maize variety except, the SNQ elemental plots of the improved Komsaya variety at the Kolokaha site and SNL and SNQ resp Komsaya and local varieties in Sohouo.

Table 6: LER values obtained from different cowpea seeding densities

Settings	LER value			
	Kolokaha		Sohouo	
	2017	**2018**	**2017**	**2018**
T1 _SNL_ Improved seed_Kom	0,81	1,08	0,82	0,96
T2_SNDL_ Improved seed_Kom	0,48	1,04	0,46	1,11
T3 _SNQ_ Improved seed_Kom	0,68	0,80	0,65	1,05
T1 _SNL_ Localseed	1,52	1,36	1,42	1,09
T2_SNDL_ Localseed	1,25	1,22	1,21	1,60
T3_SNQ_ Localseed	1,02	1,09	1,00	0,87
T1 _SNL_ Improved seed_EV87	0,47		0,46	
T2_SNDL_ Improved seed_EV87	0,44		0,46	
T3 _SNQ_ Improved seed_EV87	0,26		0,29	

IV. DISCUSSION

Comparison of the three maize varieties according to agronomic parameters

During the two years of testing, the results revealed that corn plants of the improved Komsaya and EV87 varieties grow faster and produce more than local seed plants. This performance of the seeds of the improved varieties is due to the difference between genotype, cultivation techniques and environmental effects (soil quality, temperature, quantity and frequency of rains, relative humidity, etc.). This reflects significant inter-variety variability and is consistent with the work of N'Zué et al., (2004) and Djinabou et al., (2018) which have achieved similar results on cassava varieties in Côte d'Ivoire and southern Benin. This result is also consistent with those of Moussa et al. (2018) which noted this performance in other improved maize varieties in southwestern Niger. These authors unanimously agree that improved varieties yield significantly higher yields than local varieties. Thus, it could be confirmed that the improved seeds Komsaya and EV 87, are genetically stable and effectively suitable for the study area. Our results also indicate that maize plants grow faster on the Kolokaha demonstration plot compared to those grown in Sohouo regardless of variety and growing season. The same is true for corn grain yield harvested per unit area at these two sites during the 2017 and 2018 crop seasons.The underperformance of maize plants observed on the Sohouo plot may be related to its continued strong exploitation as a result of the lack of fertile land available in the cotton basin of the dense

Korhogo area reported by N'guessan et al., (2019) and N'goran et al. (2018) compared to Kolokaha, which is very little used. As a result, in Sohouo, there has been a general decline in fertility and soil productivity, the plot of which is characterized today by its high sand wealth (78.17 per cent) particularly coarse sand (61.28%) and clay poverty (10.17 per cent) and organic carbon (0.93%) compared to the ground of the Kolokaha plot as evidenced by the results of the work carried out on this project by Gnagne (2019). This negatively impacts the texture and gives the soil of the sohouo plot, poor water retention between rains and a tendency to dry out very quickly and easily lose the fertilizers brought by leaching and joins the observations of N'guessan et al., (2019). Moreover, the results of Gnagne's work (2019) confirmed the low soil richness of the Sohouo plot in mineral elements including nitrogen, potassium, calcium and magnesium and a deficiency of nitrogen compared to phosphorus. In view of the above, low physical and chemical fertility of the soil would be one of the main causes of the poor yield of corn grains obtained in Sohouo compared to that of Kolokaha. For, according to Barro et al., (2016), maize is very demanding in fertiliser and, it is very difficult to get good yields on soils poor in fertilizer elements (NPK, Urea, ...).

Effect of cowpea seeding density on corn growth and yield parameters

In order to optimize the maize/cowpea combination, the choice of seedling density remains a crucial step (M'BAYE et al., 2014; Barro et al. (2016) that would better manage arable space (M'Baye et al., 2014) and help improve soil fertility by symbiotic nitrogen fixation in the air (N'goran et al., 2011; Coulibaly et al., 2017). Based on field work, the results indicate that cowpea seeding density had no significant effect on corn grain growth and yield parameters per unit of land regardless of study site and season. These results are in line with those of N'guessan et al., (2010) and Foidl et al. (2001) who observed that the increase in seeding or planting density does not affect the individual performance of the plants, since the density remains below the level of occurrence of food competition between plants. As a result, the corn plants in each of the two demonstration plots behaved substantially in the same way regardless of the seeding density of the cowpea and the growing season. Based on our results, it could be said that the three methods of combining cowpea tested are indeed suitable for maize in associated crops. Nevertheless, looking at our data, we note during the 2017 growing season that the increase in the seeding density of cowpea tends to induce a decline in yield per unit of surface and a delay in the growth and development of corn from elementary plots in associated cultivation compared to pure-grown plants.This result is consistent with those of Coulibaly et al., (2017) and N'goran et al., (2011), which achieved similar results in assessing the performance of food corn-legume swings and yam-legumes in western Burkina Faso and in Central West Côte d'Ivoire. It joins the work of Kouassi et al., (2017) and N'guessan et al., (2010) who have made similar findings with three varieties of cowpea and plants from savannah tea cuttings (Lippia multiflora) tested respectively between three and four seeding and planting densities in Côte d'Ivoire. They also corroborate the findings of Ayaz et al. (2004) reported by Pageau et al. (2006) which, in Canada, observed that the increase in pea stand density reduced the number of grains per pod and the number of pods per plant. Under the conditions of the experiment, our results could be explained by the semi-simultaneous maize and cowpea which favored, in the elementary plots in associated culture, a competition between the plants for the water and nutrients resources. Therefore, the shift of semi, as recommended by Kouassi et al. (2016), M'baye et al. (2014) and Coulibaly et al. (2012) could allow a better use of the resources of the soil and consequently an improvement in the productivity of the associated crops.In addition, our results revealed that the downward trend in corn grain yield and stunting are more pronounced in the seeds of the improved Komsaya and EV87 varieties in associated crops, with an LER value of less than 1 , against an increase in this parameter at the level of those grown with the local variety for an LER greater than 1. This result suggests that the association of cowpea with maize was beneficial only with local corn seed and there was no productivity-saving association in this system with improved seeds.It is thought that climate variability as described by Dekoula et al., (2018a), Dekoula et al., (2018b) and Noufé et al., (2015), may be responsible for the underperformance of plants of improved varieties compared to local seeds. Indeed, the rainfall irregularities observed during this crop ping could be a major handicap to the possibilities of expression of the characters and the recovery of soil moisture by corn plants of improved seeds compared to local seeds that appear to be more drought-resistant. Added to this is the low physical and chemical fertility of the soils of the locality of Sohouo and Kolokaha reported by Gnagne (2019). On the other hand, in the second year of the trial, on each of the two demonstration plots, there was a slight performance of corn grain yield in the associated elementary plots for each maize variety compared to the pure culture with an LER greater than 1. This result could be correlated with the previous crop that allowed maize plants to benefit from the back effect of soil fertilizer as reported by Barro et al., (2016) as well as nutrients from the decomposition of crop residues Previous. According to Coulibaly et al., (2017), the biomass supplement from legumes can increase in a non-significant 10-43% increase in total forage production on the association plots compared to the pure corn plot. This is an asset inthatcoulibaly et al., (2017) advocate for environments where soils are poor due to over-exploitation and where there is a lack of fodder for animals, food crop associations with legumes to ensure forage safety (forage production), food security (food production) and improve soil fertility. Specifically, our data revealed that the performance of corn plants is more pronounced in Kolokaha in the basic Plots SNL followed by SNLDI compared to pure-grown treatment. This justifies the fact that, with a low density of cowpea (SNL), competition between maize and cowpea is reduced while promoting good maize production. On the other hand, the SNLDI association of the high density of cowpea seeding has been more effective in Sohouo, regardless of the variety of maize. It is followed by SNL and SNQ treatments respectively with local and improved varieties. It is thought that the high density of seeding-SNLDI has led to a gain in maize productivity due to the maintenance of sufficient moisture and soil enrichment of the corresponding plots of nutrients, notably organic carbon and nitrogen. Because the functioning and performance of cereal-legume associations depend heavily on the nitrogen availability of the environment (Naudin et al., 2010). Overall, it can be said that maize can be associated with legumes without significantly decreasing its yield. A good control of the density and the semi lag of cowpea can lead to better yields and this would have an advantage in the management of land that is becoming increasingly scarce with population growth.

V. CONCLUSION

The results of this work show that corn plants in the improved Komsaya and EV87 varieties grow faster and produce more than local seed plants. Cowpea seeding density does not significantly affect all growth parameters and corn grain yield per unit area. Nevertheless, during the first year of testing, the increase in cowpea semi density tends to induce a decline in yield per unit of surface and a delay in the growth and development of corn plants in the elementary plots in cultivation compared to pure-grown plants. On the other hand, there was a slight performance of corn grain yield in the associated elementary plots in the second year of the trial. Although the three methods of association are effective, the SNL and SNLDI association models that confirm themselves as the most competitive can, preferably, be recommended to farmers. However, the study of the shift of cowpea with corn could be considered to allow a better use of the soil resources and consequently, an improvement of the productivity of the associated crops.

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P-Available Enhancement Mechanism through Combinations of Organic Matters and Incubation Period in Psammentic Paleudults Soil

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Abstract— *Understanding the mechanisms underlying the availability of phosphorus (P) is important for improving soil productivity Psammentic Paleudults. This research aimed to determine the mechanism for increasing phosphorus availability due to the application of various organic matters and incubation period in the Psammentic Paleudults soil from Labuhan Batu Selatan District, Sumatera Utara Province. This research was conducted at the Research Laboratory of Faculty of Agriculture, Universitas Sumatera Utara, using Factorial Completely Random Design with 2 treatment factors and 3 replications. Factor 1 was organic matters (20 tons/ha) consisting of Control, Tithonia diversifolia Compost, Durian Skin Compost, Empty Fruit Bunches Compost, Chicken Manure, Tithonia diversifolia Compost + Chicken Manure, Durian Skin Compost + Chicken Manure and Empty Fruit Bunches + Chicken Manure. Factor 2 was the incubation period consisting of 1 week incubation, 2 weeks incubation, 3 weeks incubation and 4 weeks incubation. The results showed that the combination of Tithonia diversifolia compost with chicken manure was able to increase P-available soil higher and reduce Al-P and Fe-P content.Organic matters incubation for 3 weeks reduced soil Al-P and Fe-P content. The interaction of compost Tithonia diversifolia + chicken manure with 3 weeks incubation was the best treatment increasing soil P-available and reducing Al-P and Fe-P content in Psammentic Paleudults soil.*
Keywords— ***phosphorus; organic matter; incubation; Psammentic Paleudults.***

I. INTRODUCTION

Psammentic Paleudults soil is one of Ultisol soil sub-group formed by sand as its main material with base saturation (BS) <35%, cation exchange capacity (CEC) <16 me/100g and has a relatively low C-organic content [15]. Besides that, this soil has a texture of sandy clay to sand, causing a capacity to withstand nutrients and low water hence it is prone to drought.

The chemical characteristics of Psammentic Paleudults in Silankitang Subdistrict, Labuhan Batu Selatan District, Sumatera Utara Province are characterized by very acidic soil reactions (pH 4.31 - 4.49), low soil CEC (12-14 me/100 g) and poor in macro-nutrient, especially Phosphorus (low P-total) [11].In acidic mineral soils generally, the availability of dissolved Al and Fe elements were higher, causing these ions to react very rapidly with P to form Al and Fe phosphate minerals [1] hence the P availability of this soil is low [2] and will interferest with plant growth and productivity [19]

Efforts that can be done to improve the productivity of Psammentic Paleudults are through liming, fertilizing and applying organic matters. Liming is done to increase soil pH and also to suppress the saturation of Al ions hence they can maintain P supply.But in practice, these efforts face obstacles such as over liming (excessive use of limestone) causes P fixation by Ca and also the use of excessive or unbalanced P fertilizer causes eutrophication of water bodies such as rivers and lakes (not environmentally friendly).

The application of organic matters can be used to overcome nutrients problems and increase soil productivity. Organic matters in the decomposition process produce organic acids that can bind Al and Fe thereby reducing P fixation in the soil [18].It is generally assumed that phosphorus (P) availability for plant growth on highly weathered and P-deficient tropical soils may depend more on biologically mediated organic- P[15]

The application of organic amendments such as crop residues and manure, either singly or in combination will support increased soil fertility and low water holding capacity [13], further consistently enhanced maize crop growth and development[8]. Organic matters sourced from plant tissues such as empty fruit bunches,durian skin and *Tithonia diversifolia*is generally more difficult to decompose when compared to organic matters sourced from animal residues such as chicken manure. Hence the combination of some plant residues with chicken manure besides being able to enrich nutrients which will improve the quality of these organic matters also assists in accelerating the mineralization process.At the time of organic matter application in the soil, incubation is needed. Hence the mineralization process of organic matter occurred, which becomes the supplier in fulfilling the phosphorus nutrients for plant growth and yield. The effect of organic matter application on P availability in acid soils can be directly through the mineralization process and indirectly by assisting the release of P which is bound to Al and Fe [17].The mechanism for increasing P-available in the soil is the process of making P in the soil change from bound-solid phase form which does not dissolve into a form that can be absorbed by plants.

II. MATERIALS AND METHODS

Place and time of research

This research was conducted at the Research Laboratory of the Faculty of Agriculture, Universitas Sumatera Utara - Medan and the Asean Agri Research and Development Laboratory - Tebing Tinggi. This research was conducted from February 2016 to July 2016.

The material used for this research was a sample of Psammentic Paleudults soil taken from Kampung Dalam Village, Silangkitang sub-district, Labuhan Batu Selatan District, Sumatera Utara Province at a depth of 0-20 cm compositely.The organic matters used were Tithonia diversifolia compost, oil palm empty fruit bunches, durian skin compost and chicken manure and other chemicals used for soil analysis in the laboratory.

The tools used for this research were GPS, clinometer, ground drill, pH meter, Spectrophotometer, Atomic Absorption Spectrophotometer (AAS) and other equipment for analysis needs.

Materials and methods

This research used a factorial Completely Randomized Design (CRD) with 2 (two) treatment factors and 2 replications, namely: Factor I: Organic Matter namely Without Organic Matters (0 tons Ha^{-1}), Compost of *Tithonia diversifolia* (20 tons Ha^{-1}), Compost of Durian Skin (20 tons Ha^{-1}), Compost ofEmpty Fruit Bunches (20 tons Ha^{-1}), Chicken Manure (20 tons Ha^{-1}), Compost of *Tithonia diversifolia* (10 tons Ha^{-1}) + Chicken Manure (10 tons Ha^{-1}), Compost of Durian Skin (10 tons Ha^{-1}) + Chicken Manure (10 tons Ha^{-1}), Compost of Empty Fruit Bunches (10 tons Ha^{-1}) + Chicken manure (10 tons Ha^{-1}).Factor II: Incubation Period: Incubation in 1 week, Incubation in 2 weeks, Incubation in 3 weeks, Incubation in 4 weeks. Based on the above combination, 64= (8x4x2) experimental units were obtained.

The sampling of Psammentic Paleudults soil from Kampung Dalam Village, Silangkitang Subdistrict, Labuhan Batu Selatan District, Sumatera Utara Province was carried out at a depth of 0-20 cm with a zigzag method and then composite. After that, the soil sample was air-dried and sieved with a 10 mesh sieve. Next, the soil sample was put into a plastic pot, equivalent to 2 kg of dry air.Initial soil analysis included pH H_2O and pH KCl using Electrometry method, Cation Exchange Capacity (CEC) NH_4Oac extraction pH 7 (me/100g), Al-exchangeable KCl 1N extraction (me/100g), Bases-exchangeable (Ca, Mg, K, Na) NH_4OAc extraction pH 7 (me/100g), Base Saturation (BS) (%), Aluminum Saturation (%), P-available using Bray II (ppm) method.Compost made from empty fruit bunches (EFB), durian skin and *Tithonia diversifolia* (T. *diversifolia*) plants before composting were chopped using a chopper. Next, each one was put in a separate open plastic bucket and applied the EM 4 (Effective Microorganism 4).To speed up the composting process each material was reversed every week and watered to maintain temperature and humidity. Furthermore, chicken manure before being applied was put into open plastic burlap for 1 week.

The application of compost and chicken manure according to the treatment with a dose equivalent to 20 tons H^{-1} was put into a pot that has been filled with soil as much as 2 kg and stirred evenly until homogeneous. Then each one was incubated according to the treatment for 1 to 4 weeks.The parameters measured for each incubation period included: pH H_2O Electrometry method, C-organic (%) Walkley & Black method, P-available contents (ppm) Bray II method, Al-P content (ppm), and Fe-P content (ppm) the method of Chang & Jackson [10]

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III. RESULTS AND DISCUSSION

Soil Reaction (pH H_2O)

General the effects of incubation interactions from 1 to 4 weeks, soil pH increased higher in the application of compost combinations with chicken manure compared to controls and by compost application without chicken manure (Table 1). The highest pH value was 7.07 (neutral) obtained in the combination treatment of chicken manure with an incubation period of 2 weeks followed by Compost *Tithonia diversifolia* + Chicken Manure with an incubation period of 1 weeks which was 7.07 (neutral) while the lowest pH of 4.73 (acid) was obtained in Control with an incubation period of 1 weeks.

Table 1. Effect of applying organic matter and incubation period on soil pH

Organic Matter	Incubation Period (Weeks)				mean
	1	2	3	4	
Control	4.73j	5.31hij	5.21ij	4.78j	5.01
Compost*T diversifolia*	5.77ghi	6.35c-g	6.03fg	6.04fg	6.05
CompostDurian Skin	5.87gh	5.92gh	6.55b-f	5.77ghi	6.03
CompostEFB	6.25efg	6.03fg	5.87gh	5.86gh	6.00
Chicken Manure	6.68a-e	7.17a	6.92abc	6.59b-f	6.84
Compost*T.diversifolia* + Chicken Manure	7.07ab	6.87a-d	6.90abc	6.31d-g	6.79
CompostDurian Skin+ Chicken Manure	6.93ab	6.60b-f	7.01ab	6.29d-g	6.71
Compost EFB+ Chicken Manure	6.37c-g	6.13efg	5.93gh	5.90gh	6.08
Mean	6.21	6.30	6.30	5.94	

Note: The numbers followed by the same letters in the same column and row were not significantly different from the DMRT test at the 5% level.

The average value of soil pH showed that the interaction without organic matter application with an incubation period of 1 to 4 weeks soil pH ranged from 4.73 - 5.31 with acidic criteria to slightly acidic but after being treated with organic matter the soil pH increased to 5.77 - 7.17 with criteria slightly acidic to neutral.The increasing of soil pH was caused by the decomposition of organic matter during incubation produces organic acids which can chelate Al ions to form complex compounds (chelate) hence Al is not hydrolyzed again. This was consistent with Suntoro's (2001) report which stated that the application of organic matter to acid soils such as Ultisol can increase soil pH and decrease Al-exchangeable [16].An increase in soil pH will also occur if the organic matter applied has been decomposed further because the mineralized organic matter will release the mineral in the form of basic cations.

Soil C-Organic (%)

The application of various organic matters can significantly increase the C-Organic content of Psammentic Paleudults soil compared to control (Table 2). Treatment compost Durian Skin produced the highest soil C-organic content, from 0.62% to 1.34%, hence an increase in soil C-organic content was 0.72%. This was because carbon content as the main constituent of the two organic matters itself is higher hence by adding organic matter in the form of durian skin and empty fruit bunches compost can increase the C-organic content in the very low Psammentic Paleudults soil.

Table 2. Effect of applying organic matter and incubation period on soil C-organic

Organic Matter	Incubation Period (Weeks)				Mean
	I1	I2	I3	I4	
	-------------------%------------------				
Control	0.75	0.66	0.58	0.50	0.62d
Compost *T diversifolia*	1.16	1.13	1.02	1.07	1.10c
Compost Durian Skin	1.25	1.63	1.37	1.10	1.34a
Compost EFB	1.52	1.26	1.23	1.15	1.29ab

Chicken Manure	0.96	1.03	1.02	1.00	1.00c
Compost *T.diversifolia* + Chicken Manure	1.16	1.17	1.17	1.11	1.15bc
Compost Durian Skin + Chicken Manure	1.19	1.20	1.13	1.08	1.15bc
Compost EFB + Chicken Manure	1.11	1.16	1.17	0.77	1.05c
Mean	1.14a	1.15a	1.09ab	0.97b	

Note: The numbers followed by the same letters in the same column and row were not significantly different from the DMRT test at the 5% level.

The incubation treatment for 4 weeks can reduce the soil C-organic content of Psammentic Paleudults. Starting from C-organic soil 1,14% fell to 0.97%.This was due to the mineralization of organic matter with the increasing of incubation period hence the residual mineralization of the plant will be further which at first the C-organic content of plant was higher will be lower because carbon was used by microbes as an energy source and some of the carbon was lost and become CO_2.In accordance with Jama **et. al**., statement, which stated that incubation, is carried out to be able to provide an opportunity for microorganisms to develop and metabolize to decompose organic matter into inorganic compounds [7].

The relationship of incubation period with the content of soil C organic (Figure 1) was a linear line equation Y = -0.0557 X + 1.2267 and r2 = 0.88. From this relationship showed a negative tendency, namely the longer the incubation period, the soil C-organic will decrease. The incubation treatment can reduce soil C-organic by 1.22%. Every 1% of incubation period affects the decrease in soil C-organic content by 0.05%. This linear correlation equation model was strong enough to be accepted because it includes 88% of the effect of the incubation period on the soil C-organic content, while the other external influences were 12%.

The relationship of incubation period with the content of soil C- organic can be seen in Figure 1.

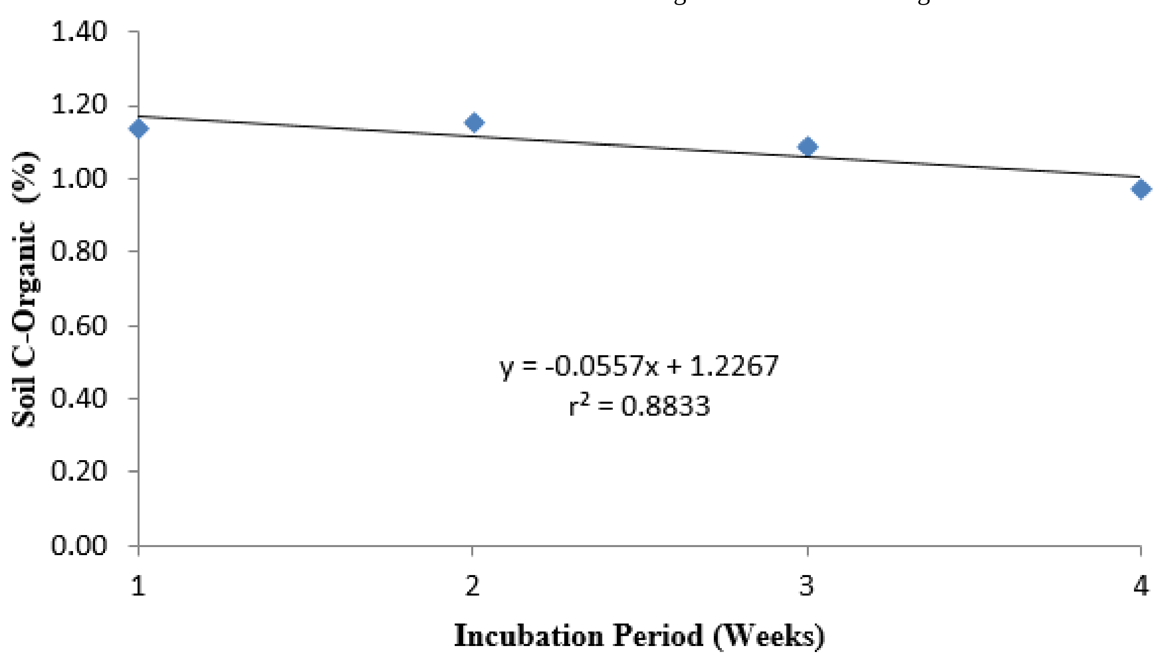

Fig.1: Relationship between incubation period and soil C-organic content

Soil Al-P Content (ppm)

Table 3. Effect of applying organic matter and incubation period on soil Al-P

Organic Matter	Incubation Period (Weeks)			
	1	2	3	4
	------------------ ppm ------------------			
Control	182.32	173.41	170.56	169.42
Compost *Tithonia diversifolia*	141.88	136.38	133.49	132.33
Compost Durian Skin	149.27	147.39	144.81	143.77
Compost Empty Fruit Bunches	153.42	151.93	149.87	150.22
Chicken Manure	150.03	148.30	147.57	144.20
Compost *Tithonia diversifolia* + Chicken Manure	124.33	123.15	119.61	121.91
Compost Durian Skin + Chicken Manure	141.63	133.99	130.36	135.93
Compost EFB + Chicken Manure	149.28	148.43	139.47	145.04
Mean	149.02a	145.37b	141.98b	142.85bc

Note: The numbers followed by the same letters in the same column and row were not significantly different from the DMRT test at the 5% level.

The application of all organic matter independently capable of significantly reducing the soil Al-P content compared to treatment Control (Table 3). Furthermore, the application of a combination of organic matter on Compost *Tithonia diversifolia*+ Chicken Manurewas able to reduce Al-P soil more than other treatments, from 173.93 ppm to 122.25 ppm. Thus a decrease in the content of Al-P soil Psammentic Paleudults due to the application of Compost *Tithonia diversifolia* + Chicken Manure amounted to 29.71%.The high ability of *Tithonia diversifolia* compost and chicken manure in reducing Al-P content was due to the fact that *Tithonia diversifolia* and chicken manure through decomposition have the ability to produce organic acids namely citric acid, acetate and malic acid which are higher than other organic matters, according to Magdoff and Ray, these acids produce ions which can break the bonds between P and Al hence P becomes available[9].Furthermore, by Winarso et al. added organic decomposition substances to release humic compounds, which can decompose metals including Al in acid so that they can release Al activity and P fixation on acidic soils[20]. The effect of incubation from 2 and 4 weeks significantly reduced the soil Al-P content compared with 1-week incubation and the lowest at 3 weeks incubation. The relationship of the incubation period of organic matter with the soil Al-P content can be seen in Figure 2.

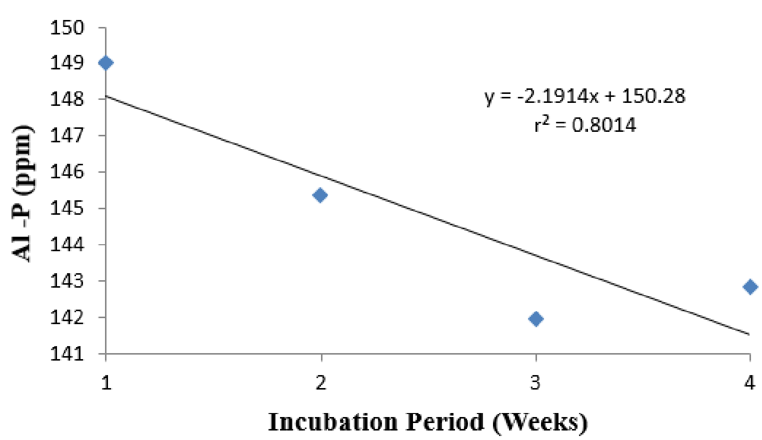

Fig.2: Relationship of Al-P soil with incubation period

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Based on Figure 2, it can be seen that the soil Al-P content decreases linearly with the equation Y = -2.1914X + 150.28 with the regression coefficient r^2 = 0.8014. From this relationship showed a negative tendency, namely the longer the incubation period, the Al-P content of Psammentic Paleudults will decrease. This linear regression equation model was strong enough to be accepted because it includes 80% of the influence of the incubation period on soil Al-P contents, while other external influences were 20%.

Soil Fe-P Content (ppm)

The application of all organic matter independently has significantly reduced the soil Fe-P content of Psammentic Paleudults soil compared to treatment Control (Table 4). Furthermore, the application of a mixture of organic matter in Compost *Tithonia diversifolia* + Chicken Manure was significantly reduced soil Fe-P compared to other treatments, from the initial Fe-P value of 138.79 ppm to 83.40 ppm. Hence, there was a decrease in the Fe-P content of Psammentic Paleudults soil by 39.90%. This was due to Tithonia diversifolia and chicken manure through decomposition capable of producing organic acids, namely citric acid, acetate and malic acid which have a higher concentration than other organic matters, these acids produce ions which can break the bonds between P and element of Fe thereby a decrease in Fe-P content in the soil occurred. In accordance with the opinion of Han and Jordan that organic acids released during the decomposition of organic matter can dissolve phosphate complexes by Fe and Al thereby increasing the solubility of P in the soil [5].Conversely, without the provision of organic matter, the Fe-P content in the soil is higher due to an increase in P content in the complex along with the increase of Fe molar, this is in accordance with Fahmi's that the presence of Fe is one of the limiting factors that greatly influences the P fixation process in the soil[3].

Table 4. Effect of applying organic matter and incubation period on soil Fe-P

Organic Matter	Incubation Period			
	1	2	3	4
	-------------------- ppm ------------------			
Control	146.01	143.71	132.63	132.81
Compost *Tithonia diversifolia*	102.61	101.27	96.04	95.91
Compost Durian Skin	120.27	105.86	100.35	106.15
Compost Empty Fruit Bunches	126.52	123.08	120.73	122.28
Chicken Manure	118.93	114.03	106.85	111.59
Compost *Tithonia diversifolia* + Chicken Manure	86.14	83.42	80.02	84.04
Compost Durian Skin + Chicken Manure	105.31	99.94	99.52	98.71
Compost EFB + Chicken Manure	118.52	109.82	96.51	96.32
Mean	115.54a	110.14b	104.08c	105.97bc

Note: The numbers followed by the same letters in the same column and row were not significantly different from the DMRT test at the 5% level.

The incubation effect significantly reduced soil Fe-P contents from 1 to 4 weeks while the incubation effect of 4 weeks of soil Fe-P was not significantly different from 2 and 3 weeks. The relationship of the incubation period of organic matter with soil Fe-P can be seen in Figure 3.

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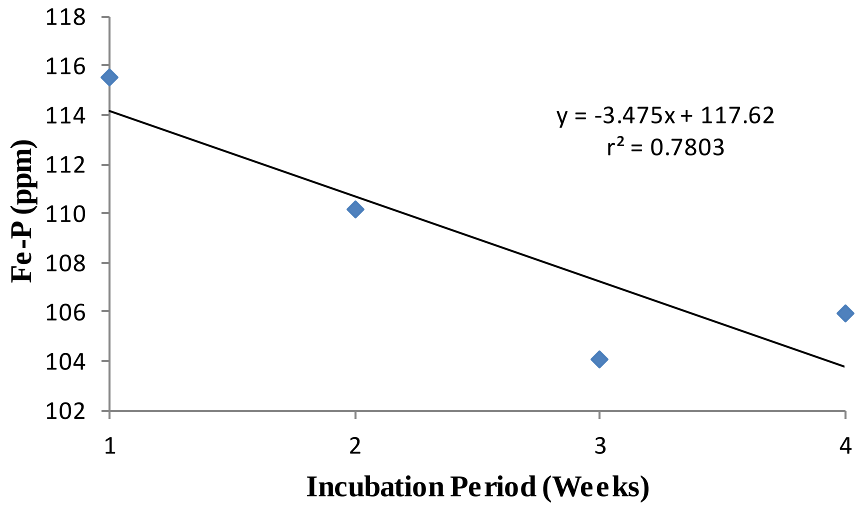

Fig.3: Relationship of Fe-P soil with incubation period.

Based on Figure 3, it can be seen that the soil Fe-P decreases linearly with the equation Y = -3.475X + 117.62 with the regression coefficient r2 = 0.7803. From this relationship it showed a negative tendency, namely the longer the incubation period then the soil Fe-P will decrease. This linear regression equation model was strong enough to be accepted because it includes 78% of the influence of the incubation period on soil Fe-P, while other external influences were 22%.

Soil P-available (ppm)

Table 5.Effect of applyingorganic matter and incubation period on soil P-available

Organic Matter	Incubation Time (Weeks)			
	1	2	3	4
	----------ppm----------			
Control	11.44k	11.93k	12.87jk	11.84k
Compost *Tithonia diversifolia*	25.78d-h	26.8c-g	27.14c-f	31.73bcd
Compost Durian Skin	21.62f-i	21.58f-i	26.34d-h	24.46e-h
Compost Empty Fruit Bunches	17.41ijk	20.06hi	22.63e-i	23.40e-i
Chicken Manure	20.16ghi	22.73e-i	28.72b-e	33.97ab
Compost *Tithonia diversifolia* + Chicken Manure	27.28c-f	28.75b-e	38.65a	31.79bcd
Compost Durian Skin + Chicken Manure	21.21f-i	19.67hij	32.99bc	34.01ab
Compost EFB + Chicken Manure	24.14e-i	24.66e-h	28.95b-e	25.09e-h
Mean	21.13	22.02	27.29	27.04

Note: The numbers followed by the same letters in the same column and row were not significantly different from th DMRT test at the 5% level.

The interaction effect of incubation period from 1 to 4 weeks on the level of soil P-available of Psammentic Paleudults was not significant on without the application of organic matter Control treatment(Table 5). While the interaction effects of incubation period ranging from 3 to 4 weeks were higher in increasing the P- available content of the soil especially in the application of a mixture of organic matters namely Compost *Tithonia diversifolia* + Chicken Manure, Compost Durian Skin + Chicken Manureand Compost EFB + Chicken Manure compared to Compost

Tithonia diversifolia, Compost Durian Skin, Compost Empty Fruit Bunches, Chicken Manureand Control.The effect of the combination of *Tithonia diversifolia* compost and chicken manure with 3 weeks incubation period was able to increase the highest soil P available compared to other combinations. Starting at combinationcontrol with an incubation period of 1 weeks, P-available was 11.44 ppm (low) increased to 38.65 ppm (very high) onCompost *Tithonia diversifolia* + Chicken Manurewith an incubation period of 3 weeks or an increase of 237.85%.This was due to the P content of *Tithonia diversifolia*compost and chicken manure classified as higher[15] than other organic matters and in the incubation for 3 weeks the mineralization process or P release into the soil will occur. Furthermore, through the organic acids produced namely citric acid, acetate and malic acid indirectly assist P released which is fixed by Al and Fe.The results stated in Tables 3 and 4 showed that a decrease in Al-P content from initially 182.32 ppm to 119.61 ppm and the Fe-P content from 146.01 ppm decreased to 80.02 ppm causing P release and increasing P availability in the soil [6].In line with Stevenson's (1982) statement that through organic acid the result of decomposition of phosphate release occurs which binds to Al and Fe which does not dissolve into a soluble form with the following reaction equation:

$$Al\ (Fe)(H_2O_3)(OH)_2H_2PO_4 + Chelate \longrightarrow PO_4^{2-}(soluble) + ComplexAl\text{-}Fe\text{-}\ Chelate$$

The relationship between the incubation period of organic matter and the P available content of soil can be seen in Figure 4.

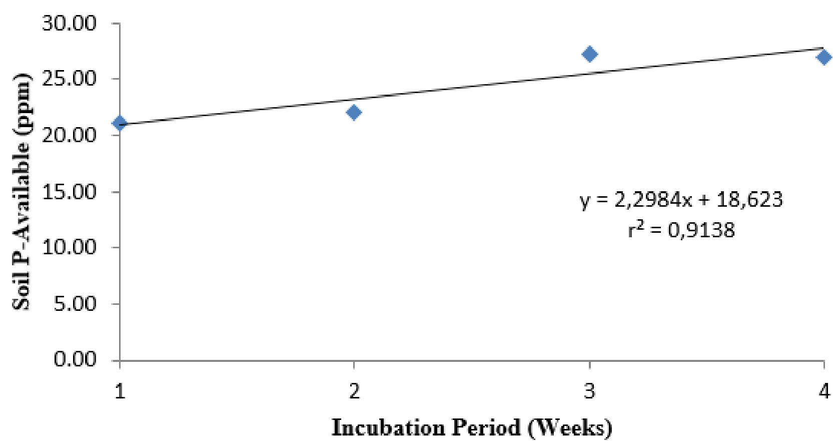

Fig.4: Relationship of Soil P-available with incubation period

Based on Figure 4, it can be seen that the soil P available content increases linearly with the equation Y = 2.2984X + 18,623 with the regression coefficient r2 = 0.9138. From this relationship showed a positive tendency, namely the longer the incubation period, the soil P available content will increase.With the treatment of incubation period can increase soil P-available content by 18.63%. Every 1% incubation period affected the increase in soil P available content by 2.29%. This linear equation model was strong enough to be accepted because it covered 91% of the influence of the incubation period on soil P available content, while other external influences were 9%.

IV. CONCLUSION

1. Application of various organic materials can increasing soil pH, C-organic and P-available soils as well as reduce the content of Al-P and Fe-P in the Psammentic Paleudults soils.
2. Incubation of organic matter for 3 weeks was able to reduce the content of Al-P and Fe-P on Psammentic Paleudults soils.
3. The interaction of compost *Tithonia diversifolia* with chicken manure with 3 weeks incubation was the best treatment in increasing soil P-available and decreasing Al-P and Fe-P on Psammentic Paleudults soil.

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