International Academic Research Consortium Journals

ISSN: 2360-9888 | Volume 9 Number 4 | Jun to December 2021
http://arcnjournals.org
arcnjournals@gmail.com

International Journal of Agricultural Science & Technology

International Academic Research Consortium Journals (IARCJ)

IARCJ International Journal of Agricultural Science and Technology
ISSN: 2360-9888
Volume 9
Number 4
June to December, 2021

Published by
ARCN Journals

International Academic Research Consortium Journals (IARCJ)

IARCJ International Journal of Agricultural Science and Technology
ISSN: 2360-9888
Volume 9
Number 4
June to December, 2021

Published by
ARCN Journals
http://arcnjournals.org/iarcj

Disclaimer

The Journal and the Editorial Board do not bear responsibility for views expressed by the authors in this Journal. Any problem relating to the articles (i.e. plagiarism, grammatical errors, lexicon errors, spelling mistakes, publishing articles in more than one journal, etc.) is the sole responsibility of the authors and the Journal bears no responsibility for that. The use of general descriptive names, trade names, trademarks, and so forth in this publication, even if not specifically identified, does not imply that these names are not protected by the relevant laws and regulations. While the advice and information in this Journal are believed to be true and accurate on the date of it going to the press, neither the authors, the editors, nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Submission

Manuscripts adhering to author's guideline should be submitted for double-blind peer-review process to the Editorial Board. Manuscripts should be submitted electronically to:

journals@arcnjournals.org

arcnjournals@gmail.com

Uploaded via our website: http://arcnjournals.org/index.php/submit-manuscript

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 1-7 (June, 2021)
www.iarcj.org, www.arcnjournals.org

Efficacy of Camel Urine in the Management of Diabetes Mellitus in Alloxan induced Albino Rats

A. Mustapha, A. M. Marte, A.A. Makinta, A.A. Benisheikh

Department of Animal Production Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria.

Corresponding Author E-mail;abuamina19@gmail.com

Abstract: *There are many anecdotal reports on traditional use of camel urine in the treatment of Diabetes Mellitus (DM). The need therefore arises to validate this claim. The objectives of the study is to; evaluate the effect of camel urine on serum glucose of rats, assess the effect of camel urine on serum lipids of rats and to Compare Different doses of the products on serum glucose and lipids. Thirty-six adult albino rats were used in 4 X 3 factorial experiment involving 4 product treatments and 3 doses. A significant decrease in the blood glucose level in the experimental groups fed camel urine when compared to diabetic untreated (control) group. In treatment group treated with 1.5 ml camel urine there was a significant decrease in glucose compared to control. The result shows that there were significant decrease in TG, TC, LDL-C and VLDL-C compared with the control while the HDL was significantly increased. The results indicate that camel urine possess anti-diabetic effects on alloxan induced rats. This study recommended that awareness should be created on the therapeutic value of camel urine.*

Keywords: *Diabetes mellitus, induced, Camel urine, alloxan, rat*

INTRODUCTION

The camel belongs to the family *camelidae* and divided into two genera: genus *camelus* (the true or old world camels) and genus *lama* (the new world camels). The genus camelus includes two species, the Dromedary, (*Camelus dromedarius)* or one-humped camel and the Bactrian camel (*Camelus bactrianus*) the two humped camel. The Dromedary (*C. dromedarius*) is adapted to hot arid environments and contributes significantly to the food security of the nomadic camel pastoral households (Schwartz & Dioli, 1992). Camelids are ruminating animals and are in proximity to ruminants but are not part of the suborder *Ruminantia*. Differences such as foot anatomy, stomach system and the absence of horns confirm this fact. They belong to the suborder Tylopoda (Werney, 2003).

DM is the fourth leading cause of death in most developed countries, and its prevalence is rising in Nigeria (IDF, 2013). The conventional medications for DM such as Biguanides, Sulfonylureas and Thiazolidinedione are associated with undesirable side effects such as allergic reactions, nausea and vomiting, diarrhea, sexual dysfunction, haemoglobin disorders and lipodystrophy (Oliver and Tellervo 1993). For this reasons cheaper alternatives such as medicinal plants and animal products are sought.

Among these alternatives to the conventional drugs are camel urine, for which there are many anecdotal reports and few scientific studies. The need therefore arises to validate this claim.

The aim of the study is to investigate the anti-diabetics effects of camel urine in alloxan induced diabetic rats. The objectives of the study are to; evaluate the effect of camel urine on serum glucose of rats, assess the effect of camel urine on serum lipids of rats and to determine different doses of the product on serum glucose and lipid profiles.

MATERIALS AND METHODS

The study was conducted at the Ramat Polytechnic Teaching and Research Farm, Maiduguri, Borno State of Nigeria. Maiduguri is located between latitude 11^0c and 12^0c longitude 13^0c and 14^0E and on an attitude of 354 above sea level (Alaku, 20005). It falls within the sub-arid zone of West Africa Characterize by short duration of rain fall (3.4 months), which varies from 580mm to 600mm with long dry season (7-8 months). Ambient temperatures are high during the month of April to June and fall within the range 40^0c and above well relative humidity at non-range from 5-45% (Alaku, 2005).

Experimental Animals and their Management

Thirty Six adult albino rats of both sexes weighing between 150 -170 g, were obtained from National Veterinary Research Institute, (NVRI) Vom, and used for the study. The rats were housed in cages in a well-ventilated room with free access to feed (grower mash) and water. The rats were allowed to acclimatize under laboratory condition for a period of two weeks before the commencement of the experiment. Fresh Camel urine was administered to the rats by oral intubation, in doses according to the experimental protocol.

Induction of Diabetes Mellitus

Diabetes mellitus was induced according to Szkudelski (2001), the rats were injected with a single dose of 120mg/kg bw of alloxan monohydrate, in dorsally recumbent position via penial vein. Food and water were given to the animals 30 minutes after the drug administration. A sample of the rat's venous blood was collected 7 days after induction and DM was confirmed by measuring the serum glucose level with the aid of Accu Chek glucometer (mode: AE-350, BY ERMA INC). Rats that had serum glucose level >7.0 mmol/l were considered diabetic.

Experimental layout

The 36 diabetic albino rats were randomly allocated into four treatment groups of nine rats each. In a Complete Ramdomised Design with 4 treatments and each treatments was replicated 3 time with dose levels (0, 0.5. 1.0 and 1.5 ml) were used

Blood collection

Blood samples for monitoring of blood glucose level were taken from the tail. The tail of each of the rats was pricked with lancet and a drop of the blood was collected on the test strip and inserted into the glucometer to read glucose concentration on the screen in mg/dl. Readings were taken before, after the induction and at 28 days post treatment. The first blood collection (pre-induction) was for screening of the animals, while the second collection (post-induction) was for the confirmation of DM. The third collection was for the determination of the effect of treatments.

The serum lipids were measured 28 days after the commencement of the treatments where the animals were fasted overnight and sacrificed. The blood of the animals was collected in plain bottle, centrifuged and the serum separated and kept in labeled sample bottles at 4°C until required for lipid profile analysis.

Data collection

Serum glucose level was measured using glucometer, Total cholesterol (TC), Triglycerides (TG) and High Density Lipoprotein (HDL) were determined using Randox cholesterol kit (mode: CAT/TYP 05075548002, ROCHE INC). Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) were calculated using Friedewald formula (Friedewald *et al.,* 1972).

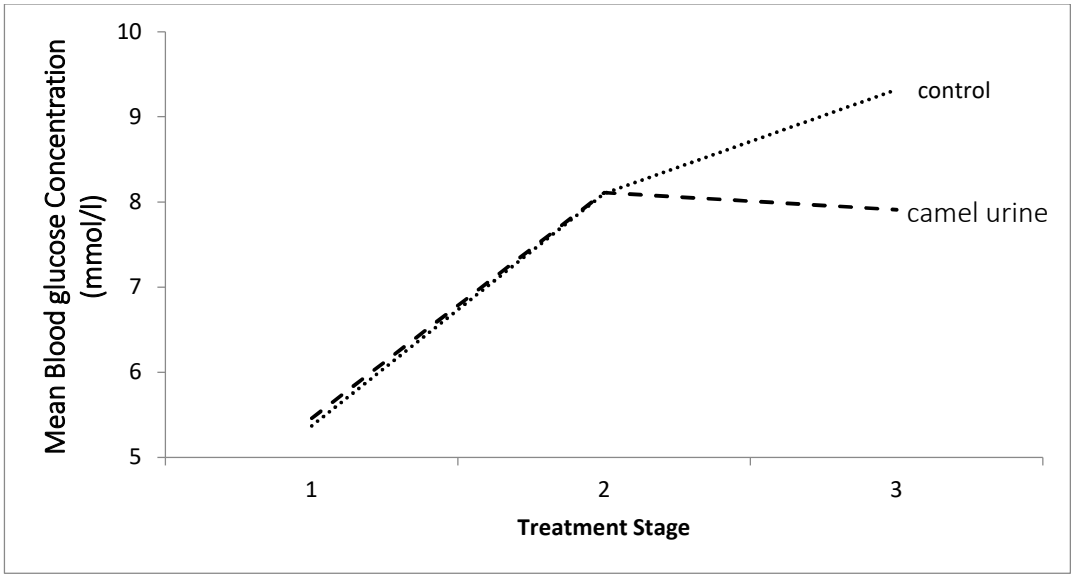
Data analyses

General Linear Model (GLM) univariate procedure was used to determine the effects of the camel urine and dose on serum glucose, TC, TG, HDL, LDL, and VLDL significant means were separated using tukey test.

RESULTS AND DISCUSSIONS

Effect of Camel Urine on Serum Glucose

Before induction all the animals were in non-diabetic state, however, after successful induction there was a sharp increase in blood glucose levels in all the rat groups. With the commencement of treatment there was a steady decline in serum glucose in groups except the control groups. The groups administered camel urine had the lowest concentration of serum glucose, while there was no decline in serum glucose in the control groups (Figure 1).

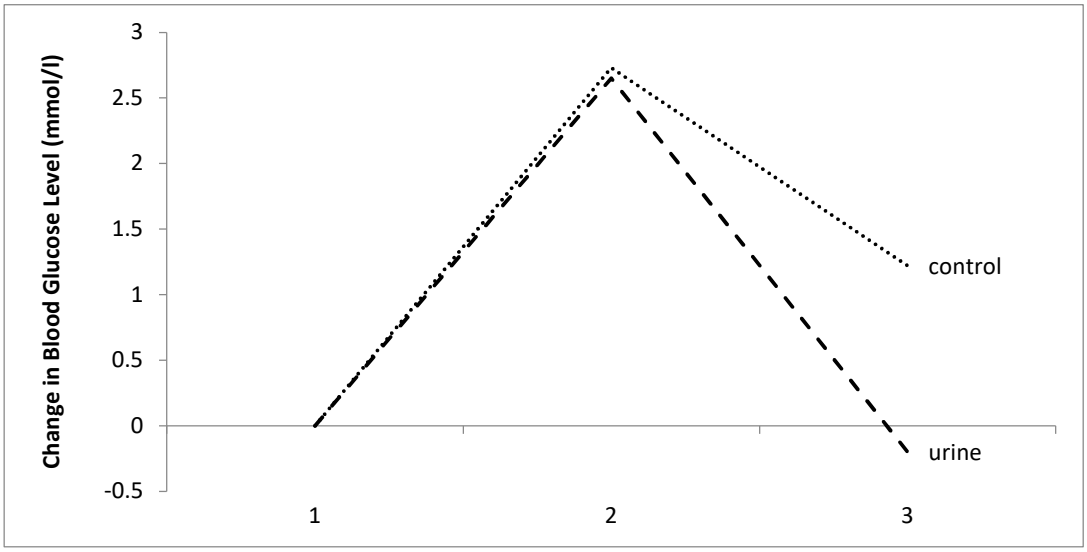


1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 1 Change in blood glucose level among the various treatments groups

The trend indicated that the camel urine had some hypoglycemic effects that might be due some hypoglycemic factors they contain.

The rate of decline in serum glucose of the control group (Figure 2) was greater in treated groups than in the control group. In all the treated groups, serum glucose fell below pre-induction stage.



1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 2: Rate of change in serum glucose across the treatment

The trend indicated that the drop in serum glucose in treated group is suggestive of the presence in the products of hypoglycemic factors, which was in fact reported for camel milk by Singh (2001). It is conceivable that this same factor might be present in the urine, in lower concentration.

There was significant difference in serum glucose between control group and groups administered with camel urine. Significant differences also exist among treated groups (Table 1.). Furthermore, the treatments appear to be dose dependent, where significant reduction in serum glucose was recorded with increasing in doses.

Table 1: Blood glucose levels (mmol/l) of albino rats according to treatments and doses

Treatment	**Serum glucose**
Urine	7.91^{b}
Control	9.32^{a}
SE	0.16
Dose (ml)	
1.5	7.44^{c}
1.0	7.88^{b}
0.5	7.96^{b}
0.00	9.32^{a}
SE	0.16

Interaction	NS

abc, means bearing different superscript along the same column within a subset differ (P<0.05);

NS not significant

The low concentration of serum glucose in rats administered with camel urine, suggest the likely presence of the insulin-like protein, since it has been established to be present in milk (Singh, 2001), its presence in urine is therefore highly probable.

The lower concentration of serum glucose in treated rats may also be related to the report of Yadav *et al.* (2015) that some plants materials consumed by camel have anti-diabetic effects and the active ingredients are present in the body fluids such as urine and milk.

Effect of Camel milk and urine on Serum Lipids

Rats administered camel urine had significantly lower TG, TC, LDL and VLDL than the control groups. HDL was however higher (P<0.05) in the treated groups. Dose had no effect (P>0.05) on all the lipid parameters among the treated groups. Treatment x Dose interaction was also not significant (Table 2).

Table 2: Serum lipids (mg/dl) in alloxan induced diabetic rats according to treatments and doses

Treatment	**Serum Lipids (mg/dl)**				
	TC	**TG**	**HDL**	**LDL**	**VLDL**
Control	248.33^{a}	237.11^{a}	15.33^{d}	296.11^{a}	54.44^{a}
Camel urine	168.78^{b}	133.0^{b}	29.36^{c}	168.79^{bc}	27.22^{b}
S.E	6.68	10.22	2.04	10.50	2.00
Dose (ml)					
1.5	182.33^{b}	141.22^{b}	177.33^{b}	33.67^{a}	28.22^{b}
1.0	163.89^{b}	132.89^{b}	160.67^{b}	39.78^{a}	27.44^{b}
5.0	172.67^{b}	137.22^{b}	169.00^{b}	36.78^{a}	28.00^{b}
0.0	248.33^{a}	273.11^{a}	296.11^{a}	15.33^{b}	54.44^{a}
S.E	7.45	4.85	9.03	1.90	0.90
Treatment x Dose Interaction	NS	NS	NS	NS	NS

abcd, means bearing different superscripts along the same column within a subset differ (P<0.05)

NS = Not significant

Key: Total cholesterol (TC), Triglycerides (TG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL)

Hyperlipidemia is a recognized consequence of diabetes mellitus (Sherma *et al.,* 2003). Thus the higher TC, LDL, VLDL and TG in the control group than in treated groups. The higher lipid value of

control group is due to DM, which led to abnormalities in lipid metabolism (Arkkila *et al.,* 2001). The increase in lipids in the control group may be attributed to excess mobilization of fat from the adipose tissue due to the under utilization of the glucose (Krishnakumar *et al*., 2000). It appears that camel milk and urine have hypolipidaemic effects because the treated groups showed significantly lower levels of these lipids (Table 3).

Since insulin has been reported to activate lipoprotein lipase (Arkkila *et al.,* 2001), an enzyme that hydrolyses triglyceride leading to low serum lipids. The presence of insulin-like protein (Singh, 2001) in camel urine will lower lipid components in camel urine treated rats. This supposition is supported by Hull, 2004 and Agrawal *et al.,* (2007b) showing that a high insulin-like factor concentration of camel urine can cause the activation of lipoprotein lipase enzyme.

The HDL level in the treated groups is higher compared to the lower group. This may probably due the presence of some enzymes in camel urine that enhance the reverse cholesterol transport system Al-Numair (2010). In addition the mechanisms by which HDL decreases in diabetes may be due to the impaired metabolism of triglycerides rich lipoprotein with decreased activity of lipoprotein lipase and impaired transfer of materials to the HDL components, in addition to the high level of hepatic lipase among diabetics (Balkis 2009). Finally, insulin resistance may be a direct cause of decrease of HDL concentration (Van Linthout *et al.,* 2010).

A significant increase in LDL and VLDL levels may lead to a significant decrease in HDL levels. The inverse relationship between VLDL and HDL (Boizel 2000) might also explain lower levels of the HDL in the control groups.

The decrease in TC and TG in the treated groups and the increase in HDL in the present study are in agreement with Hassan and Emam (2012), who reported similar findings.

CONCLUSIONS

The following conclusions were drawn from the study.

1. Camel urine reduced serum glucose in rats
2. The hypoglycemic and hyperlipidemic effects of the product is not dose dependent.

REFERENCE

Agrawal, R.P., Budania, S., Sharma, P., Gupta, R., Kochar, D.K., Panwar, R.B. (2007b) Zero prevalence of diabetes in camel milk consuming Raica community of north-west Rajasthan, India. *Diabetes Res Clin Pract.***76** (2):290–6.

Arkkila, P.E., Koskinen, P.J. and Kantola, I.M. (2001). Diabeies complications are associated with liver enzyme activities in people with type I diabetes. *Diabetes research clinical practice,* **52**:113-470.

Balkis, B. S., Othman, F., Louis, S.R., Abu Bakar M., Radzi, M., Osman, K., Das S., Mohamed, J. (2009). Effect of alpha lipoic acid on oxidative stress and vascular wall of diabetic rats. *Rom J Morphol Embryol*.; 50 (1):23-30.

Boizel, R., benhamou, P.Y., Lardy, B., Laporte, F., Foulon, T., Halimi, S. (2000). Ratio of Triglyceride to HDL Cholesterol an indicator of LDL particle size in patients with type 2 diabetes and normal HDL cholesterol levels. Diabetes Care. 2000 Nov., 23 (11): 1679-1685.

FAO (2013). Statistical Year Book. Food and Agriculture Organization of the United Nations, Rome, Italy, 2013.

Felsner, G. (2002).UNICO Technical report US/NIR/01/E01/11-51

Friedewald, W.T., Levy, R.T. and Fredrickson, D.S. (1972). Estimation of LDL-C in plasma without the use of the preparative ultracentrifuge. *Clin.Chem.* **18(6):** 499-502.

Hassan, N.S. and Emam, M.A. (2012). Protective effects of camel milk and *Ginkgo biloba* Extract Against alloxan induced diabetes in rats. *Journal of Diabetes metabolism* **3**:231doi 10.4172/2156-1000231.

Hull, S. J. (2004): Camel's milk to treat Diabetes natural. 363:446-448.

International Diabetes Federation (2013). Diabetes Atlas. 6th Edition, Available at: (http://www.idf.org/diabetesatlas). 10/09/2016, 10:27

Kamal, O. (2012). Treatment of Incurable Ailments with Camel's Milk and Urine, based on Scientific Research, Int'l University of Africa. ISBN: 978-99942-64-15-5.

Krishnakumar, K., Augustti, K.T. and Vijayammal, P.L. (2000). Hypolipedemic effect of *Solacia oblanga wall.* Root bark in Streptozotocin diabetic rats. *Med. Sci. 2000:*28; 65-67.

Mamman, A.B., Oyebanji J.O. and Peter S.W. (2000). A people united, a future assured, survey of state. Vol. 1 (112). Gabumo publishing Co. Ltd., Calabar, Nigeria.

Oliver, R.C. and Tellervo, T. (1993). Periodontitis and tooth loss; Comparing diabetics with the general population. *Journal of the American Dental Association*. 124, 71-76

Sboui A., Khorchani T., Djegham M., Agrebi A., Elhatmi H. and Belhadj O. (2010), Anti-diabetic effect of camel milk in alloxan-induced diabetic dogs: a dose-response experiment. *Journal of Animal Physiology and Animal Nutrition Berlin*; **94(4)**: 540-646.

Schwartz, H. J, Dioli, M. (1992). The one-humped Camel in Eastern Africa. A Pictorial Guide to Diseases, Health Care and Management. Verlag Josef Margraf Scientific Books Editions: Verlag, Weikersceim; p.282

Simeneh, K. (2015). Characterization of *camelus dromedarius* in Ethiopia: Production systems, reproductive performances and infertility problems (Doctoral dissertation).

Singh, R. (2001). Senior Scientist, National Research Centre on Camel, Bikaner, India. Personal Communication.

Szkudelski, T. (2001).The Mechanism of Alloxan and Streptozotocin Action in β- Cells of the Rat Pancreas. *Physiol. Res;* **50:536**–546.

Van Linthout, S., Spillmann, F., Schultheiss, H.P., Tschöpe, C. (2010) High-density lipoprotein at the interface of type 2 diabetes mellitus and cardiovascular disorders. Curr Pharm Des. ; 16(13):1504-16.

Wangoh, J. (1993) what steps towards camel milk technology? *Int. J. Anim. Sci* 8:9-11.

Wernery U. (2003). New observations on camels and their milk. Berlin: Blackwell Wissenschafts-Verlag.

Yadav, A. Kumar, M. (2015). "Composition and medicinal properties of camel milk: A Review." *Asian Journal of Dairy and Food Research* 34.2: 83-91

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 8-13 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Effect of Ensiled Rice Husk with Graded Levels of Doum Palm Molasses on the Growth Performance of Ram

A.M. Marte, A. Mustapha, A. A. Makinta, A.A. Benisheikh.
Department of Animal ProductionTechnology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Corresponding Author E-mail;alimusamarte@gmail.com

Abstract: *The 84 days feeding trial was conducted to determine the performance of Rams fed graded level of Doum Palm Molasses on the Growth Performance of Ram, a total of Forty-eight (48) rams of the non-descript breed was used for this study, the animals were allocated to treatments constitute a 4 x 3 factorial experimental design, the factors being graded level molasses (sugar cane 5 and doum palm 2.5, 5 and 7.5%) and treatment periods (7, 14 and 21 days). 4 treatments in each period of ensilage; four (4) animals were randomly allocated to each treatment each period of ensilage. T1 as control (sugar cane molasses at 5%), while Doum palm molasses was used at 2.5, 5 and 7.5 and poultry dropping at 15% (T2, T3, T4 and T5 respectively) which was dissolved in 30 liters of water and sprinkled on remained kg with rice husk for period 7, 14 and 21 days in a 300 litter capacity Plastic water reservoir as silo in triplicate. The animals were housed in individual pens with adequate ventilation. The animals were balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. The experimental diets (ensiled rice husk with 10% cotton seed cake) were offered at 4% of body weight while groundnut haulm was fed ad libitum as basal diet. Feed intake was determined as the difference of the amounts of feed offered and the refusals. Water will be offered daily and leftover was measured and the experiment lasted for 84 days (12 weeks). The rams were weighed individually on weekly basis using a hanging weighing balance to estimate body weight change. Feed conversion ratio was measured using mean feed intake (kg) divided by mean body weight gain (kg). The results of all the growth parameter measured shows no significant difference (P< 0.05) among the various treatment groups however, values for T4 where numerically higher than the others, which could be due to higher inclusion level of the doum palm and 21 days of ensilaged which might lead to adequate fermentation and increase in nutrients content of the materials, an indication that increasing levels of doum palm molasses result in increased performance of fattening rams*

Keywords: *Ensiled, Ram, Doum, Molasses, performance*

INTRODUCTION

Sheep is an important livestock species in the socio-economic lives of people around the world including Nigerians (Amin *et al*., 2018). Sheep provide meat, milk, skin, fibre, and manure to large number of low income, marginal farmers and landless labourers (Kolo *et al*., 2018). In Nigeria, livestock experience persistent serious shortage of feeds, especially during the dry season. The major problem in sheep productivity is; limited quantity and quality of feed resource (Nsahlai *et al.,* 1998). Possible way to reduce the challenge of inadequate feed supply and maintain production is to utilised crop residues which cannot be consumed by man but can be converted by ruminants into desirable products (Odeyinka, 2011).

Crop residues are parts of crops that remain after the removed of edible portions by human. Crop residues, traditionally considered as agricultural waste after extraction main products which include stovers, straws, husks, cobs, haulms and other leftovers from crop production. The several million metric tons of crop residues are annually produced in Nigeria to feed ruminant (Kolo *et al*., 2017). Nigeria produced annually over 111.5 million tones of crop residues (Lufadeju 1988).

In general, crop residues are characterized by low content of nutrients which limit their utilization by livestock. Crop residues from cereals crops have low crude protein and high fiber, (Daniel, 1988 and Solomon, 2004). Consequently, when crop residues are fed to ruminants, their intake and digestibility are low, resulting in low level of performance. Crop residues are potentially rich in some sources of energy as about 80% of their DM consists of polysaccharide, but usually underutilized because of their low digestibility, which limits feed intake (FAO, 2002). Rice husks also constitute another by-product of rice production. However, they are not as important as rice straw or rice bran for the feeding of ruminants because of its low nutritional value it is however a valuable source of roughages for ruminants. Rice husks can be milled into a fine powder and used as diluents of other high energy feed stuff. Rice husk can be included in small amounts (15%) in high-concentrate diets for feedlot cattle to help furnish bulk, stimulate appetite and decrease incidence of liver abscesses (feedipedia, 2002). the problem of Rice husk is high silica, high fibre and abrasive nature make its degradation difficult thereby limiting its utilization as feed ingredient for animals (Ikpe *et al*., 2019). Improved utilization of crop residues can be achieved either through appropriate supplementation or treatment both of which facilitate the microbial breakdown of plant cell wall (Kolo *et al*., 2017).

Material and Methods

Experimental Site

The experiment was conducted at the Livestock Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic. Maiduguri lies within latitude $11^0$50'N and longitude $13^0$09'E and has an elevation of 320m above mean sea level (BOSHIC, 2007). The mean ambient temperature could be as low as 23^0C during the harmattan season and gets as high as 40^0C or more during the hot season. Relative humidity is about 45% in August which usually drops to about 5% in the months of December and January and has evaporation of 203 mm/year. Day length varies from 11 to 12 hours (BOSHIC, 2007).

Doum palm molasses preparation

The doum palm molasses was prepared by 1kg doum palm pulp cover in 2, 3 and 5 litter water and put to boiling for 15 minutes and allowed to cool for about an hour sieving with sieve size of about 45u and 140 x 90mm size was used. The best doum palm molasses based on the viscosity will be selected for trial, and physicochemical analysis while sugarcane molasses was obtained from sugar industry serve as control.

Preparation poultry dropping

Poultry dropping was source from poultry unit and Fresh samples was properly sundried. All the samples were ground to pass through 1mm sieve. Poultry dropping of 15kg was dissolved in 30 liters of water.

Ensiling procedure

As control (sugar cane molasses at 5%) as T1, while Doum palm molasses was used at 2.5, 5 and 7.5 and poultry dropping at 15% (T2, T3, T4 and T5 respectively) was dissolved in 30 liters of water and sprinkled on remained (Table I) kg with rice husk for period 7, 14 and 21 days in a 300 litter capacity Plastic water reservoir as silo in triplicate. The proportions % are presented in Table 1.

Experimental Design

The treatments constitute a 4 x 3 factorial experimental design, the factors being graded level molasses (sugar cane 5 and Doum palm 2.5, 5 and 7.5%) and treatment periods (7, 14 and 21 days).

Experimental animal and their management

Forty-five (45) rams of the non-descript breed was used for this study. The experimental animals were sourced from Livestock Market in Maiduguri, Borno state. The animals were dewormed with Ivermitin 5% against internal and external parasites at 1ml/50kg body weight before commencement of the experiment. Also Oxytetracycline (a broad-spectrum antibiotic) long acting base was given at 1m/10kg body weight and multivitamin injection was also given at 1ml/10kg body weight for three days to reduce stress. Before commencement of the experiment the animals were adapted for one week during which groundnut haulms *ad libitum* and above ensiled rice husk with 10% cotton seed cake was given to the animals. The animals were housed in pens which have wide windows for adequate ventilation.

Experimental design and Feeding

The animals were allocated to treatments constitute a 4 x 3 factorial experimental design, the factors being graded level molasses (sugar cane 5 and doum palm 2.5, 5 and 7.5%) and treatment periods (7, 14 and 21 days). 4 treatments in each period of ensilage; four (4) animals were randomly allocated to each treatment each period of ensilage. The animals were housed in individual pens with adequate ventilation. The animals were balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. The experimental diets (Table 1) (ensiled rice husk with 10% cotton seed cake) were offered at 4% of body weight while groundnut haulm was fed *ad libitum* as basal diet. Feed intake was determined as the difference of the amounts of feed offered and the refusals. Water will be offered daily and leftover was measured and the experiment lasted for 84 days (12 weeks).

Table 1: proportion (%) of rice bran ensiled with fruit molasses

Factors		Rice bran	Poultry litter %
Molasses	Cane 5%	80	15
	Fruit 2.5	82.5	15
	Fruit 5	80	15
	Fruit 7.5	77.5	15
Treatment period (days)	7		
	14		
	21		

Data collection
Measurements of productive parameters

Feed intake

Feed consumption from each treatment was measured on daily basis by subtracting left over from feed served per sheep. Adequate measures were taken to safeguard against spillage and related wastage.

Weight change

The rams were weighed individually on weekly basis using a hanging weighing balance to estimate body weight change.

Feed conversion ratio

Feed conversion ratio was measured using the formula below:

$$\text{Feed conversion ratio} = \frac{\text{Mean feed intake (kg)}}{\text{Mean body weight gain (kg)}}$$

Statistical Analysis

Data obtained are subjected to 4 x 3 factorial experimental design and significant difference between treatment means were separated using the Duncan`s multiple range test at $P< 0.05$

RESULTS AND DISCUSSIONS

PROXIMATE COMPOSITION OF THE EXPERIMENTAL DIET

The chemical composition of the individual feed ingredients is presented in Table 2. Dry matter content of the treatments ranges between (86.00%) in T1 and (88.00%) in T5. This dry matter content indicates all constituents excluding water of the ingredients used in the formulation. The value is comparable to the range obtained elsewhere for based diets as reported by Tona et al., (2014). CP level decreases as the RHD concentration increases. Crude protein (CP) content was higher in T1 (8.0 %) and lower in T3 (12.00%). However, the crude protein values recorded for diets in this study were within the critical range of 8 to 12% reported (Isah et al., 2012). Differences and variation in crude protein percentage among formulations may be due to the type of protein source and its level of inclusions in the rations. The differences observed could also be associated with the used of poultry dropping. The highest value of ether extract (EE) was obtained in diet 2 (10.00 %) and the lowest was recorded in diet 1 (9.00). Higher ether extract has the tendency to reduce dry matter feed intake and may decrease effective digestibility. Hence having this diet formulation will be an added advantage to the animal fed with the diets. It has been reported that NDF content of feed can be used to predict the feed intake since it measures the total fibre component of feed.

Table 2. proximate composition of the experimental diets

Constitutes	T1	T2	T3	T4	T5
Dry Matter	86	87	86	86	88
Crude Protein	8.0	11	9.0	10	12
Ether Extracts	9.0	12	10	11	10
Crude Fibre	15	18	17	19	18
Ash	3.0	3.5	4.5	4.0	4.5
Nitrogen Free Extract	42	42.5	45.5	47	42

Table 3. Growth performance of Rams fed graded level of doum palm molasses in ensiled Rice Husk

Parameter	**T 1**	**T 2**	**T 3**	**T4**	**T5**	**SEM**
Induction body weight (kg)	21.39	21.91	23.92	21.91	21.39	2.56^{NS}
Body weight gain (kg)	12.10	13.09	13.61	14.09	12.28	2.22^{NS}
Average daily gain (g/day)	192.10	207.70	216.10	223.6	194.90	35.20^{NS}
Feed intake (g/day)	896.00	983.00	973.00	931.0	911.00	77.00^{NS}
Feed conversion ratio (g/g)	4.71	4.89	4.67	4.23	4.65	0.95^{NS}

SEM=Standard error of mean, NS= Not significant.

The results of all the growth parameter measured shows no significant difference ($P< 0.05$) among the various treatment groups however, values for T4 where numerically higher than the others, which could be due to higher inclusion level of the doum palm and 21 days of ensilaged which might lead to adequate fermentation and increase in nutrients content of the materials

REFERENCES

Amin, A.B., Yousuf, M.B., Ibrahim, A.A., Kolo, U. M., Muhammad, A. I. and Audu R. (2018). Effects of Periodic Administration of Garlic Extract On Growth Performance and Carcass Characteristics of Grazing Lambs *Wayamba Journal of Animal Science – pp. 1636-1642*

BOSHIC, (2007) Borno State Ministry of Home Affairs Information and Culture.http://www.bornonigeria.com/index.phoption.com69:geography

Daniel, K. (1988). Role of crop residues as livestock feed in Ethiopian highlands. African Forage Plant Genetics Resources. Evaluation of Forage Germplasm and Extensive Livestock Production System. In: Dzoweda B.H. (ed). Proceedings of the 54 3rd Workshop Held in the International Conference Center, Arush, Tanzania. pp. 430-439.

FAO (Food and Agriculture Organization of the United Nations), (2002). Animal Production Based on Crop Residues; China's Experiences. FAO Animal Production and Health Paper. No. 149. 39p.

Kolo, U. M., Adeloye, A. A and Yousuf, M. B (2018) Influence of Urea-Fortified Corncob Diets on Growth Performance and Carcass Characteristics in West African Dwarf Goats Momona Ethiopian Journal of Science (MEJS) *Volume 10(2):271-281, 2018* http://dx.doi.org/10.4314/mejs.v10i2.7

Kolo, U. M., Adeloye, A. A. and Yousuf, M. B. (2017).Effect of urea-fortified all concentrate corncob diets on serum biochemical and haematological indices of West African dwarf goats agricultural science and technology, vol. 9, no 2, pp114 - 118 doi: 10.15547/ast.2017.02.020

Lufadeju, E.A. (1988) Evaluation of Methods of Improving Utilization of Mature and Ropozon Gayauns (Ganba Hay)By Frieslan Bunuji Heifers. Ph.D. Thesis Ahmadu Bello University, Zaria Nigeria

Nsahlai, I.V., Bonsi, M.L.K., Umunna, N.N., Sileshi, Z. and Bediye, S. (1998). Feed utilisation strategies for improved ruminant production in the arid region. Ann. Arid Zone, 37: 283-310.

Odeyinka (2001). Effects of feeding varying levels of Leuceana leucocephala And gliricidia sepium on the performance of West Africa Dwarf Goats. *Nigeria J. Anm. Prod*. 28:61-64

Tona, G.O., Ogunbosoye D.O. and Bakare B.A. (2014). Growth performance and nutrient

Isah, O.A., Fayemi, P.O., Gazaly, M.B. and Aderunboye, R.Y.(2012). Nutritional characteristics of four browse plants consumed by free-ranging ruminants in Western part of Nigeria, Livestock Science 129 (2010) 24–30

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 14-24 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Evaluation of Differently Processed Karanj (*Pongamia Pinnata*) Seed Cake on Haematological and Serum Biochemical Indices of Broiler Chickens

Benisheikh, A.A., Mustapha, A., Marte, A.A., and Jibrin, T. A.
Department of Animal Production Technology Ramat Polytechnic, Maiduguri

Abstract: *A study was conducted to determine the effects of differently processed karanj (Pongamia pinnata) seed cake (KSC) on blood profile broiler chickens. The karanj seed were processed using three different methods (soaking for 24 hours; boiling for 60 minutes; and toasting). Diets were formulated and designated as: T1 (0% KSC), T2 (5% of raw KSC), T3 (5% soaked KSC), T4 (5% KSC boiled for 60 minute) and T5 (5% toasted KSC). The birds were allocated to the five treatments in groups of 30 birds, each treatment replicated three times with 10 birds per replicate in a completely randomised design (CRD). Data collected were RBC, Hb, WBC, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration, (MCHC) with the exception of white blood cells count, MCH, MCHC, neutrophils, and lymphocytes, all other haematological parameters measured were not affected (P>0.05) by the treatments. The results of serum biochemical indices showed that total protein, globulin, glucose, conjugated bilirubin, aspartate aminotransferase (ASAT) and alanine aminotransferase (ALAT) were significantly (P<0.05) affected by the dietary treatments. Broiler chickens fed 0 % KSC recorded significantly (P<0.05) lower values for both ASAT and ALAT than the other treatments groups. The outcome of this study therefore indicated that inclusion of 5 % toasted KSC has no adverse effects on the blood profile of broiler chickens.*

Keywords: *Karanj Seeds Cake (KSC), Haematology, Serum Biochemical, Pongamia pinnata*

Introduction

The development of poultry industry has been described as the fastest way of ameliorating the animal protein deficiency in third world countries, due to the high turn-over rate associated with poultry production and economic efficiency. (Dipeolu *et al*., 2004). However, the ever-increasing cost of poultry product (meat and eggs) make it necessary to explore the use of alternative feed ingredients that are cheaper, locally available and low human preference. In realization of this, there is the need to evaluate the nutritional adequacy of such feed stuff. One of such alternative feed ingredients is karanj (*Pongamia pinnata*) seed cake.

Pongamia pinnata popularly known as karanj, belongs to the family *Leguminosae,* and is a medium-sized glabrous tree capable of growing under wide range of agro-climatic conditions. The tree is abundantly found in Andhra Pradesh, Bihar, Karnataka, Maharastra, Tamil Nadu and West Bengal. It naturalized from India, Pakistan and Sri Lanka throughout south-east Asia to north-eastern Australia, Fiji and Japan. It is planted in the humid tropical lowlands around

the world, and has been introduced into Egypt and the United States (Orwa *et al.,* 2009); It is also available in Nigeria as ornamental plant.

Oil is the most important product of the pongamia seed and vast amounts of seeds are collected in India for commercial processing for industrial uses. In India, the availability of karanj seed has been estimated to be 2, 000,000 metric tons per year (Anon., 2006). The production of bio-fuel from karanj oil has already commenced in some areas and considerable quantity of karanj seed cake is produced as a by-product (Anon., 2006). Besides, karanj oil has been traditionally used for different industrial purposes like leather dressing, soap making, lubrication, and illumination among others. Currently, karanj seed has limited demand and is going for low value applications like manure especially in India (Anon., 2006).

MATERIALS AND METHOD

The study was conducted at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri is located between latitude 11°5' and 12^0 North, longitude 13°09' and 14^0 East at an altitude of 354 m above sea level
(DNMA, 2013).

Seed Collection and processing

The karanj seeds were obtained from pongamia plant (karanj) *(Pongamia pinnata)* across Maiduguri Metropolitan Councile. The seeds were divided into four (4) batches. The first batch was left raw, while the other three (3) batches were classified according to the following processing methods;

1. Process 1: The second batch was soaked in tap water for 24 hours at room temperature in a plastic container. At the end of soaking, the water was decanted and the seeds later sun-dried for three days or more depending on the weather.
2. Process 3: The seeds was boiled for 60 minutes. Timing was commenced few minutes after adding the karanj seeds in boiling water. The boiled seeds were drained and sundried.
3. Process 4: The karanj seeds was toasted on open frying pan containing sand; it was stirred continuously until the seeds are crispy and acquired a characteristic aroma of roasted beans. The processed seeds were milled and oil was extracted and stored in bags until needed for feed formulation.

Experimental Stock and their Management

A total of 150 day- old broiler chicks were purchased from Zatex hatcheries for the study. The chicks were brooded for two weeks during which they were fed commercial broiler starter diet and then fed the formulated/ experimental starter diet from three to four weeks and experimental finisher diet from 5^{th} to the 9^{th} weeks.

Experimental Diets and Experimental Design

Experimental diets at the starter and finisher phases were formulated using locally procured feed ingredients which include maize, wheat offals, full-fat soya bean, karanj seed cake, fish cake, bone cake, limestone, premix, methionine, common salt and lysine.

five starter and finisher diets were formulated with the same inclusion levels of 5% of karanj seed cake. The diet was designated as: T1
(control) (0% karanj seed cake), T2 (5% cake from raw karanj), T3 (5% cake from karanj seed soaked in water), T4 (5% cake from boiled karanj seed), and T5 (5% cake from roasted karanj seed) as shown in Tables1 and 2. The experimental birds were allocated to the experimental diets in groups of 30 birds each and each treatment group were replicated three times with 10 birds per replicate in a completely randomized design (CRD). The study lasted for 7 weeks.

Table 1: Ingredient Composition and Calculated Analysis of the Experimental Broiler Starter Diets

Ingredient	Level of karanj seed cake included				
	T_1	T_2	T_3	T_4	T_5
	(0% KSC)	(5% RKS)	(5% SSKM)	(5%BKSC)	(5% RKSC)
Maize	47.93	44.95	45.27	44.73	46.14
Full-fat Soya bean cake	28.37	25.85	25.53	26.07	24.66
GNC	05.00	05.00	05.00	05.00	05.00
KSC	00.00	05.00	05.00	05.00	05.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish cake	05.00	05.00	05.00	05.00	05.00
Limestone	01.00	01.00	01.00	01.00	01.00
Bone cake	02.00	02.50	02.50	02.50	02.50
Min-vit-premix*	00.25	00.25	00.25	00.25	00.25
Methionine	00.10	00.10	00.10	00.10	00.10
Lysine	00.10	00.10	00.10	00.10	00.10
Table salt (NaCl)	00.25	00.25	00.25	00.25	00.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein (%)	23.88	23.35	22.59	23.69	22.96
Crude fibre (%)	04.00	04.06	04.10	04.07	04.10
Ether extract (%)	03.89	03.87	03.65	0385	03.77
Methionine (%)	00.48	00.47	00.46	00.44	00.44
Lysine (%)	01.49	01.48	01.46	01.44	01.39
Calcium (%)	01.00	01.00	01.00	01.00	01.00
Phosphorus (%)	00.65	00.65	00.65	00.65	00.65
ME (kcal/kg)	2848.15	2841.65	2854.49	2850.54	2921.44

ME= Metabolizable energy; GNC= groundnut cake, KSC= karanj seed Cake, RKS= Raw karanj seed Cake, SSKM= Cake from seeds soaked in water for 24 hours, BKSC A= Boiled for 60 minutes karanj seed Cake, RKSC= Roasted karanj seed Cake.

** = Bio Mix Broiler Premix supplying the following per Kg of feed:*
Vitamin A=4,000,000IU, VitaminD_3=1,000,000IU, Vitamin E = 9,200mg, VitaminK_3 = 800mg, VitaminB_1 = 400mg, Vitamin B_2 = 2200mg, Niacin=1,100mg, Pantothenic acid=3300mg, Vitamin B_6 = 1200mg, Vitamin B_{12} =6mg Folic acid = 300mg, BiotinH_2=24mg, Choline Chloride=1,200,000mg, Cobalt = 800mg, copper = 1200mg, Iodine=400mg, Iron=800mg, Manganese=16,000mg, Selenium=80mg, Zinc=12,000mg and Antioxidant=500mg

Table 2: Ingredients Composition and Calculated Analysis of the Experimental Broiler Finisher Diets.

Ingredient	Level of karanj seed cake included				
	T_1 (5% KSC)	T_2 5% 5%RKSC)	T_3 (5% SSKM)	T_4 (5% BKSC)	T_5 (5% TKSC)
Maize	49.64	46.66	46.98	46.44	47.86
Full fat Soya bean cake	21.16	19.14	18.82	19.36	17.94
GNC	05.00	05.00	05.00	05.00	05.00
KSC	00.00	05.00	05.00	05.00	05.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish cake	05.00	05.00	05.00	05.00	05.00
Limestone	01.00	01.00	01.00	01.00	01.00
Bone cake	02.50	02.50	02.50	02.50	02.50
Min-vit-premix*	00.25	00.25	00.25	00.25	00.25
Methionine	00.10	00.10	00.10	00.10	00.10
Lysine	00.10	00.10	00.10	00.10	00.10
Table salt (NaCl)	00.25	00.25	00.25	00.25	00.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein (%)	21.00	21.00	21.00	21.00	21.00
Crude fibre (%)	04.05	04.05	04.12	04.11	04.14
Ether extract (%)	03.90	03.88	03.67	03.76	03.78
Methionine (%)	00.45	00.44	00.43	00.42	00.41
Lysine (%)	01.39	01.38	01.36	01.34	01.31
Calcium (%)	01.00	01.00	01.00	01.00	01.00
Phosphorus (%)	00.65	00.65	00.65	00.65	00.65
ME (kcal/kg)	2854.16	2854.30	2940.93	2936.97	2947.29

*ME= Metabolizable energy; GNC= groundnut cake, KSC= karanj seed Cake, RKSC= Raw karanj seed Cake, SSKM= karanj Cake from seeds soaked in water for 24 hours, BKSC A= Boiled for 60 minutes karanj seed Cake, BKSC= * = Bio Mix Broiler Premix supplying the following per Kg of feed:*
Vitamin A=4,000,000IU, VitaminD_3=1,000,000IU, Vitamin E = 9,200mg, VitaminK_3 = 800mg, VitaminB_1 = 400mg, Vitamin B_2 = 2200mg, Niacin=1,100mg, Pantothenic acid=3300mg, Vitamin B_6 = 1200mg, Vitamin B_{12} =6mg Folic acid = 300mg, BiotinH_2=24mg, Choline Chloride=1,200,000mg, Cobalt = 800mg, copper = 1200mg, Iodine=400mg, Iron=800mg, Manganese=16,000mg, Selenium=80mg, Zinc=12,000mg and Antioxidant=500mg

RESULTS AND DISCUSSION

Haematological Parameters of Broiler Chickens Fed Raw and Differently Processed Karanj (*Pongamia pinnata*) Seed Cake

The results of haematological parameters of broiler chicken fed differently processed karanj (*Pongamia pinnata*) seed cake (KSC) are presented in Table 3. With the exception of white blood cells (WBC) count, mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), neutrophils, and lymphocytes, all other haematological

parameters measured were not affected (P>0.05) by the treatments. The packed cell volume (PCV) of 23.33 to 25.00 % obtained in this study were slightly lower than the values (25 to 45 %) reported by Banerjee (1998) for healthy chickens. However, they are close to the values of 24.33 - 26.33 % and 22.70 – 26.16 %, reported by Kwari *et al.* (2019) and Aguibe and Kehinde (2019) for broiler chickens fed processed sickle pod *(Senna obtusifolia*) seed cake and differently processed shea butter cake, respectively. Kwari *et al.* (2019) conducted their study in a similar environment. Mitruka and Rawnsleiy (1997) reported that when the PCV values are below the normal range, the chickens may likely be anaemic which invariably could result in the alteration of other physiological processes such as assimilation and utilization of nutrients. In this study, these adverse effects were not observed.

The haemoglobin concentration and RBC count were within the normal range (Anon, 1980). This is an indication of nutritional adequacy of the diets. Banerjee (1998) reported RBC values of 2 - 4 (x 10^6 / mm^3) and Hb of 7 – 13 g/dl as the ideal ranges for healthy chickens. The white blood cells (WBC) count of the birds fed 5 % RKSC and 5 % B. 30 M. KSC were (P<0.05) higher than those of control and other treatment groups. This shows that the ability of the bird fed KSC to fight against infections/foreign substances was not compromised due to effectiveness of the processing methods/

Table 3: Haematological Indices of Broiler Chickens Fed Raw and Differently Processed Karanj *(Pongamia pinnata)* Seed Cake

Parameter	Experimental Diets					SEM
	TI(0% KSC)	T2(5% RKSC)	T3(5% SKSC)	T4(5% B 60KSC)	T5(5% TKSC)	
Packed Cell Volume (%)	25.00	28.00	23.33	23.00	24.00	2.78^{NS}
Haemoglobin Concentration (g/dl)	10.20	9.300	7.77	7.63	7.93	0.92^{NS}
Red Blood Cell (10^6/ mm^3)	4.25	4.67	3.90	3.83	3.97	0.41^{NS}
White Blood Cell (x 10^3 /mm^3)	10.20^b	13.10^a	11.00^b	10.00^b	11.40^b	0.67^*
Mean Corpuscular Volume (fl)	67.17	71.86	65.00	69.72	73.61	11.00^{NS}
Mean Corpuscular Haemoglobin (Pg)	6.34^a	6.23^{ab}	5.04^{abc}	4.53^c	4.89^{bc}	0.66^*
Mean Corpuscular Haemoglobin Concentration (%)	33.23^{ab}	33.23^{ab}	33.29^a	33.19^{ab}	33.05^b	0.08^*
Differential counts						
Neutrophils (%)	20.33^b	20.67^b	24.67^{ab}	33.00^a	26.33^{ab}	5.12^*
Eosinophils (%)	0.00	0.67	2.00	0.00	1.00	1.02^{NS}
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00^{NS}
Lymphocytes (%)	79.67^a	79.67^a	73.33^{ab}	72.33^{ab}	67.00^b	4.70^*

NS = Not Significant (P > 0.05) * = Significant (P < 0.05): SEM = Standard Error of Mean
a, b, c, = Means within the same row bearing different superscripts differ significantly (P < 0.05)
RKSC = Raw karanj seed cake
SKSC = karanj seed cake soaked for 24 hours
B.60 M. KSC = Karanj seed cake boiled for 60 minutes
TKSC = Toasted karanj seed cake

In reducing the level of anti-nutritional factors in the test ingredient. According to Oyawoye and Ogunkunle (1998), haematological components of blood are valuable in monitoring level of toxicity in feed with emphasis on feed constituents that affects blood formation.
Neutrophils values in all the treatment groups were similar except the group fed 5 % B. 60 M. KSC which recorded higher values than T1 (0 % KSC) and T2 (5 % KSC). Neutrophils are component of WBC that are involved in combating viral and bacterial infections. Broiler chickens fed KSC recorded similar lymphocyte values except birds fed 5 % TKSC which recorded the lowest value. The eosinophils and basophils values were within the normal range (0.00 – 5.00 %) as reported by Anon (1980) for domestic chickens. Eosinophils are known to phagocytize particles formed when an antigen and anti-bodies react, a strategy for combating disease infection by chickens (Adeyemo and Longe, 2007).
With respect to this study, the chickens did not suffer from any problems that may result to anaemic condition. Therefore, the processed KSC at 5 % level were well-tolerated by the broiler chickens.

Serum Biochemical Indices of Broiler Chicken Fed Raw and Differently Processed Karanj (*Pongamia pinnata*) Seed Cake

The results of serum biochemical indices of broiler chickens fed differently processed karanj **(***Pongamia pinnata***)** seed cake are presented in Table 4. The results showed that total protein, globulin, glucose, conjugated bilirubin, aspartate aminotransferase (ASAT) and alanine aminotransferase (ALAT) were significantly ($P<0.05$) affected by the dietary treatments. On the other hand, albumin, urea, creatinine, cholesterol, total bilirubin and alkaline phosphate were not significantly ($P>0.05$) affected among the treatment groups. The total protein values fall within the range (5 – 8 g/dl) reported by Jain (1986) for healthy chickens. The normal values for total protein and globulin are indication of adequate protein utilization. The different processing methods used have reduced the level of the anti-nutritional factors which resulted in better protein utilization by the broiler chickens fed the processed KSC. The normal values for total protein and globulin are reflection of better quality and amount of protein in the diets (Omoikhoje *et al.,* 2004). Bush (1991) reported that an increase in total protein may be due to increase in the level of globulin while a decrease in total protein level is always due to a low albumin level.

Table 4: Serum Biochemical Indices of Broiler Chickens Fed Raw and Differently Processed Karanj (*Pongamia pinnata*)
Seed Cake

Parameter	Experimental Diets					
	TI(0% KSC)	T2(5% RKSC)	T3(5% SKSC)	T4(5% B.60 M. KSC)	T5(5% TKSC)	SEM
Total protein (g/dl)	7.00^{a}	6.67^{ab}	6.00^{b}	6.33^{b}	5.67^{c}	1.54^{*}
Albumin (g/dl)	3.6	3.67	3.67	2.67	3.23	4.45^{NS}
Globulin (g/dl)	3.00^{a}	3.00^{ab}	3.33^{a}	2.67^{bc}	1.67^{c}	4.78^{*}

Glucose (g/dl)	3.73^{c}	3.97^{bc}	6.17^{a}	5.93^{a}	5.70^{ab}	0.82^{*}
Urea (mmol/l)	4.36	4.25	4.33	4.46	4.55	0.11^{NS}
Creatinine (mmol/l)	58.43	57.00	58.00	56.43	58.23	6.58^{NS}
Cholesterol (mg/dl)	6.00	6.27	6.57	6.9	6.47	0.43^{NS}
Total bilirubin (mmol/l)	2.23	2.27	1.60	1.33	2.10	0.45^{NS}
Conjugated bilirubin (mg/dl)	3.50^{ab}	3.53^{ab}	4.33^{a}	2.60^{b}	3.90^{ab}	0.63^{*}
Alkaline phosphate (IU/L)	78.67	79.33	73.33	73.67	131.00	28.52^{NS}
Aspartate aminotransferase (ASAT) (IU/L)	139.33^{b}	222.33^{a}	222.33^{a}	217.00^{a}	226.33^{a}	29.82^{*}
Alanine aminotransferase (ALAT) (IU/L)	53.00^{b}	91.00^{a}	110.33^{a}	107.00^{a}	109.00^{a}	11.61^{*}

NS = Not Significant ($P > 0.05$)

* = Significant ($P < 0.05$): SEM = Standard Error of Mean

a, b, c, d = Means within the same row bearing different superscripts differ significantly ($P < 0.05$)

RKSC = Raw karanj seed cake

SKSC = Karanj seed cake soaked for 24 hours

B.60 M. KSC = Karanj seed cake boiled for 60 minutes

TKSC = Toasted karanj seed cake

The albumin values ranged from 2.67 to 3.67 g/dl and these were within the reference value of 2-4 g/dl reported by Jain (1986). Ewulola and Egbunike (2008) reported that values for serum albumin indicates adequacy in quality and quantity of the dietary protein whereas value less than the normal physiological value indicate hypoalbuminemia. Melluzzi *et al*. (1991) reported that changes in nutritional protein status are better shown in the albumin than in the globulin content of the blood.

The glucose levels of broiler chickens showed significant ($P<0.05$) differences among the treatment groups. The birds fed processed KSC recorded similar values which are significantly ($P<0.05$) superior to the birds fed 0 % KSC and 5 % RKSC diets. Blood glucose, which is an end product of carbohydrate digestion, is directly used to provide energy for the body. However, excess of it is being converted and stored in the form of glycogen in the liver and muscle, and for fat, protein and other biosynthesis. The finding of Melluzzi *et al*. (1991) showed that low blood glucose could be an indication of inadequate intake of energy.

The values for urea are within the acceptable range (4.25 – 4.55 mmo/l) for broiler chickens (Jain, 1986). This could be attributed to the effect of the processing methods. Serum urea originates from the diet and tissue deamination of proteins and it also indicates the quality of dietary protein (Ewulola and Egbunike, 2008). Abiola *et al*. (2001) reported that increase in urea concentration is an indication of poor protein quality. Ani and Omeje (2008) further explained that the values within the normal range imply that the dietary protein is well-utilized by the animal and this tallied with the results obtained in this study.

Serum creatinine values showed non-significant (P>0.05) differences among the treatment groups. Nworgu (2004) reported that the level of creatinine measures the degree of muscle wastage. Creatinine levels have been reported to be used as biochemical marker employed in the diagnosis of renal damage (Ojediran *et al*., 2012). The normal values obtained have further confirmed the nutritional adequacy of the dietary protein.
The levels of cholesterol (6.00 – 6.90 mg/dl) and total bilirubin (1.33 – 2.27 mmol/l) were within the normal range (2.42 – 7.80 mg/dl and (0.3 – 5.1 mg/l) respectively, reported by Zunft *et al.,* 2003. Anti-nutritional factors have been reported to reduce fats and cholesterol levels in tissues (Zunft *et al.,* 2003). Broiler chickens fed 5 % B.60 M. KSC recorded lower values for conjugated bilirubin than T3 (5 % SKSC)

The values for alkaline phosphate of broiler chickens fed the experimental diets fall within the acceptable range (73.33 to 131.00 IU/L). Akinmutimi and Onen (2008) explained that an increase in the level of alkaline phosphate was due to challenge of the liver by toxic components, consequently forcing the liver to produce more of these enzymes in a bid to detoxify the toxic effects. However, this is not the case in the present study.

Broiler chickens fed 0 % KSC recorded significantly (P<0.05) lower values for both ASAT and ALAT than the other treatments. These are liver enzymes that have linkages between the liver and the blood. Mandal and Banerjee (1982) found no adverse effect on ASAT activity in broilers fed diet containing 6 % solvent extracted karanj seed cake (SKC). The slightly higher values of ALAT observed in birds fed KSC diets could be possibly due to the effects of residual tannins and trypsin inhibitors in the diets. Ojediran *et al.* (2012) reported that the appearance of abnormal amounts of certain enzymes of intercellular origin in the blood reflects damage to an organ or tissue and anti-nutritional factors are capable of exerting such effects. The results show that broiler chickens could tolerate up to 5 % processed KSC in their diet without showing adverse effects on some serum biochemical parameters.

Conclusion

The outcome of this study further indicated that inclusion of 5 % toasted KSC has no adverse effects on the blood profile broiler chickens. The performance of the chickens fed processed KSC, especially toasted, showed similar performance to those fed control diet (0 % KSC), an indication that the processing methods used were effective in reducing the adverse effects of Anti-nutritional factors (ANFs) in KSC.

FERENCES

Abiola, S.S. (2001). Haematological indices and serum metabolites of cockerel fed hatchery waste cake diets. *Tropical Veterinarian* 18:79-84

Adeyemo, G.O. and Longe, O.G. (2007). Effect of graded levels of cotton seed cake on the performance, haemotological and carcass characteristics of broilers fed from day-old to 8 weeks of age. *African Journal of Biochechnology* 6 (8):1064-1071

Agbabiaka, L. A., Madubuike, F. N and Esonu, B. O (2012). Performance, carcass and organs weight chacteristics of broiler finisher fed varying levels of tigernut (*Cyprus esculentus L*) cake as dietary supplement. *British Journal of Poultey Science* 1 (2): 11-17.

Akinmutimi,A.H. and Onen, G.E. (2008). The response of broiler finisher birds fed graded levels of yam peel cake in place of maize-based diets. *International Journal of Poultry Science* 7(5):474-479

Ani, A. O. and Omeje, O. D. (2008). Effect of raw Bambara nut (*Vigna subterranean* (L) Verde) waste and supplementary enzymes on haematological parameters of broiler finishers. *Proceeding 13th Conference Animal Science Association of Nigeria (ASAN).* Sept. 15th – 19th, ABU, Zaria, Pp. 288-291.

Anon. (1980). *Guide to the Care and Use of Experimental Animals*. (Vol. 1). Canadian Council for Animal Care. Ottawa Ontario, Canada. Pp. 85-90.

Anon. (2006). Trifed, Ministry of Tribal Welfares. Government of India. New Delhi, India.

Aro, S. O., Ogunwale, F.F., and Falade, O.A. (2013). Blood Viscosiyy of Finisher Cockerel Fed Dietary Inclusion of Fermented Cassava Tuber Wastes. *Proc. Of the 18th Annual onference of Animal Science Association of Nigeria. 74- 77*

Asafa, A.R., Ologhobo, A.D., and Adejumo, J. (2012) Performance and carcass characteristics of broiler finishers fed different levels of poultry offal cake and crayfish waste cake as replacement for fishcake. *American Journal of Experimental Agriculture*. 2(4):690 – 699.

Bush, B.M. (1975). *Veterinary Laboratory Manual.* William Heinemann Medical Books ltd. London, UK. Pp. 447.

Bush, B.M. (1991). *Interpretation of Laboratory Results for Small Animal Clinician*. Blackwell Scientific publication. U. K. Pp. 32- 37.

Dipeolu, M.A., Adebayo, A.J and Oke, O.M. (2004). Residues of streptomycin anti-biotic in commercial layers in Abeokuta and Ibadan Metropolis, *Nigerian Journal of Animal Production* 31: 130-134

DNMA (2013). Data Report by the Weather Station, 65 2013. Department of Nigerian Metrological Authority (DNMA). Accessed on 8/11/2013 at www. dnma.org

Ewuola, E.O. and Egbunike, G.N. (2008). Haemotological and serum biochemical response of growing rabbit bucks fed dietary funonisin B_1. *African Journal of Biotechnology,* 7:4304-4309

Halilu, A., Lalabe, B. C., and Olusiyi, J. A. (2016). Effect of on farm formulated and commercial diets on the performance and carcass prime cuts of broiler finisher chickens. Federal *University of Wukari Trends in Science and Technology Journal*. 1(1): 206 – 208.

Jain, N.C. (1986). *Veterinary Haematology.*4th edition Lea and Febiger Publisher Philadelphia, USA. Pp. 165- 166.

Kwari, I.D., Medugu, C.I., Maisakala, A.A., Yokasa, G.A. and Saleh, B. (2019). Growth performance, carcass characteristics and blood parameters of broiler chickens fed differently processed sickle pod (*Senna obtusifolia*) seed cake in a sahelian environment.

Nweze, B.O. (2011). *Poultry Production Management.* Innarrok Enterprises in Association with Dika's Publication, Abakaliki, Ebony State, Nigeria.

Mandal, L. and Banerjee, G. C. (1982). Studies on the utilization of karanj (*Pongamia glabra*) cake in poultry rations effects on growth on blood composition and organs weight of cockerals. *Indian Veterinary Journal*, 59: 385- 390

Melluzzi, A., Giuseppe, P., Faffaell, G. and Guglielmo, F. (1991). Determination of blood constituents, reference value in broilers. *Poultry Science* 71:337- 345

Nworgu, F.C. (2004). Utilization of forage cake supplements in Broiler chicken production, Ph.D. Thesis. Animal Science Department, University of Ibadan, Ibadan, Nigeria. Pp. 214- 222

Omoikhoje,S.O., Bamgbose, A. M., Oboh, S.O. and Eghiaruwa, B. (2004). Replacement value of groundnut cake with Bambara groundnut (*Voandziea subterranean*) on the haemotological traits and serum biochemistry of broilers. *Proceedings 9th Annual Conference of Animal Science Association of Nigeria* (ASAN). 13th – 16th September, 2006. Abakiliki, Nigeria. Pp. 86-89

Ojediran, T.K., Emiola, I.A., Ogunwemmimo, O. and Olayemi, T.B. (2012). Effect of processed Jatropha curcas kernel cake on the blood profile and biochemical indices of broiler, In: *Proceeding of the 17th Annual Conference of Animal Science Association of Nigeria (ASAN)* 9th – 13th September, Abuja Pp. 509 – 512

Omojola A.B., and Adesehinwa, R. E. (2007). Performance and Carcass characteristics of broiler chickens fed diets supplemented wide graded levels of *Roxazymse* G. *International Journal of Poultry Science*. 6 (5):335 – 339.

Omole, A.J., Adejinmi, O.O., Adejuyige, A.D., Tiamiyu, A.K. and Raji, A.M. (2006). *Small and Medium Scale Broiler Chicken Farming*. Area choice Agric. Publications, Ibadan, Nigeria.

Orwa, C. Mutua, A., Kinndt, R., Jmna, R., and Anthony, S. (2009). Agro forest tree Database: a tree reference and selection guide version 4.0. World Agro forestry Centre, Kenya.

Oyawoye, B. M. and Ogunkule, H. N. (2004). Biochemical and haemotological reference values in normal experimental animals. Masson, New-York, 212-218.

Panda, A. K., Sastry, V. R. B. and Mandal, A. B. (2008). Growth, nutrient utilization and carcass

characteristics in broiler chickens fed raw and alkali processed solvent extracted karanj (*Pongamia glabra*) cake as partial protein supplement. *Indian Journal of Poultry Science* 45: 199-205.

Sanusi, M., Rabi, A., Doma, U.D., and Haruna, N.A. (2015). Comparative effect of self-formulated and four commercial diets on the growth performance carcass and haematologcal parameters of broiler finisher in the tropics. *Sokoto Journal of Veterinary Science.* 13(2):14 – 19.

Zunft, H.J.F, Luder, W., Haber, B. Graubaum, H.J., Koebnick, C. and Gruwald, J. (2003). Carbo pulp preparation reach in insoluble fibre lower HDL and LDL cholesteron in hypercholesterondermic patents. *European Journal of Nutrition* 42:235-242

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 14-20 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Effect of Dietary Levels of Soya Bean Waste Meal on digestibility and haematological indices of Broiler Chickens in the Semi-Arid Region of Nigeria

B. G. Makinta[1], Ibrahim Ali Gava[2], A. Mustapha[3], & T. A. Jibrin[4]
[1,2&3]Department of Agricultural Production Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
[4]Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria
Corresponding Author @gmail.com | +2348035127503

Abstract: *The effects of feeding graded levels of soya beans waste meal on digestibility and hematological parameters of broilers chickens were evaluated. The soya beans waste meal was included at 0, 2.5, 5, 7.5 and 10% levels into diets 1, 2, 3, 4 and 5 respectively as replacement for full fat soya beans meal. One three hundred (300) four week Amo breed broiler chickens were randomly assigned to five diets in a Completely Randomized Block Design (CRBD). Each treatment was replicated three times with 20 birds per replicate. At end of the experiment, 9 birds per treatment were selected for digestibility and hematological parameters. The nutrient digestibility of dry matter and ether extract digestibility were not significantly (P>0.05) different among the treatment groups while crude protein and crude fibre digestibility were affected (P<0.05) by the inclusion of soya beans waste meal. Broiler chickens fed T3 diet (5% soya beans waste meal) utilized better crude protein and crude fibre compared to those fed T5 (10% soya beans waste meal) diet, but similar (P>0.05) to other treatments. Most of the hematological parameters were not affected (P>0.05%) by the soya beans waste meal in the diets but only red blood cell count, mean corpuscular volume and mean corpuscular hemoglobin were affected (P<0.05) by the test material. The values obtained in this study were within the normal ranges of healthy broiler chickens. Therefore, the study indicating that up to 7.5% soya beans waste meal can replace with full fat soya bean meal without adverse effect on the digestibility and hematological parameters of broiler chickens.*

Keywords: *Broiler chickens, Soya bean waste meal, Digestibility and Haematological parameters*

INTRODUTION

The poultry industry in Nigeria has undergone significant transformation since the early fifties from a backyard, peasant and primitive household, oriented husbandry of breed of semi-wild chicken to the cash oriented modern large scale poultry. Broiler was introduced into Nigeria in the 1950s to supplement the fast declining rate of cattle production in a bird to supply much required protein in the diet of Nigerians (Oluyemi, 2000).

Feed supply is the major limiting factor in poultry production in developing countries such as Nigeria (Nwagu, 2005). Feed alone account for 65-80 of total cost of production (Yegany *et al.,* 2002).

The great source of dilemma in poultry industry is feed stuff like maize and soya bean (Adene, 2004). Another factor that affects the availability and affordability is the seasonality nature of the produce and therefore are scarce and very expensive when they are off season.

This result in animal nutritionist resorting to replacement of conventional ingredient with non-conventional alternative sources protein such as soya beans waste (Ezieshi *et al.,* 2004 Okeudo *et al.,* 2005, Okon and Ogunode, 2006). However, quantities of this product in the diet for optimum growth were not fully established.

MATERIALS AND METHODS

Experimental Animals and Management

The study was conducted at the Ramat Polytechnic Teaching and Research Farm, Maiduguri, Borno State of Nigeria. Maiduguri is located between latitude 11^0c and 12^0c longitude 13^0c and 14^0E and on an attitude of 354 above sea level (Alaku, 20005). It falls within the sub-arid zone of West Africa Characterize by short duration of rain fall (3.4 months), which varies from 580mm to 600mm with long dry season (7-8 months). Ambient temperatures are high during the month of April to June and fall within the range 40^0c and above well relative humidity at non-range from 5-45% (Alaku, 2005).

Three hundred (300) four week Amo breed broiler chickens were used for the experiment, the chicks were brooded together in a deep litter system using black charcoal with kerosene for heat production. A 200 watt electric bulb used at night to illuminate the house and lantern is provided in case of power failure in the night. A commercial broiler starter was provided and water *ad libitum* throughout brooding phase. Vaccination for Newcastle and Gumboru disease were strictly observed as scheduled.

At the end of the brooding phase, the birds were randomly assigned in to five treatment diets containing various level of soya beans waste replacing full fat soya bean for four weeks. Each treatment was replicated three times with 20 birds per replicate.

The experimental diets and portable water was supplied *ad libitum* throughout the experimental period of four weeks.

Processing of Soya Bean Waste Meal

Soya bean waste (SBW) which is popularly called *Dusan awara* in Hausa were collected from local that produce *awara* in Maiduguri, Borno State. The SBW was then spread on clean concrete floor and sundried for a period of 2 days and obtained a 95% dry matter content. then it was ground to obtained fine and uniform particles in cooperated in the various treatment diets.

Experimental Diets

The ingredients composition of broiler finisher diets is presented in Table 1. The experimental diets were compounded using the following feed ingredients such as: Maize, soybean meal, groundnut cake, wheat offal, soya bean waste meal, fish meal, bone meal, limestone, methionine, lysine, common salt and premix. In each diet, the soya bean meal was replaced soya bean waste meal at graded levels of 0, 2.5, 5, 7.5 and 10% in treatments 1, 2, 3, 4 and 5, respectively. The proximate compositions of the experimental diets were analyse using AOAC (2000) method.

Table 1: Ingredients composition of broiler finisher diets

Ingredients	T1	T2	T3	T4	T5
Maize	65.36	65.36	65.36	65.36	65.36
Groundnut cake	6.64	6.64	6.64	6.64	6.64
Soya bean meal	10.00	7.50	5.00	2.50	0.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
SBW meal	0.00	2.50	5.00	7.50	10.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Common salt	0.35	0.35	0.35	0.35	0.35
*Premix	0.20	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**	**100**

** Premix (grow fast) Manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplying the following per kg of premix: Vitamin A, 5000,000 IU; Vitamin D_3 800,000IU; Vitamin E, 12,000mg; Vitamin K, 1,5000mg; Vitamin B_1, 1,000mg; Vitamin B_2, 2,000mg, Vitamin B_6, 1,500mg; Niacin, 12,000mg; Pantothenic acid, 20.00mg; Biotin,10.00mg; Vitamin B_{12}, 300.00mg; Folic acid, 150,000mg; Choline, 60,000mg; Manganese, 10,000mg; Iron;15,000 mg, Zinc 800.00mg; Copper 400.00mg; Iodine 80.00mg; Cobalt 40mg; Selenium 8,00 mg*

Digestibility Study

The nutrient digestibility study was conducted at the end of the week of the experiment. Faecal samples were collected from nine chickens per treatment (i.e. 3 from each replicate) for a period of seven days using fine wire mesh trays placed under the cage cells. The amount of faeces voided daily was weighed and allowed to dry for 24 hours at 80^0C in an oven. The dried faecal samples were stored in air -tight bottles for chemical analysis. The proximate composition of the diets and faecal samples were determined according to AOAC (2000).

Hematological Parameters

At end of the experiment, blood samples were collected randomly from three (3) chickens per replicate (i.e nine chickens in each treatment) for the determination of the hematological indices. The blood samples were collected in sample bottles containing dipotassium salt of ethylene diamine–tetra acetic acid (EDTA–K^{2+}) which served as an anticoagulant. The hematological analysis of blood samples were carried out at the Department of Animal Science University of Maiduguri, Nigeria, using the routinely available clinical methods (Bush, 1975). The hematological indices determined were packed cell volume (PCV), hemoglobin concentration (Hb), red blood cell (RBC) counts and white blood cell (WBC) counts and differential counts. Mean corpuscular hemoglobin (MCH), mean corpuscular

volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were obtained from calculation according to standard formulae (Jain, 1986).

Statistical analysis

All the data collected were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980). Means were separated where applicable using the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSIONS

Proximate Composition of Experimental Diets

The proximate composition of the experimental diets is shown in Table 2. The crude protein, crude fiber and ether extract values were numerically similar among the diets and values were adequate as recommended by Olomu (2011) for broiler finisher in Nigeria. The ash content of the diets were slightly increase as the levels of SBW meal increased in the diets while nitrogen-free extract decrease as the levels of SBW meal increased in the diets. The metabolizable energy of the diets were also similar and adequate as recommended by Olomu (2011).

Table 2: Proximate composition of experimental diets

Nutrients	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%)	T5 (10%)
Dry Matter (%)	83.90	93.95	93.70	93.25	94.05
Crude Protein (%)	19.25	19.39	19.53	19.67	20.80
Crude Fibre (%)	8.57	8.56	8.56	8.58	9.0
Ether Extract (%)	3.50	3.50	3.00	3.00	3.00
Ash (%)	3.50	3.80	4.50	5.50	6.00
NFE (%)	65.18	64.75	64.41	63.25	61.20
ME (kcal/kg)	3238.64	3274.71	3287.67	3287.17	3185.20

ME = Metabolizable energy calculated according to the formula of Pauzenga (1985): ME = 37x% CP+81x%EE+35.5 x %NFE NFE = Nitrogen-free extract

Nutrient Digestibility of Broiler Chickens Fed Different levels of SBW Meal

The nutrient digestibility of broiler chicken fed different levels of SBW meal is shown in Table 3. The result of nutrient digestibility showed that the dry matter and ether extract digestibility were not significantly ($P>0.05$) different among the treatment groups while crude protein and crude fibre digestibility were affected ($P<0.05$) by the inclusion of SBW meal in the diets. Broiler chickens fed T3 diet (5% SBW meal) utilized better crude protein and crude fibre compared to those fed T5 diet, but similar ($P>0.05$) to other treatments. The result shows that SBW meal can replace FFSB meal up to 7.5% level of inclusion without any effect on crude protein and crude fibre digestibility. The result can be compared favourably with the work of (Ajayi, 2014) who fed graded levels of hydrolyzed SBW meal in the diets of broiler chickens.

Table 3: Nutrient Digestibility of Broiler Chickens Fed Different Levels of SBW Meal

Parameters (%)	T1	T2	T3	T4	T5	SEM
Dry Matter	88.86	85.21	86.02	88.86	82.61	7.82 ^{NS}
Crude Protein	77.03^{ab}	79.25^{ab}	88.63^{a}	77.03^{ab}	67.18^{b}	7.96 *
Crude Fibre	67.60^{ab}	65.24^{ab}	84.70^{a}	67.60^{ab}	51.17^{b}	8.53 *
Ether Extract	82.76	82.78	82.01	82.76	81.32	6.04 ^{NS}

SEM = Standard error of mean; NS = Not significantly different (P>0.05); * = Significantly different (P<0.05) and Means in the same row with different superscripts are significantly different (P<0.05)

Hematological Parameters of broiler chickens fed graded levels of SBW meal

Hematological parameters of broiler chickens fed SBW meal are shown in Table 3. All the hematological parameters measured were not significantly (P>0.05) different expect red blood cell, mean corpuscular volume and mean corpuscular hemoglobin. The packed cell volume values (25.66-28.66%) were within the range from 25 to 45% as reported by Anon (1980). This means that protein of the diets was not affected by the inclusion of SBW meal in the diets. The hemoglobin concentration values (8.50-9.53g/100ml) obtained falls within the ranged (7-13g/100ml) as observed by Anon (1980).

The broiler chickens fed T4 diet recorded the highest value compared to other treatments but similar to those fed T3 diet. The red blood cell (RBC) values obtained were within the range 21.00-27.00x10^6mm^3 which were similar to the ranged of 25-32 10^6/mm^3 reported by Anon (1980). The function of the RBC is to transport hemoglobin, which in turn carries oxygen from the lungs to the tissues (Bush, 1991). As a result of the higher value of RBC in T4 is a clear indication that the chickens were free from blood related disease like anemia. The white blood cell values (16.00-17.00x10^3/mm^3) were within the normal ranged (9-31x 10^3/mm^3) for healthy chicken as reflected by Anon (1980). Bush, (1991) reported that high level of white blood cell (WBC) indicates that the body is fighting infection while lower value shows problems with the bone marrow production which was not occur in this study.

. The broiler chickens fed T4 recorded lowest value of mean corpuscular volume (MCV) compared to other treatments with similar values. The MCV ranged between 12.12 and 12.57fl were within the ranged as reported by Anon (1980) for normal healthy chickens. Bush (1991) explained that the MCV values aid in assessing the anemia conditions of an animal and the capacity of the bone marrow to produce red blood cells of normal size and metabolic capacity as earlier stated. This observation was supported by Anon (1980) who reported that hemoglobin reflects the responsiveness of the animal to its internal and external environment which includes nutritional status. The mean corpuscular hemoglobin values ranged from 3.15 to 4.47pg were also tallies with the values reported by Anon (1980). The chickens fed T1 had the highest value when compared to those fed other diets, but similar to chickens fed T2 diet. However, lowest value was obtained in those chickens fed T4 diet. The values were within the range recommended by Anon (1980). The mean corpuscular hemoglobin concentration values ranged from 33.13 to 35.85% were within the ranged 32 to 42% as recommended by Anon (1980). The differential counts (%) parameters are associated with body defense mechanism. All the parameters were not significantly (P>0.05) different among the treatment groups. The values are within the reference values for healthy chicken as recommended by Anon (1980). This is an indication that the diets are adequate in nutrient to support the healthy condition of broiler chickens.

Table 3: Hematological parameters of broiler chicken fed graded levels SBW meal

Parameters	TI	T2	T3	T4	T5	SEM
Packed cell volume (%)	26.33	28.66	28.66	25.66	25.66	1.51^{NS}
Hemoglobin concentration (g/100ml)	9.33	9.50	9.53	8.50	8.53	0.37^{NS}
Red blood cell count ($x10^6mm^3$)	21.00^b	23.00^b	23.66^{ab}	27.00^a	22.00^b	1.05^*
White blood cell($x10^6mm^3$)	16.00	16.00	16.00	16.66	17.00	1.39^{NS}
Mean corpuscular volume (fl)	12.57^a	12.51^a	12.12^a	9.50^b	11.69^a	0.53^*
Mean corpuscular hemoglobin (pg)	4.47^a	4.14^{ab}	4.03^b	3.15^c	3.89^b	0.13*
Mean corpuscular hemoglobin concentration (%)	35.85	33.13	33.25	33.12	33.24	1.12^{NS}
Differential count (%)						
Monocytes	8.33	2.78	0.33	0.33	0.08	0.19^{NS}
Neutrophils	44.00	38.33	40.00	38.33	45.41	9.36^{NS}
Eosinophils	3.33	1.66	1.66	1.66	0.16	1.15^{NS}
Lymphocytes	52.66	60.00	59.66	58.00	54.83	9.46^{NS}

SEM**:** Standard Error of Mean, NS= Not significant (P > 0.05) difference; *= Significant (P<0.05) difference, a b c= Means in the same row with different superscripts are significantly different (P<0.05)

CONCLUSION

Based on the digestibility and hematological indices results indicated that inclusion level of up to 7.5% SBW in the diets of broiler chickens shown no any adverse effect on the health status of the broiler chickens. However, there is need to conduct studies on the growth performance parameters of broiler chickens fed SBW.

REFERENCES

Ajayi, H. I. and Iyayi, E. A. (2014). Nutrient digestibility and growth performance in broilerchickens fed graded levels of SBW meal. *Ibadan Journal of Agricultural Research.* Volume 10 (1): 78-87.

Anon (1980) Guide to the use of experimental animal vol. 1 canadian council of animal care. Ontario Canada pp. 185 – 190.

AOAC (2000). *Official Methods of Analysis of Official Analytical Chemists*. 17th Edition. Ed. Horwitz, W., Washington, D.C., Association of Official Analytical Chemists. Pp 55-101

Anon. (1980). *Guide to the Care and Use of Experimental Animal Vol. I* Canadian Council on Animal Care, Ottawa, Ontario, Canada Pp. 85 -90.

Bush, B. M. (1991). *Interpretation of Laboratory Results for Small Animal Clinicians.* Black Well Scientific Publications, U. K. Pp. 22 –67.

Duncan, D. B. (1955). Multiple range and multiple F. tests. *Biometrics* 11: 1–42.

Ezieshi, E.V and Olomu J.M. (2004) comparative performance of broiler chicken feed varying level of pkc and maize offals patotan gtrition, 3(4); pp. 254 – 257.

Isika, M.A., Agiang, E.A. and Eneji, C.A. (2006). Complementary effect of processed broilers offal and SBW meals on nutrient retention, carcass and organ mass of broilers chickens. *International Journal of Poultry Science,* 7: 656-661

Nakhash, R.M.S. (2008). The effects of partial replacement of soybean meal in the grower diet with sun dried blood and boiled SBW meals on the performance of broiler chicks. *Thesis for Master of Animal Production, Faculty of Graduate Studies,* An-Najah National University, Nablus, Palestine.

Nwagu, B.I. (2005) production and management of indigenous poultry species. A training manual in national training workshop on poultry production in Nigeria National animal production research instate, shika, zaria 10 – 26pp.

Ogundipe, S.O and Sanni, S.A (2004) economic of poultry production in Nigeria. In: J.O Gefu, I.A. Adeyinka and A.A. Sekomi ledal. A training manual on National Training workshop on poultry production in Nigeria. national institute for animal production research institute (NAPRI), Ahmadu Bello university, Zaria, nigeria pp 27 – 45.

Okeudo, N.J., Ebsh, K.v., Izugbokwe, N.V., and Akanno, E.C (2005) Growth rate carcass characteristics and organopletic quality of broiler fed graded levels of palm. Kernel cake. International journal of poultry Sc. 4(5); 330 – 333.

Okon, B.I and Ogunmodeded, B.K (2006). Carcass characteristics of broiler fed penwinkle F. test and palm kernel cake. Nigerian journal of animal production (28) 16 – 20.

Oluyemi, J.A (2000) pootry production in worm climates 2nd edition Ibadan, sectrum book Ltd. 244 pp.

Olomu, J. M. (2011). *Monogastric Animal Nutrition. Principles and Practice.* A Jachem Publication, Benin City, Nigeria Pp. 109 – 119.

Torrie. J. A. (1980). *Principles and Procedures of Statistics. A Biometrical Approach,* 2nd Ed. Mc Graw. Hill Book Co. Inc. New York. Pp. 633

Yegany, M., Butcher G.N., Nipour, A.H (2002) feed hygiene and poultry health. World poultry vol. 18 (67); 17 – 19.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 21-30 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Influence of Organic Manure (FYM) and Inorganic Fertilizer (N PK) on Nutrient Uptake, Growth and Yield of Sorghum in Maiduguri.

Buba, A.
Department of Cereal crop, Lake Chad Research Institute Maiduguri P.M.B 1293 Borno State, Nigeria.
(aishatu.buba7@gmail.om)
Mustapha, B.
Department of Cereal crop, Lake Chad Research Institute Maiduguri P.M.B 1293 Borno State, Nigeria.
(Mongonu2020@gmail.om)
Sugun, K.M.
Department of Cereal crop, Lake Chad Research Institute Maiduguri P.M.B 1293 Borno State, Nigeria.
(Kashimsugun1@gmail.om)
Muhammad K.K
Agricultural Technology, College of Agriculture Science and Technology Gujba, Yobe State, Nigeria.
(muhdkolo@gmail.om)

Abstract: *The experiment was conducted in the Research and Demonstration Farm of Lake Chad Research Institute, in Maiduguri (semi-arid region). The experiment consists of nine fertilizer treatments which include both organic and inorganic sources and was accomplished using A 3 x 3 factorial experiment was laid out, comprising one sorghum variety (ICSV III), tested under three levels of FYM (0, 5.0 and 7.5 t/ha) and three levels of NPK (0, half and full dose of the recommended rates). The experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The revealed that Plant height at three growth periods was significantly higher under 7.5t FYM + $N_{64}P_{32}K_{30}$ than under all other treatments. Similarly, the grain yield and panicle weight in the different fertilizer treatments ranged from 180.8 to 2051.6 kg/ha and 372.5 to 3106.9 kg/ha, respectively. The highest values of both parameters was obtained in treatment with the application of 7.5t FYM + $N_{32}P_{16}K_{15}$ kg/ha. Straw weight and total dry matter ranged from 2398.6 to 5740.6 kg/ha and 2771.1 to 8847.5 kg/ha, respectively, of all the treatments, the one with application of 7.5t FYM + $N_{64}P_{32}K_{30}$ had significantly higher values than the other treatments. Plant analysis for N P and K as well as uptake in leaf, straw and grain indicate that application of 7.5t FYM + $N_{32}P_{16}K_{15}$ kg/ha gave the best result. Therefore, the application of 7.5t FYM + N32P16K15 kg/ha is, therefore, recommended for sorghum production in the study area.*

Keywords: *Sorghum; Organic; Inorganic and Fertilizer.*

1.0 INTRODUCTION

Sorghum (*Sorghum bicolor L.*) occupies about 45 - 50% of the total land area under cultivation in Nigeria, mostly in the savanna zone where it constitutes the major food grain sources. The production of sorghum in Nigeria has been estimated to be about 8.824 million tonne of grain sorghum (CBN, 2000). In the last few years' local farmer in the savanna region of Nigeria, where bulk of the crop is grown, perceived a steady decline in the productivity of this crop mainly due to soil and climatic constraints (Rayar, 1988). This crop is continuously produced with little or no nutrient replacement through chemical or organic fertilizer (Smaling *et al.,* 1997). Many interrelated factors which are both natural and managerial, cause soil fertility decline as characterized by decline in per capita food availability among smallholder farms in Africa. An estimated rate of 130 – 150 kg per person over the

past 35 years of production has been reported (Bationo, 2003). This downward trend is attributed to insufficient nutrient inputs relative to exports, primarily through harvested products, leaching and gaseous as well as erosion losses (Smaling *et al.*, 1997). Although the use of organic manure has been an age-long practice in crop production, it is now receiving renewed attention worldwide. This renewed attention has been encouraged by the recent clamor for improvement in the organic matter contents of agricultural soil as sink for CO_2 and the high demand for organic foods (Agboola and Fagbenro, 1985). The use of chemical fertilizer and recycling of nutrient in crop residues are the obvious source to arrest the nutrient depletion in soils (Rayar, 2000; Brady and Weil, 2002). Innovative combination of organic and inorganic nutrient sources must be used to increase nutrient input and to recycle the nutrients once they are incorporated. Synergistic effects have been achieved when organic and inorganic fertilizers are applied in combined form, it initiates better yield increase more than when they are applied separately (ICRISAT, 1997). The combination can be used to increase yields and simultaneously maintain and improve soil quality as reported by Kwari *et al.* (1998). Maiduguri zone is an area embattled by low organic matter contents and facing inadequate supply of mineral fertilizer input, for reason of the foregoing, the present work tries to investigate the scenario envisaged in the area. Organic materials directly and indirectly have significant effects on soil physical conditions. These effects are usually manifested in soils through aggregation which in turn influences the hydro-thermal properties of the soil and biochemical processes occurring in the soil as well as on root penetration. Lombin *et al.* (1991), observed that deterioration in the physical properties of Western Nigerian soil has occurred as a result of declining organic matter content in such soils, therefore addition of organic materials would go a long way in alleviating such adverse effect on the soil structure. The use of organic materials such as manure not only improves the soil physical condition in terms of its water holding capacity, aeration and drainage, but also enhances good root growth and development (Addiscott *et al*., 1992). Similarly, Manures are usually applied at higher rates, relative to inorganic fertilizers. When applied at high rate, they give residual effects on the growth and yield of succeeding crops (Makinde and Ayoola, 2008). Improvements of environmental condition as well as the need to reduce cost of fertilizing crops are reasons for advocating the use of organic materials as well as improve soil fertility by activating soil microbial biomass. Application of manure sustains cropping system through better nutrient recycling, Manures provide a source of macro and micro nutrient in available forms, thereby improving the physical and biological properties of the soil (Abou E1-Magd *et al*., 2006).

2.0 MATERIALS AND METHODS

2.1 Description of Experimental Site

An experiment was conducted in Research and Demonstration farm of the Lake Chad Research Institute in Maiduguri (11^0 54' N, 13^0 05' E), in order to study the nutrient uptake, growth and yield of sorghum as influenced by organic and inorganic fertilizers. The study site has an annual precipitation of 550.3 mm falling between late June and late September, with average monthly temperature of 28.5 – 32.8^0C, high temperature is recorded in the area in March to May and low temperature in November to February.

2.2 Treatments and Experimental Design

A 3 x 3 factorial experiment was laid out, comprising one sorghum variety (ICSV III), tested under three levels of FYM (0, 5.0 and 7.5 t/ha) and three levels of NPK (0, half and full dose of the recommended rates). The experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The resultant nine fertilizer treatment combinations comprised varying levels of FYM in combination with half (N_{32} P_{16} K_{15}) kg /ha and full (N_{64} P_{32} K_{30}) kg /ha the recommended rates of NPK fertilizer as listed below.

2.3 Treatments

$T_1 = N_0P_0K_0$) kg ha^{-1} (Control)

$T_2 = N_{32}P_{16}K_{15}$ kg ha^{-1}

$T_3 = N_{64}P_{32}K_{30}$ kg ha^{-1}

T_4 = 5.0 t ha^{-1} FYM

T_5 =7.5 t ha^{-1} FYM

T_6 = 5.0 t ha^{-1} FYM + $N_{32}P_{16}K_{15}$ kg ha^{-1}

T_7 = 5.0 t ha^{-1} FYM + $N_{64}P_{32}K_{30}$ kg ha^{-1}

T_8 = 7.5 t ha^{-1} FYM + $N_{32}P_{16}K_{15}$ kg ha^{-1}

T_9 = 7.5 t ha^{-1} FYM+ $N_{64}P_{32}K_{30}$ kg ha^{-1}

2.4 Agronomic Practices

The experimental site was harrowed and marked out into plots and blocks. Dimension of each plot was 5.25 m x 4.5 m at an alley between rows and plots of 0.5 m. Cow dung was incorporated to the plots according to the treatments requirement at two weeks before sowing. The inorganic fertilizer (NPK 15:15:15) was applied at the rate of 64 kg N/ha, 32 kg P/ha and 30 kg K/ha for the full dose and 32 kg N/ha 16 kg P/ha and 15 kg K/ha for half dose at sowing and the N and P requirement ware made up using urea (46% N) and SSP (18% P_2O_5) respectively at two weeks after sowing. The seed of sorghum variety (ICSV111), were sown in plots at a row spacing of 0.75 m apart and 0.3 m between stands in a row. Weeds was controlled manually using hand hoe, the plants were thinned to two plant per stand during the first weeding at 3 WAS. The second weeding was done at 6 weeks after sowing. According to (Agyenim *et al*., 2006), in an experiment with poultry manure and NPK, Agyenim et al. (2006), observed that the lowest poultry manure rate plus one-half rate of chemical fertilizer (i.e. 2 t/ha + ½ NPK) yielded significantly higher than the full rate of NPK alone. This implies that integrated application of organic and inorganic fertilizers might be more desirable than either type of fertilizers alone. In such cases, synergism might be at work. Vasanthi & Kumaraswamy (2000) reported that poultry manure plus one-half rate of the chemical fertilizer rate yielded significantly greater amount of green fodder of corn than the full rate of NPK alone. In another experiment on maize Ibrahim (1995), reported that the combined application of FYM at 5 t/ha and N fertilizer at 100 kg/ha showed significant effect on uptake by 3-fold increase and total dry matter yield by over 500% increase over control and the N-fertilizer application. The effect of manure alone was only appreciable at l0 t/ha rate and that of N-fertilizer at 120 kg/ha. A long term cropping studies in Kenya and Nigeria indicate that organic plus inorganic inputs could sustain soil fertility at a higher level than expected additive effects of either input (Kang and Balasubramanian, 1990).

2.5 Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA). The treatment means were compared using Duncan's multiple range test (DMRT) at 5% level of significance. The data were also subjected to correlation and regression analysis, in order to relate yield obtained in the different treatments to their respective NPK in plant samples, according to the procedure of Gomez and Gomez (1984), using computer software STATISTIX 8.0.

3.0 RESULTS AND DISCUSSION

3.1 Effects of Organic and Inorganic Fertilizers, and their Combinations on the Growth of Sorghum

3.2 Plant height at different periods

Table 1 shows the effects of the different levels of organic and inorganic fertilizers on the height of sorghum at 3, 6 and 9 weeks after sowing (WAS). Effect of the treatments was significant ($P<0.01$) on the growth of sorghum at all the three growth periods. Plant height at 3 WAS ranged from 7.4 to 27.1 cm and the lowest and highest were obtained from the control and 7.5t FYM + $N_{64}P_{32}K_{30}$, respectively. Application of 7.5t FYM + $N_{64}P_{32}K_{30}$ gave significantly higher growth than all other treatments, followed by 5.0t FYM + $N_{64}P_{32}K_{30}$. However, all applied fertilizer treatments gave significantly higher growth than the control, except 5.0 FYM. Similarly, Plant height at 6 WAS ranged from 18.9 to 57.6 cm, and application of 7.5t FYM + $N_{64}P_{32}K_{30}$ resulted in significantly higher growth than in any of the treatments. However, the height of sorghum that received 5.0t FYM + $N_{64}P_{32}K_{30,}$ 5.0t FYM + $N_{32}P_{16}K_{15}$, 7.5t FYM + $N_{32}P_{16}K_{15}$ and 7.5t FYM did not differ significantly ($P<0.05$). Similarly, growth in the control and 5.0t FYM treatment did not differ significantly as also was observed among $N_{32}P_{16}K_{15}$, 5.0t FYM and 7.5t FYM treatments. Result of sorghum height at 9 WAS ranged from 47.4 to 156.9 cm with the lowest and the highest obtained from control and 7.5t FYM + $N_{64}P_{32}K_{30}$, respectively. The treatment of 7.5t FYM + $N_{64}P_{32}K_{30}$, closely followed by 5.0t FYM + $N_{64}P_{32}K_{30}$ gave significantly higher growth than any of the other treatments. Application of 7.5t FYM +$N_{32}P_{16}K_{15}$ and 5.0t FYM + $N_{32}P_{16}K_{15}$ also gave significantly higher growth than all single sources of either organic or inorganic fertilizer treatment. All applied fertilizers resulted in significantly higher growth than the control. The result is in line with (Chroma *et al*.,2004).

Table 1. Effect of farm yard manure and inorganic fertilizers on the growth of sorghum at 3, 6 and 9 weeks' periods at Maiduguri

	Plant height (cm)		
Treatment	**3 WAS**	**6 WAS**	**9 WAS**
Control	7.4^{f}	18.9^{f}	47.4^{g}
$N_{32}P_{16}K_{15}$	13.1^{de}	30.7^{de}	84.0^{de}
$N_{64}P_{32}K_{30}$	14.0^{cde}	34.8^{cd}	92.7^{d}
5.0t FYM	10.3^{ef}	24.7^{ef}	69.7^{f}
7.5t FYM	11.5^{e}	29.1^{de}	79.8^{ef}
5.0t FYM + $N_{32}P_{16}K_{15}$	15.5^{cd}	36.8^{bcd}	105.9^{c}
5.0t FYM + $N_{64}P_{32}K_{30}$	21.2^{b}	40.1^{bc}	112.1^{c}
7.5t FYM + $N_{32}P_{16}K_{15}$	17.5^{bc}	44.9^{b}	133.3^{b}
7.5t FYM + $N_{64}P_{32}K_{30}$	27.1^{a}	57.6^{a}	156.9^{a}
SE±	1.28***	2.91***	3.61***

*Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability of the DMRT. ** Significant at 1% probability level of the F-test. WAS = Weeks After Sowing*

3.3 Effects of Organic and Inorganic Fertilizers, and their Combinations on Panicle, Straw, Total Dry Matter and Grain Yields in Sorghum

Table 2 shows the effect of different fertilizer treatments on four agronomic parameters in sorghum. Result shows that the fertilizer treatments differed significantly in their effects on the panicle weight, straw weight, total dry matter and grain yield ($p< 0.001$) of sorghum. Panicle weight among the different fertilizer treatments ranged from 372.5 to 3106.9 kg/ha. Panicle weight was significantly higher with application of 7.5t FYM + $N_{32}P_{16}K_{15}$, followed by 7.5t FYM + $N_{64}P_{32}K_{30}$ than other treatments. The 5.0t FYM + $N_{64}P_{32}K_{30}$ treatment gave higher panicle weight than the single sources; and 5.0t FYM + $N_{32}P_{16}K_{15}$ and 7.5t FYM were in turn gave significantly higher value than the control. However, there was no significant difference in panicle weight among $N_{32}P_{16}K_{15,}$ $N_{64}P_{32}K_{30}$ and the control. Straw weight ranged from 2398.6 to 5740.6 kg/ha among the different fertilizer treatments, with the lowest and highest values obtained from the Control and 7.5t FYM + $N_{64}P_{32}K_{30}$, respectively. Results did not show significant difference in the weight of straw among combined sources and $N_{64}P_{32}K_{30}$. Results further revealed that straw weights of all combined sources were statistically higher, but the single sources did not differ significantly from the control. Total dry matter ranged from 2771.1 to 8847.5 kg/ha, in which application of 7.5t FYM + $N_{64}P_{32}K_{30}$ was significantly higher than other treatments. This was closely followed by 7.5t FYM + $N_{32}P_{16}K_{15}$ and 5.0t FYM + $N_{64}P_{32}K_{30}$ with significantly higher dry matter yield than other single sources, $N_{32}P_{16}K_{15}$, $N_{64}P_{32}K_{30}$, 5.0t FYM and the Control.

Grain yield in the different fertilizer treatments ranged from 180.8 to 2051.6 kg/ha. The highest grain yield was obtained in treatment with application of 7.5t FYM + $N_{32}P_{16}K_{15}$, while the lowest yield was recorded where fertilizer was not applied (control). Combine application of 7.5t FYM + $N_{32}P_{16}K_{15}$ gave significantly higher yield than all the other treatments. This was followed by application of 7.5t FYM + $N_{64}P_{32}K_{30}$ and 5.0t FYM + $N_{64}P_{32}K_{30}$ which exerted similar effects, and significantly higher yield than the other treatments. Grain yield obtained in treatment with combine application of 5.0t FYM + $N_{32}P_{16}K_{15}$ was also significantly higher than those fertilized with single sources. However, the effects of $N_{64}P_{32}K_{30}$, 5.0t FYM and 7.5t FYM on yield did not differ significantly; as the case also was among $N_{32}P_{16}K_{15}$, $N_{64}P_{32}K_{30}$ and the control and the result was similar to the finding of (Awod *et al*., 2012).

Table 2. Effect farm yard manure and inorganic fertilizers on panicle weight, straw weight, total dry matter and grain yield of sorghum at Maiduguri

Treatment	Panicle weight (kg/ha)	Straw weight (kg/ha)	Total dry matter (kg/ha)	Grain yield (kg/ha)
Control	372.5^{g}	2398.6^{d}	2771.1^{e}	180.8^{e}
$N_{32}P_{16}K_{15}$	605.3^{g}	3851.9^{bcd}	4654.2^{d}	300.1^{e}
$N_{64}P_{32}K_{30}$	695.2^{fg}	4048.9^{abc}	4870.7^{cd}	361.1^{ed}
5.0t FYM	1134.4^{ef}	2582.0^{cd}	3830.7^{de}	607.4^{d}
7.5t FYM	1248.7^{de}	3826.5^{bcd}	4860.8^{cd}	607.4^{d}
5.0t FYM + $N_{32}P_{16}K_{15}$	1608.5^{cd}	4176.4^{abc}	5460.4^{bcd}	910.1^{c}
5.0t FYM + $N_{64}P_{32}K_{30}$	1909.0^{c}	4523.4^{ab}	6432.4^{bc}	1262.6^{b}
7.5t FYM + $N_{32}P_{16}K_{15}$	3106.9^{a}	4697.7^{ab}	7186.4^{ab}	2051.6^{a}
7.5t FYM + $N_{64}P_{32}K_{30}$	2488.9^{b}	5740.6^{a}	8847.5^{a}	1478.5^{b}
SE±	156.05**	569.08**	576.05**	88.02**

*Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability of the DMRT. ** Significant at 1% probability level of the F-test.*

3.4 Effects of Organic and Inorganic Fertilizers and their Combinations on Plant nutrient content

3.5 Leaf N, P and K content

Table 3 shows effects of the different fertilizer treatments on the content of N, P and K in the leaf of sorghum. The fertilizer treatments differed significantly (P<0.001) in their effects on the N, P and K content in sorghum leaf. N-content in the leaf ranged from 0.4667 to 1.8200%. The treatment, 7.5t FYM + $N_{32}P_{16}K_{15}$, closely followed by 7.5t FYM + $N_{64}P_{32}K_{30}$ had significantly higher N than all the other treatments. All the combined fertilizer treatments gave significantly higher leaf N-content than single fertilizer sources. However, all applied fertilizer treatments had significantly higher N-content in the leaf, than the control. The treatments also differed significantly (P<0.001) in their effects on P-content in the leaf of sorghum, which ranged from 0.1367 to 0.2367 %, obtained from the control and 7.5t FYM + $N_{32}P_{16}K_{15}$, respectively (Table 5). Application of 7.5t FYM + $N_{32}P_{16}K_{15}$ gave significantly higher leaf P-content than all the treatments. Similarly, 7.5t FYM + $N_{64}P_{32}K_{30}$ and 5.0t FYM + $N_{64}P_{32}K_{30}$ also gave significantly higher leaf P-content than all single sources; while the content in all fertilizer treatments was also higher than the control. Similarly, the effect of the treatments was also significant (P<0.001) on K content in the leaf, which ranged from 1.1500 to 2.9333%, Application of 7.5t FYM + $N_{32}P_{16}K_{15}$ gave significantly higher K-content in the leaf than any of the treatments. Combined fertilizer sources also resulted in higher leaf K-content than single sources; while the control had significantly lower K-content in the leaf than all treatments, which is tallied with the finding of (Azrafulhaq *et al*.,2004)

Table 3. Effect of farm yard manure and inorganic fertilizer on sorghum leaf NPK at Maiduguri

Treatment	N (%)	P (%)	K (%)
Control	0.4667^{e}	0.1367^{f}	1.1500^{i}
$N_{32}P_{16}K_{15}$	0.8667^{d}	0.1533^{e}	1.4867^{h}
$N_{64}P_{32}K_{30}$	1.0467^{cd}	0.1700^{d}	1.6033^{g}
5.0t FYM	1.0833^{cd}	0.1800^{cd}	1.7800^{f}
7.5t FYM	1.1900^{c}	0.1800^{cd}	2.0267^{e}
5.0t FYM + $N_{32}P_{16}K_{15}$	1.4400^{b}	0.1867^{bc}	2.2767^{d}
5.0t FYM + $N_{64}P_{32}K_{30}$	1.5667^{b}	0.2000^{b}	2.5100^{c}
7.5t FYM + $N_{32}P_{16}K_{15}$	1.8200^{a}	0.2367^{a}	2.9333^{a}
7.5t FYM + $N_{64}P_{32}K_{30}$	1.6767^{ab}	0.2000^{b}	2.6833^{b}
SE±	0.0812**	0.0048**	0.0320**

*Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability according to DRMT. ** Significant at 1% probability level of the F-test.*

3.6 Straw N, P and K content

Table 4 shows effects of the different fertilizer treatments on the content of N, P and K in the straw of sorghum. Results show that the fertilizer treatments differed significantly ($P<0.001$) in their mean straw N, P and K content. The result indicates that N content in the straw of sorghum ranged from 0.4167 to 1.9767%. The 7.5t FYM + $N_{32}P_{16}K_{15}$ treatment gave significantly higher N-content than all others, while all the combined fertilizer sources, except 5.0t FYM + $N_{32}P_{16}K_{15}$ also had higher N-content than single sources. The lowest straw N-content was obtained from the control, which however was statistically similar to content under $N_{32}P_{16}K_{15}$, $N_{64}P_{32}K_{30}$ and 5.0t FYM treatments. Similarly, P-content in the straw ranged from 0.0267 to 0.2767%; with the 7.5t FYM + $N_{32}P_{16}K_{15}$ treatment gave significantly higher straw P-content than all the other treatments. Similarly, sorghum straw obtained from 7.5t FYM + $N_{64}P_{32}K_{30}$ also had significantly higher P-content than the remaining treatments. On the other hand, the control gave the lowest P-content than any of the fertilizer treatments. Application of combined fertilizers resulted in higher straw P-content than single sources, however, P-content in the straw of sorghum that received 5.0t FYM + $N_{32}P_{16}K_{15}$ and 7.5t FYM were statistically at par.

K content in the straw ranged from 1.2300 to 2.6267%, with the lowest and highest values obtained from the control and 7.5t FYM + $N_{32}P_{16}K_{15}$, respectively. The K-content under 7.5t FYM + $N_{32}P_{16}K_{15}$ treatment was significantly higher than under all the other treatments, followed by 7.5t FYM + $N_{64}P_{32}K_{30}$ which was significantly higher than under the remaining treatments. All plot with organo-mineral fertilizer combination gave the best.The finding is in line with one reported by (Eifediyi. *et al*.,2020).

Table 4. Effect of farm yard manure and inorganic fertilizer on straw NPK at Maiduguri

Treatment	N (g/kg)	P (mg/kg)	K (Cmol/kg)
Control	0.4167^{f}	0.0267^{g}	1.2300^{h}
$N_{32}P_{16}K_{15}$	0.4700^{ef}	0.0667^{f}	1.3200^{g}
$N_{64}P_{32}K_{30}$	0.5600^{ef}	0.0767^{ef}	1.4533^{f}
5.0t FYM	0.6533^{def}	0.0867^{e}	1.7333^{e}
7.5t FYM	0.7700^{de}	0.0900^{de}	1.7833^{e}
5.0t FYM + $N_{32}P_{16}K_{15}$	0.9600^{cd}	0.1033^{d}	1.8867^{d}
5.0t FYM + $N_{64}P_{32}K_{30}$	1.2200^{c}	0.1267^{c}	2.1033^{c}
7.5t FYM + $N_{32}P_{16}K_{15}$	1.9767^{a}	0.2767^{a}	2.6267^{a}
7.5t FYM + $N_{64}P_{32}K_{30}$	1.6467^{b}	0.1500^{b}	2.2700^{b}
SE±	0.1034**	0.0054**	0.0287**

*Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability according to DRMT. ** Significant at 1% probability level of the F-test*.

3.7 Conclusion and Recommendations

3.7.1 Conclusion

Based on the results obtained it can be concluded that the application of 7.5t FYM + $N_{32}P_{16}K_{15}$ kg/ha, resulted in higher nutrient uptake, growth and acquisition of the highest yield of sorghum in the study area. However, application of 7.5t FYM + N64 P32 K30 kg/ha resulted in higher residual soil nutrient.

3.7.2 Recommendation

The application of 7.5t FYM + $N_{32}P_{16}K_{15}$ kg/ha is, therefore, recommended for sorghum production in the study area and similar experiment should be repeated in similar agro-climatic condition in order to confirm the findings

REFERENCES

Abida A., Mussarraf F., Safar A., Ghulam J. and Rehana A. (2007). Growth yield and nutrient up take of sorghum in response to integrated phosphorus and potassium management. *Pakistan Journal of Botany,* 39(4): 1083-1087.

Abou El-Magd, M.M. Hoda, A. Mohammed and Fawzy, Z.F. (2005). Relationship, growth and yield of broccoli with increasing N,P or K ratio in a mixture of NPK fertilizers. Annual Agriculture Science Monitor, 43(2): 791-798.

Addiscott, T.M., A.P. Whitemore and D.S. Pwlson (1992). Farming, fertilizer and nitrate problems. *Journal of Agricultural Science* (Cambridge), 109: 141-157.

Agbim, U.N., and K.B. Adeoye (1991). The role of crop residues in soil fertility maintenance in, organic fertilizer in the Nigeria Agriculture: present and future. A Seminar organized by the *Federal ministry of Agriculture* and *natural Resources* at Kaduna Nigeria. March, 1991, PP 26-27.

Agboola, A.A. and Fagbenro, J.A. (1985). Soil organic matter and its management in humid tropics with particular references to degradation in the humid tropics. Proceedings ISSS/SSSN, Ibadan 215 - 283pp.

Agboola, A.A. and Ray, P.A. Anamma (1991). Maintenance of soil fertility under traditional farming system inorganic fertilizer in Nigeria Agriculture. Present and Future. A seminar organized by the Federal Ministry of Agriculture and Natural Resources at Kaduna Nigeria. March, 26-27, 1991.

Agyenim S. Boateng, Zickermann J. and Kornahrens M. (2006), Poultry Manure Effect on Growth and Yield of Maize *West Africa Journal of Applied Ecology* (WAJAE) –ISSN: 0855-4307 Volume 9 (Jan – Jun 2006)

Awad O. Abusuwar and Hala A., El Zilal (2010). Effect of chicken manure on yield and PCN concentration of two sorghum (*Sorghum bicolor* (L) Moench) cultivars. A*gricultural and Biology Journal of North America*, 1(1): 27-31.

Azam M.J. Sikora, L.J. (1999). Effects of cowpea-fertilizer combination on wheat yield. Compose science and land utilization. Vol.1: 93-96.

Azraf-ul-haq A., Imran Q. and Naeem M. (2004), Effect of Intergrated use of organic and inorganic fertilizers on fodder yield of sorghum, *Pakistan Journal of Agric. Science,* 44(3): 415-421.

Bationo A. (2003). Introductory note In: Gichuru, M.p., Bationo, A., Bekunda, M.A., Goma, H.C., Matongoya, P.K., Mugend, D.N., Murwira, H.M. Nandwa, S.M., Nyathi, P.and swift, M.J. (Eds). *Soil fertility management in Agric: A regional perspectives*. Academic sci. pub. Kenya, 306 P.

Brady, N.C. and Weil, R.R., (2002). *The nature and properties of soil* (13th ed). Prentice tall, Inc- New Jersey U.S.A.

Bremner, J.M. and Mulvaney, C.S. (1982). Total N. in: page, A.L. (Ed). Methods of soil Analysis part 2. Chemical and mineralogical properties (2nd ed). *Agronomy Monograph* vol.9 ASA-SSSA, Madison, Wisconsin, USA. Pp. 595-622.

Chiroma, A.M., Rayar A.J., and Alhassan, A.B (2002) Effect of management practices on selected fertility parameters in a sandy soil in northeast Nigeria J*ournal of sustainable Agriculture and Environment*, 4: 264-274.

Chiroma, A.M., Rayar A.J., and Alhassan, A.B. (2004). Response of onion (*Allium cepa L.*) to application of farmyard manure and NPK in a semi-arid savanna soil of northeastern Nigeria. *Journal of Arid Agriculture,* 14: 95-100.

Cooke, G.W. (1967). The nature and properties of soil. 8th Edition, Macmillan Publishing Company, Inc, New York, 137-163.

Eifediyi. E, Remison. E.K, S. U. and Okaka, V. B. 2010. Effect of farm yard manure on the dry matter components of cucumber varieties. Nature and Science 8 (5): 16-22.

Elbasri A. Mohamed, Ahmed M. El Naim, Bashir E. Ebeadallah and Khalid A.Ibrahim.(2011). Effect of Tillage and Farm Yard Manure on Yield and Yields Components of Grain Sorghum (Sorghum Bicolor L.Monech) In Rain-Fed. International Journal of Current Reseach, Vol. 3, Issue.6, 389-392.

Food and Agriculture Organization of the United Nations (FAO/UN) (FAOSTAT) (1996), Agriculture statistical data base FAO, Rome Italy.

Freedbairn, D.M. Ward, L.K., Clarks, A.L. and Smith, G.D. (1986). Research and development of reduced tillage systems for vertisols in Queensland, Australia. Soil Tillage Research, 8: 211-229.

Sanchez, P.A., Shepherd, K.D., Soule, M.J., place F.M., Buresh, R.J., Izac, A.M.N., Mokwunye, A.U., Kwesiga, F.R., Ndiritu, C.G. and woomer, P.L. (1997). Soil fertility replenishment in Africa: An investment in natural resource capital. *In*: Buresh, R.J., Sanchez, P.A. and Calhoun, F. (eds). *Replenishing, soil fertility in Africa SSSA special pub*. No.51 Madison, Wisconsion, USA.

Shaver, T. (2010). Crop Residues and Soil Physical Properties. Proceeding of the 22nd Annual Central Plains Irrigation Conference, Keamey, Feb. 24th – 25th.pp22-27.

Smaling, E.M.A., Nandwa, S.M. and Janssen, B.H. (1997). Soil fertility in Africa is at stake. In: Buresh, R.J., Sanchez, P.A. and Calhoun, F. (eds). Replenishing soil fertility in Africa. *SSSA special pub*. SI. SSSA. Madison, Wisconsin, USA.

Tamas N. (2009) effect of Nutrient supply on Nutrient up take, Dry matter accumulation and yield of sweet sorghum, Ph.D. Thesis, University of Debraecen, Hankoczy Jeno Doctoral School of Plant Production, Horticultural and Food Science.

Taore M., Bismark H. Nacro, R. Tabo, Nikiema A and H.Ousmane, (2012) potential for agronomical enhancement and millet yield via *Jatropha curcas* oil cake fertilizer amendment using placed application technique; International journal of Biology Chem Science, 6(2): 808-819.

Tekwa, I.J., Shehu H.E and Maunde, S.M. (2011). Soil nutrient status and productivity potentials of lithessols in mubi area, North-Estern Nigeria. *Agriculture and Biology Journal of North America,* 2(6): 887-896.

Tolamur S.I. (2009). Effect of compost vemicompost farm yard manure green manuring and fertilizer Nitrogen on yield up take of major nutrient by Rabi–sorghum in vertisol. *Agri. Science Digest*, 29(1); 60-62.

Uyovbisere, E.O and Elemo, K.A. (2002). Effect of three foliage of locust bean (*Parkia biglobosa*) and Neem (*Azadirachta indica*) on soil fertility and productivity of maize in a savannah alfilsol. Nutrient cyclying in Agro ecosystem 62 pp. 112-115

Vasanthi D. and Kumaraswamy K. (2000). Effects of manure – fertilizer schedules on the yield and uptake of nutrients by cereal fodder crops and on soil fertility. *J. Indian Soc. Soil Sci.* 48 (3): 510–515.

Watts, C.W. & Dexter, A.R., 1997. The influence of organic matter in reducing the destabilization of soil by simulated tillage. *Soil & Tillage Research*, 42: 253-275.

Yusuf, A.A., Iwuafor E.N.O., Abaidoo R.C., Ohifajo O.O. and Sanginga, P. C. (2007). Effect of crop rotation and Nitrogen fertilization on yield and Nitrogen efficiency in maize in the Northern Guinea Savana of Nigeria. *Africa Journal of Agricultural Research*, 4(10): 913-921.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 31-36 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Effect of Differently Processed African Locust Seed Bean on the Haematological and Serum Biochemical Indices of Broiler Chickens in the Semi-Arid Region of Nigeria

Makinta, A.A[1], A, Mustapha[1], A.M. Marte[1] and A.A. Benisheikh[1]
[1]Department of Animal Production Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Corresponding Author: makintaalhajiali@gmail.com

Abstract: *An experiment was conducted to evaluate the nutritional value of different processing methods of African locust bean seed meal (ALBSM) on two hundred and twenty five (225) day old chicks. ALBSM was used at 5%. The birds were randomly allotted to the five diets in groups of forty five (45) each and replicated thrice of fifteen (15) birds. Conventional management practices were strictly adhered to. A set of 2 ml blood samples were taken from 3 broilers per treatment into plastic tubes containing the anti-coagulant ethylene diamine tetra acetic acid (EDTA) and the other bottle without the anticoagulant for the determination of haematological and serum biochemical parameters respectively. The haematology includes PCV, Hb, RBC, WBC, MCV, MCH and MCHC while the serum biochemistry includes total protein, albumin, globulin glucose, cholesterol, urea, creatinine, ALAT and ALAT. Data on haematological and serum biochemical indices were analysed using completely randomized design and significant means were separated using least significant difference. The results for the haematology revealed significant ($P<0.05$) differences among the dietary treatment groups for PCV, Hb concentration, RBC count, and WBC count. The parameters evaluated are all within the recommended haematological range values for broiler chickens. The result obtained in this study revealed that there were significant ($P<0.05$) differences for the serum biochemical indices (albumin, globulin, glucose, cholesterol, creatinine, urea, ASAT and ALAT) among the treatment groups. However, there were no significant ($P>0.05$) differences for total protein among the treatment groups. The values however, did not follow any definite trend. It is concluded that soaking for one day and fermenting for 3days of ALBSM gave the best results among all the four processing methods tested. The processing methods employed did not impede oxygen carrying capacity of the blood in meeting the demand for broilers chickens.*

Keywords: *Broilers; Locust bean; protein; Haematology; Serum.*

INTRODUCTION

The insufficient quantity and quality of protein in the diets of the Nigerian population affects not only the health status and efficiency of the present generation but also the future generation because such deficiency result in various clinical and sub- clinical conditions. These include reduced growth, possible deficiency in mental development of the citizens, impaired health, reduced resistance to diseases and lowered working efficiency in adults. Due to an urgent need to meet the demand and supply of protein of animal origin, it is pertinent to embark on the

production of animal species with quick turn-over rates. The broiler chicken production is the most favourable alternative to bridge the gap of protein supply and demand in Nigeria. The main constraint of the industry is feed because the conventional vegetable protein ingredients such as soyabean and groundnut cake have become scarce and expensive (Longe, 2006). A viable option appears to be the exploitation of legumes which have very low human food preference. The high cost of animal proteins has stimulated interest towards several leguminous seeds as potential sources of vegetable proteins for human food and livestock feeds. Grain legumes are potential substitutes for soybean and groundnut cakes because of the similarity of their amino acid profiles (Saulawa, 2011). The grains of legumes used in poultry diets are considered as the main source of dietary protein. They are consumed worldwide, especially in the developing countries where consumption of animal protein may be limited as a result of economic predicaments.

MATERIALS AND METHODS

The study was carried out at the Poultry unit of the Animal Production Technology, Ramat Polytechnic, Maiduguri, Borno State. The feeding trial lasted for 45 days. Two hundred and twenty five broilers chickens of the 'Abore Acre' strain were purchased from a reputable hatchery. The birds were brooded together for two weeks in a deep litter pen measuring 2m x 3m2. Kerosene stoves and lanterns were used to provide the necessary heat used to maintain the optimum temperature range for the birds at this stage. Feeding was carried out twice daily between the hours of 07.00-08.00 am and 5.30-6.30 pm. Water was provided *ad libitum*. All the necessary vaccines and medication needed by the birds were strictly administered. At the end of the two weeks of brooding, Forty five birds were randomly selected from the pool on the basis of vigour. The birds were randomly assigned to five treatments with forty five birds per treatment in a Completely Randomized Design. Each treatment was further replicated thrice with fifteen birds each. Fresh neem leaves were harvested from neem trees within Polytechnic campus, Maiduguri. The African locust bean seed meal (ALBSM) were differently processed viz; soaked, boiled toasted and fermented and were later ground to fine particle size using a plate mill. The milled ALBSM were incorporated into the diets at level of 50% in treatments 1, 2, 3, 4 and 5, respectively. Treatment 1 had no ALBSM and served as the control. A 23% CP diet (Table 1).

Table 1: Ingredient Composition of the Experimental Broiler Finisher Diet

	Levels of ALBSM (5%)				
Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**
Maize	62.00	60.00	60.00	57.00	51.00
Groundnut Cake	18.00	17.00	16.00	19.00	16.00
Soya bean meal	10.00	10.00	10.00	10.00	10.00
ALBSM	0.00	5.00	5.00	5.00	5.00
Fish Meal	3.00	3.00	3.00	3.00	3.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25

0.25	0.25	0.25	0.25	Lysine	0.20
0.20	0.20	0.20	0.20	**Total**	**100.00**
100.00	**100.00**	**100.00**	**100.00**	**Calculated analysis**	
ME (Kcal/kg		2967.85	2974.29	8314.13	2945.67
2983.47 Crude protein (%)			19.68	19.67	19.39	18.98
19.69					

T1 (Control), T2 (Soaked), T3 (Boiled), T4 (Toasted) and T5 (Fermented).

was fed to the birds during the finisher phase (29-49 day). All the data collected were subjected to analysis of variance (ANOVA) according to the procedure of Steel and Torrie (1980). Significantly different means were separated according to Least Significant Difference.

RESULTS AND DISCUSSION

Haematological and Serum biochemical Indices of Broiler Chickens

The results for haematological indices (Table 2) revealed significant ($P<0.005$) differences among the dietary treatment groups for Packed Cell Volume (PCV), Haemoglobin (Hb) concentration, Red Blood Cells (RBC) count, and White Blood Cells (WBC) count, respectively. PCV fell within the normal range (22-35%) as reported by Banergee (2007). RBC and WBC values were higher for 5% roasted ALBSM dietary level. This may be attributed to reduction of anti-nutritional factors that might affect the blood compositions of other birds fed other treatments. The values are within the normal range of chickens as reported by Sunchint *et al*. (2004). This observation is also supported by many reports in literature, which generally recommended that cooking for 35 - 40 minutes is adequate for processing legume seeds for monogastric rations, (Balogun *et al*., 2001, Bawa *et al*., 2003; Amaefule and Onwudike, 2000). RBC counts recorded in this study are 2.00 to 3.43 $X10^6/mm^3$ for treatments 1, 2, 3, 4 and 5, respectfully were within the normal range ($2 – 4\ X10^6/mm^3$) for broiler chickens reported by Anon (1998). The results for haematological concentration obtained in this study showed that the different processing methods did not impede oxygen carrying capacity of the blood in meeting the demand for broilers chickens (Egbewande *et al*., 2011). The results obtained for WBC in this study ranged from 10.30 to 11.20 $X10^3mm^3$ for treatments 1, 2, 3, 4 and 5, respectfully were within the normal range for broiler chickens ($9 – 13\ X10^3mm^3$) reported by Aiello and Mays (1998). The effect of cooked ALBSM diets on haematological indices is presented in Table 2. The results obtained for MCV and MCH differed ($P<0.05$) significantly except MCHC showed no significant ($P>0.05$) difference among the treatment groups. The results of haematology did not show any depressive effect of feeding ALBSM. This implied that, all the treatment groups may have adequate immune status.

The results for serum biochemical indices (Table 2) revealed that there were significant ($P>0.05$) differences for the serum biochemical indices (albumin, globulin, glucose, cholesterol, creatinine, urea ASAT and ALAT) among the treatment groups. However, total protein did not differ significantly ($P>0.005$) among the dietary treatment groups. The values however, followed a definite trend. The levels of total blood protein and creatinine contents usually depend on the quantity and quality of dietary protein fed (Awosanya *et al*., 1999; Esonu *et al*., 2001). The albumin values obtained in this study are within the normal recommended range (1.30 to 2.80 g/dl) for broiler chickens as reported by Aiello and Mays (1998). The

slightly higher value recorded for treatment 5 (fermented ALBSM) may suggest a higher protein intake by the chickens, in order to meet the demand for physiological body function. The rise in the globulin levels with subsequent significant rise in the total protein levels was observed to have better resistance and immune response to disease infection according to Abdel-Fatal (2008), globulin levels have been used as indicator of immune response and source of antibody production. The mean urea values obtained in this study ranged from 4.30 to 5.33 mmol/l were in line with recommended values of 4.46 – 4.54 mmol/l by Aiello and Mays (1998). This indicates that ALBSM can be included up to 5% in the diets of broiler chickens without any adverse effect on the serum biochemical indices of broiler chickens.

The mean values for Alanine aminotransferase (ALAT) (16.87 to 26.57 U/L) obtained in this study are in line with the report of Obikaonu *et al.* (2011) who obtained 16.87 to 23.00 U/L. The aspartate aminotransferase (ASAT) values (28.67 to 75.47 U/L) are within the range of 18.00 to 53.33 U/L except treatment T2 reported by the same authors.

Table 2: Haematological and Serum Biochemical Indices of Broiler Chickens Fed Differently Processed African Locust Bean Seed Meal (ALBSM)

	Level of Inclusion of ALBSM (5%)					
Constituents	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Packed Cell Volume (%)	25.40^{b}	26.26^{a}	25.13^{b}	20.13^{c}	26.67^{a}	0.35*
Haemoglobin (gldl)	8.50^{ab}	8.63^{ab}	8.37^{b}	6.70^{c}	8.83^{a}	0.15*
Red Blood Cell (x 10^{6}ml)	2.00^{b}	3.10^{a}	3.40^{a}	3.43^{a}	2.60^{b}	0.18*
White Blood Cell (x 10^{3}ml)	11.13^{a}	10.53^{b}	10.63^{b}	11.20^{a}	10.30^{b}	0.15*
MCV (fl)	20.67^{ab}	20.05^{b}	18.76^{c}	15.00^{d}	21.16^{a}	0.45*
MCH (pg)	6.91^{ab}	6.59^{bc}	6.24^{c}	4.99^{d}	7.01^{a}	0.18*
MCHC (%)	33.46	32.87	33.29	33.21	33.14	0.74^{NS}
Total protein (gldl)	46.00	45.33	44.67	46.00	48.65	18.74^{NS}
Globulin (gldl)	14.67^{b}	13.33^{b}	16.34^{c}	15.67^{a}	15.17^{a}	0.46*
Glucose (gldl)	5.00^{b}	4.23^{d}	4.67^{c}	6.17^{a}	5.33^{b}	0.17*
Cholesterol (mg/dl)	4.20^{a}	4.60^{a}	3.16^{b}	3.50^{b}	4.33^{a}	0.24*
Creatinine (mg/dl)	50.00^{c}	55.67^{b}	61.00^{a}	62.00^{a}	55.00^{b}	69.00*
Urea (mmol/l)	4.43^{b}	4.53^{b}	5.27^{a}	5.33^{a}	4.30^{b}	0.13*

ASAT (IU/L) 0.14*	50.93^{c}	75.47^{a}	28.67^{e}	37.67^{d}	54.33^{b}
ALAT (IU/L) 0.38*	22.23^{c}	18.87^{d}	16.87^{e}	23.47^{b}	26.57^{a}

*a,b,c, = Means within the same row bearing different superscripts differ significantly (P < 0.05), NS = Not Significant (P>0.05), * =Significant (P<0.05), SEM = Standard error of mean, MCV = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCH = Mean corpuscular haemoglobin concentration, ASAT=Aspartate aminotransferase, ALAT=Alanine aminotransferase, T1 (Control), T2 (Soaked), T3 (Boiled), T4 (Toasted) and T5 (Fermented).*

Conclusion and Recommendation

It was concluded that soaking for one day and fermenting for 3days of ALBSM gave the best results among all the three processing methods tested. Based on the findings, it can be concluded that the processing methods tested did not impede oxygen carrying capacity of the blood in meeting the demand for broilers chickens. Investigations into higher levels in the finisher diet were recommended.

Reference

Abdel Fatal, K. A., Ahmed, M. E., Mohamed, H. H. (2008). The effects of dietary graded *Leucaena leucocephala* seeds on performance and blood parameters in broiler chicks. Pak. J. Nutr., 7: 385–390.

Ailelo, S.E. and Mays, A. (1998). *The Merck Veterinary Manual.* 8th ed. Merck and Co. Inc: Whitehouse station, New Jersey pp 321

Amaefule, K.U. and Onwudike, O.C. (2000). Evaluation of processing methods of pigeon pea seed (*Cajanus cajan*) as protein source for broiler starter. *Journal of Science, Agriculture and Environment* 2 (1):30-39.

Anon. (1980). *Guide to the Care and Use of Experimental Animals*. Vol 1.Canadian Council of Animal Care.Ontario, Canada. pp: 185–190.

Banerjee, G.C. (2007). A Text book of Animal Husbandry, Oxford and IBH Publishing Co. Pvt. LTD. New Delhi. p118-144.

Bawa, G.S. (2003). Effect of cooking time on the levels of anti-nutritional factors and nutritive value of Dolichos Labblab (*Lablab purpureum*) Seeds for pigs Unpublished Ph.D. Dessertation Department of Animal Science, A.B.U. Zaria.pp 25-57.

Egbenwade ,O.O., Jimoh, O.O., E. Ibitoye, E.B., and Olorede, B.R. (2011).Utilization of African mistletoe (*Tapinanthus bangwensis*) leaf meal by broiler chickens. *Pakistan Journal of Nutrition.* 10 (1):19-22.

Esonu, B.O., Emenalom, O.O., Udedibie, A.B.I., Okoli, T.C., Herbert U and Ekpor, C.F. (2001). Performance and blood chemistry of weaner pig fed raw mucuna beans (Velvet bean) meal. T*ropical Animal Production Investigation.* 4:49-54.

Longe, O.G. (2006). Poultry: Treasure in chest, an inaugural lecture delivered at University of Ibadan Nigeria.pp 1-10

Obikaonu, H.O., Okoli, I.C., Opara, M.N., Okoro, V.M.O., Ogbuew, I.P., Etuk, E.B. and Udedibie, A.B.I. (2011). Haematological and indices of starter Broilers fed neem (*Azadirachta indica*) leaf meal. *Online Journal of Animal Feed Resorces.* 1(4):50-54

Saulawa, A.L. (2011). Chemical and nutritional evaluation of Baobab (*Adensonia digitata* L.) seed as alternative protein source in broiler diets. A Ph.D dissertation submitted to Department of Animal Nutrition and Forage Science, Micheal Okpara University of Agriculture, Umudike, Nigeria. pp. 99-110.

Steel R G Dand J.H Torrie, (1980). *Principles and Procedures of Statistics*. McGraw Hill Book Co Inc. New York, USA.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 37-49 (July, 2021)
www.iarcj.org, www.arcnjournals.org

Effects of Rate of Nitrogen Fertilizer and Intra -row spacing on Growth and Yield of Sesame (*Sesamum indicum* L.) in the Sudan Savanna Zone of Nigeria

Modu K. A[1], Mustapha S[2].
Department of Agricultural Technology Ramat Polytechnic, PMB 1070 Maiduguri Borno State, Nigeria

Abstract: *Field trials were conducted to evaluate the effects of nitrogen rates and intra-row spacings on growth and yield of sesame (Sesamun indicum L) in the Sudan Savana zone of Nigeria, during 2020 cropping season at Maiduguri (11^0 50' N, 13^0 10' E, altitude 354 above sea level (asl). The experiment consisted of five (5) nitrogen rates (0, 20, 40, 60 and 80 kgN/ha) and four (4) intra-row spacings (5, 10, 15 and 20 cm). The treatments were arranged in a split plot design laid out in Randomized Complete Block Design Arrangement and replicated three times at each. Nitrogen rates were assigned to the main plot and intra-row spacings in the sub-plot. Growth, yield and yield components were measured, the result showed that application of 40 to 80 kgN/ha resulted in significant increase in the plant height, number of leaves per plant, number of primary branches per plant, number of secondary branches per plant, and number of capsules per plant. While application of 80 kgN/ha consistently significantly increase total dry matter, but similar to when 60 kgN/ha was applied. Higher TDM were recorded was recorded at 80 kgN/ha and widest intra-row spacing of 20 cm at Maiduguri, while application of 20 kgN/ha with 20 cm intra-row spacing increased TDM value. Similarly, grain yield per hectare were at optimum at 60 kgN/ha of nitrogen rate application and maximum grain yield was recorded at 20 cm intra-row spacing . Based on the result of the present study; the growing of sesame with application of 60 kgN/ha at intra-row spacing of 20 cm had greater yield in the Sudan Savannah Zone of Borno State, Nigeria.*

Keyword: *Nitrogen rates, Intra-row spacings, sesame (Sesamun indicum L), sudan savanna*

INTRODUCTION

Sesame (*Sesamun indicum* L.) has been recognized as a crop with a high economic potential in Nigeria, both as a source of raw materials for industries and a reliable foreign exchange commodity (Alegbejo, 2003; NCRI, 2008). Sesame belongs to the family *Pedaliaceae* and is one of the oldest cultivated oilseed crops in the world (Purseglove, 1974). The genus consists of about 36 species of which 19 are indigenous to Africa (Weis, 1983; Uzo, 1998). In Nigeria, three species have been reported to be grown for different purposes namely; *Sesamun alatum*, *S. indicum* and *S. radiatum* (karkashi and kaulubul in Hausa and Kanuri respectively) (Dabir, 2000). The most popular specie is *S. indicum* which has hundreds of varieties and strains with considerable variations in size, form, and growth pattern, color of flowers, seed size, seed color and composition. The crop is known as Beniseed in West Africa (Seegeler, 1989). In Nigeria, it is locally called *Ridi, Ekuku, Isasa and* Moroshi by

Hausa's, Yoruba's, Ibo's and Kanuri's, respectively. It is also known as *til* (Hindi), simsim in Arabic, *huma* (Chinese), *Sesame* (French), *goma* (Japanese), *gergelim* (Portuguese) and *ajonjoli* (Spanish) (Seegeler, 1989).

Sesame is a crop of tropical, sub-tropical and warm temperate regions. Optimum temperatures for growth are between 20^0 C and 24^0 C during vegetative growth and about 27^0 C during flowering and fruiting. The crop is drought tolerant and can grow in areas with annual rainfall between 500 and 1500 mm and soil of medium texture that is well drained and free from salt, with neutral to alkaline (Anon, 2004). In Nigeria the production areas are located within latitudes 7^0 to 14^0, with a dry season that last about 4 to 5 months, and annual rainfall of about 500 to 1500 mm, a vegetation of open savanna woodland and a top soil of sandy loam texture (Van Rheenen, 1973).

In Nigeria, annual production stood at about 300,000 metric tonnes of benni seed in the year 2017 (seed production and export statistic), of which about 50,000 tones was exported (Anon, 2008). Sesame seed contains approximately 50 % oil and 25 % protein and is used in baking, candy making, and in other food industries. Oil from the seed, which contain about 47 % oleic and 39 % linoliec acid, is used in cooking, salad and in making margarine. Sesame oil and food fried in sesame oil have long shelf life because the oil contains an antioxidant called sesamol. The oil can be used in the manufacture of soap, paints, perfumes, pharmaceuticals and insecticides. Sesame meal left after oil extraction is an excellent high crude protein (35 to 50 %) feed for poultry and livestock (Oplinger, 1990).

MATERIALS AND METHODS

Field experiments was conducted during the rainy season of 2020 at the Teaching and Research Farm, Ramat Polytechnic Maiduguri (11^0 50' N, 13^0 10' E altitude 354 above sea level (asl), Maiduguri, Borno State, Sudan Savanna Zone Nigeria. The treatment consists of five (5) Nitrogen fertilizer rates (0, 20, 40, 60 and 80 kg N/ha) and four (4) intra-row spacings (5, 10, 15 and 20 cm). The treatments was laid out in a split plot design and replicated three times each. Nitrogen rates were assigned to the main plots and intra-row spacings to the subplots. A total of 60 plots were used and each measuring 3.0 m x 4.0 m (gross size of 12 m^2), The net plot size of 6 m^2 consists of two (2) most central rows in each gross plot. While the Two boarder rows were used as destructive sampling. Within replicate plots rows was separated at 0.75 m apart walking alley and 1m between each replication. The estimated land area for the experiment was 0.12 ha.

Data Collection

Data for growth and yield and yield component were collected as per procedure mention as follows: Plant height (cm), Number of leaves per plant, Number of primary branches per plant, Number of secondary branches per plant, Total dry matter (TDM) per plant (g), Number of secondary branches per plant, Total dry matter (TDM) per plant (g), Number of capsules per plant, Number of seeds per capsule, 1000- Grain weight (g), Grain yield per plant (g), Grain yield per hectare (kg)

Data analysis:

Data collected was subjected to Analysis of variance (ANOVA) and differences between means were identified using Duncan Multiple Range Test (DMRT) at 5% level respectively as reported by Gomez and Gomez (1984).

Table 4: Effect of rates of Nitrogen fertilizer and intra –row spacings on number of leaves per plant of sesame at Maiduguri and Njimtilo and the combined means during 2014 cropping season

Treatments	Plant height(cm)			Number of leaves/plant		
N-rates (kg ha^{-1})	6WAS	8WAS	10WAS	6WAS	8WAS	10WAS
0	38.5^{c}	44.7^{c}	67.4^{b}	34.73^{b}	51.40^{b}	89.33^{b}
20	43.5^{bc}	54.9^{b}	99.4^{b}	38.51^{ab}	57.81^{a}	109.63^{a}
40	49.1^{ab}	60.1^{ab}	108.5^{a}	41.10^{a}	59.86^{a}	105.78^{ab}
60	49.6^{ab}	62.5^{ab}	112.9^{a}	38.03^{ab}	58.43^{a}	116.40^{ab}
80	51.1^{a}	65.3^{a}	103.1^{a}	43.83^{a}	56.63^{a}	125.93^{a}
SE±	2.76	4.47	9.94	2.56	3.78	13.96
Spacing (cm)						
5	40.3^{b}	49.3^{d}	84.9^{c}	32.02^{b}	48.09^{c}	90.03^{c}
10	43.5^{b}	53.5^{c}	91.6^{b}	34.80^{b}	53.36^{b}	96.28^{c}
15	49.6^{a}	60.3^{b}	105.6^{a}	46.08^{a}	62.66^{a}	119.25^{b}
20	52.1^{a}	66.9^{a}	107.8^{a}	44.06^{a}	63.20^{a}	132.11^{a}
SE	1.63	1.75	3.58	1.42	2.02	5.81
Interaction						
N X S	NS	*	*	NS	*	*

Means followed by the same letters within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at 5% level of probability

Plant height (cm)

Table 2 shows the effect of nitrogen rates and intra-row spacings on plant height per plant of sesame crop. Application of N fertilizer significantly influenced plant height at all the sampling period when 20 and 0 kg N ha^{-1} were applied shows no significant response was observed. it was observed that plant height increased only up to 40 kg N ha^{-1}. Further increase in N beyond the three mention rate did not affect the parameter significantly. The use of different levels of intra- row spacing had significant effect on plant height at all the sampling period. Each increase in intra-row spacing from 5 – 10 cm and further to 15 cm had resulted in a corresponding increase in plant height at all the sampling periods. except at 8 WAS when plant are spaced at 15 cm was not significant.

Number of leaves per plant

The effect of rates of Nitrogen fertilizer and intra-row spacings on number of leaves per plant is presented in Table 1. Number of leaves generally influenced by the application of N fertilizer. Application of 20 kg N ha^{-1} led to significant increase in number of leaves across all the sampling periods statistically similar results was recorded at the applications of 40, 60 and 80 kg N ha^{-1} resulted to a significant improvement in leaf production. Intra-row spacing had significant effect on number of leaves at all the sampling periods. Leaf number was not significantly affected by the increase in intra-row spacing from 5 – 10 cm at 6, 8 and 10 WAS. Further increase in intra-row spacing to 15 cm generally led to production of more leaves. Increase intra-row spacing beyond 15 cm increase leaf number only at 6 8 and 10 WAS in Maiduguri; the parameter was statistically unaffected at other instances.

Table 2: Effect of rates of nitrogen fertilizer and intra row-spacings on number of Primary, secondary branches and TDM per plant at harvest of sesame at Maiduguri during 2014 cropping season

Treatment	NPB	NSP	TDM
N-rates (kg ha^{-1}**)**			
0	2.65^{c}	1.17^{c}	46.38^{c}
20	2.98^{b}	1.41^{b}	88.90^{b}
40	2.89^{b}	1.74^{a}	94.50^{b}
60	3.36^{a}	1.62^{a}	116.14^{a}
80	3.30^{a}	1.75^{a}	123.62^{a}
SE ±	0.06	0.06	5.82
Spacing (cm)			
5	2.30^{c}	1.17^{d}	70.27^{d}
10	2.81^{b}	1.40^{c}	81.78^{c}
15	3.45^{a}	1.69^{b}	111.05^{b}
20	3.57^{a}	1.88^{a}	117.52^{a}
SE ±	0.07	0.05	3.84

Means followed by the same letters within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at 5% level of probability
NPB =Number of primary branches
NSB =Number of secondary branches
TDM= Total dry matter

Number of Primary branches per plant

The effect of nitrogen rates and intra-row spacing on the number of primary branches of sesame was significant (Table 2). Increase in N rates from 0 – 20 kg N ha^{-1} and 40 – 60 kg N ha^{-1} significantly increased number of primary branches per plant at harvest. Application of 60 kg N ha^{-1} did not affect the parameters significantly. N rate at 60 and 80 kg N ha^{-1} had statistically similar. While the control (0 kg N ha^{-1}) significantly produced the lowest number of primary branches per plant at harvest. Intra-row spacing had significant effect on the number of primary branches. Significant increase in number of primary branches per plant was observed with each increases in intra-row spacing from 5 -10 and from 15 -20 cm. However, the intra-row spacing consistently recorded statistically similar and highest number of primary branches per plant at harvest at 15 and 20 cm respectively. The lowest number of primary branches per plant was generally recorded by narrow intra-row spacing of 5 cm. There was no significant interaction between rates of N fertilizer and intra-row spacings. However, the number of secondary branches per plant of sesame was significantly influenced by Nitrogen fertilizer and intra-row spacing (Table 2). application of 40, 60 and 80 kg N ha^{-1} consistently produced statistically similar and more number of more number of secondary branches per plant than 20 and 0 kg N ha^{-1}.it was followed by 20 kg N ha^{-1} while the control (0 kg N ha^{-1}) produced statistically the lowest number of secondary branches. Wider intra-row spacing of 20 cm produced significantly the higher number of secondary branches per plant (1.88), it was followed by 15, 0 and 5 cm in decreasing order. The lowest number of

significantly lowest number of secondary branches in Maiduguri, was from the narrow intra-row spacing of 5 cm (1.17).

Total Dry Matter (TDM) per Plant (g): Total dry matter per plant as significantly influenced by nitrogen rates and intra-row spacings is presented in Table 2. the highest value for total dry matter per plant was reached at highest N rate of 40 - 80 kg N ha^{-1}, The control (0 kg N ha^{-1}) consistently produced the lowest TDM per plant. The highest total dry matter was attained at the wider intra-row spacing of 20 cm at harvest. The lowest TDM were consistently from the 5 cm intra-row spacing

Number of Capsules per Plant

The effect of rates of nitrogen fertilizer and intra- row spacings on number of capsules per plant was significant at Maiduguri and Njimtilo and the combined means (Table 3). Application of 60 and 80 kg N ha^{-1} produced statistically similar, it was followed by 40, 20 and 0 kg N ha^{-1} in decreasing order. while 20 and 40 kg N ha^{-1} had statistically similar and had higher capsule number than the control (0 kg N ha^{-1}) produced lowest number of capsules per plant. Intra-row spacing had significant effect on number of capsules per plant with widest intra-row spacing of 20 cm having the highest number of capsules per plant. It was followed by that from 15 and 10 cm intra row spacing but statistically the same. Significantly lowest number of capsules per plant was recorded when sesame is spaced at either 5 cm spacing.

Number of Grains per Capsule: shows the effect of treatments on number of grains per capsule of sesame at Maiduguri. The number of grains per capsule was not significantly influenced by the application of nitrogen fertilizer. The wider intra-row spacing of 20 cm produced statistically the highest number of grains per capsule. Planting sesame at 5 cm intra-row spacing produced significantly the lowest number of grains per capsule.

1000- Grain Weight (g)

The response of 1000- grain weight of sesame to rates of nitrogen fertilizer and intra-row spacing is presented in Table 3. The 1000-grain weight was not significantly influenced by the application of N fertilizer. Intra-row spacing generally had significant effect on 1000-grain weight. The intra-row spacing of 20 cm produced statistically similar 1000- grain weight that from 15 and 10 cm narrow intra-row spacing but more than that from 5 cm. Values recorded by 5, 10 and 15 cm intra-row spacings were statistically at par.

Grain yield per plant (g)

The significant effect of nitrogen fertilizer and intra-row spacing on grain yield per plant of sesame during 2020 cropping season at Maiduguri is presented in Table 3. The response of the parameter to application of N were inconsistent. that highest grain yield per plant was attained at the highest N rate of 80 kg N ha^{-1}. It was followed by 60 kg N ha^{-1}, 20 kg N ha^{-1} and 40 kg N ha^{-1} while the lowest grain yield per plant (3.92 g) from the control (0 kg N ha^{-1}).

Intra-row spacing had significant effect on grain yield with wider intra-row spacing of 20 cm producing the highest grain yield per plant. But statistically similar values were recorded at 15,10 and 5cm respectively

Table 3: Effect of rates of Nitrogen fertilizer and intra-row spacing on yield and yield components of sesame during 2020 cropping season at Maiduguri

Treatment	NCPP	NGPC	1000GW	GYPP	GYPH	FYPH
N-rates (kg ha^{-1}**)**						
0	30.62^{d}	48.50	3.09	3.91^{c}	268.60^{b}	245.00
20	42.30^{c}	47.90	3.17	5.14^{b}	349.53^{b}	335.83
40	51.30^{bc}	50.20	3.11	4.93^{b}	610.37^{a}	336.25
60	57.33^{ab}	49.90	3.11	5.25^{b}	622.97^{a}	329.58
80	60.87^{a}	48.40	3.13	5.84^{a}	699.98^{a}	314.17
SE±	3.53	1.09	0.03	0.14	39.34	47.01
Spacing (cm)						
5	44.17^{c}	40.00^{c}	3.06^{b}	4.21^{b}	460.20^{b}	199.70^{d}
10	46.81^{bc}	42.90^{c}	3.13^{ab}	4.30^{b}	490.11^{ab}	251.33^{c}
15	49.80^{b}	51.97^{b}	3.13^{ab}	5.62^{a}	537.29^{ab}	346.33^{b}
20	53.90^{a}	60.86^{a}	3.17^{a}	5.91^{a}	553.55^{a}	447.33^{a}
SE	1.74	1.65	0.01	0.20	26.22	22.46

Means followed by the same letters within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at 5% level of probability

NCPP =Number of capsule per plant **NGPC =Number of grain per capsule**

1000GW= thousand grain weight **GYPP = grain yield per plant**

GYPH = grain yield per hectare **FYPH = fodder yield per hectare**

Fodder yield per hectare (kg ha^{-1})

The effect of treatments on fodder yield per hectare at harvest showed that there was no significant effect of nitrogen fertilizer on fodder yield at Maiduguri (Table 3). Intra– row spacing had significant effect on fodder yield per hectare in Maiduguri. The widest intra-row spacing of 20 cm produced the highest fodder yield as compared to all the spacing tested 5, 10 and 15 cm intra-row spacing's (Table 3). It was followed by 15 cm intra- row spacing while the lowest fodder yield was generally from 5 cm intra-row spacing.

DISCUSSION

Response to Nitrogen fertilizer

The result of this study shows that application of Nitrogen significantly influenced all the yield, growth and yield components of sesame, number of capsules per plant, weight of grain per plant and 1000-grain weight which did not respond to application of N fertilizer. The positive response of most of the measured growth and yield character to applied N fertilizer was expected. This is due to the fact that crop is known to respond positively to N fertilizer in soil with low N content as is the case for that which the experiment was conducted. Likewise crops also respond to N application because of the role play by N in growth and development of plant. Nitrogen is a constituent of chlorophyll, nucleic and amino acid and thus play an important role in photosynthesis; the process that produce assimilates use for the development of different plant organ and hence result in increased growth (Das, 2009). It was also generally observed that the response of the crop to N application varied or are similar for some of the parameters between locations tested. This is not surprising for some of the variation that existed in both the soil and micro-climate between the two experimental locations, hence the difference in crop performance. The increased values for number of primary and secondary branches and total dry matter as well as, plant height with intra-row spacing could be probably due to the fact that, sesame plants grown at wider intra- row spacing of 15 and 20 cm are less exposed to intra specific competition for light, nutrient, moisture and space, due to fewer plant stands, therefore, tend to grow more vigorously as compared with narrower intra-row spacing of 5 and 10 cm which tend to exert pressure on scarce growth resources such as light, space, moisture and nutrients as a result of higher plant population per unit area thereby leading to poor growth. This is in harmony with the findings of Umar *et al*, (2010), Samson, (2005), Caliskan *et al*, (2004), Ngala *et al* (2013); and Gupta, (1982). Who reported a significant increase in number of branches and TDM per plant at wider intra- row spacing of 15 cm than 10cm.

Conclusion

Based on the results obtained in this study, it can be concluded that application of 60 kg N ha^{-1} at wider intra-row spacing of 20 cm gave the optimum grain yield per hectare of sesame, in Sudan savanna zone of Nigeria.

Recommendation

From the study, it could be recommended that farmers should be advised to apply 60 kg N ha^{-1} and use wider intra-row spacing of 20 cm for optimum sesame grain yield per hectare. Further research work should be pursued to ascertain the results obtained in the present study

REFERENCE:

Adedisi, M.A (2004). Variability, stability and correlation studies in seed quality and yield of sesame (*Sesamum indicum* L). An unpublished PhD thesis, University of Agriculture, Abeokuta, Ogun State.

Adebisi, M.A; Ajala, M.O; Ojo, D.K and Salau, A.W. (2005). Influence of population density and season on seed yield and its component in Nigerian sesame genotypes. *Journal of Tropical Agriculture*. **43** (1-2)13-18.

Adeyemo, M.O and Ojo, A.A. (1992). Genetic variability and association of a agronomic traits and seed of sesame (sesamum indicum L.). *Nigerian Journal of genetics* **VIII**: 39 -40

Adeyemo, M.O; Ojo, A.O and Gungula, D.T (2005). Effect of population densities on some agronomic traits and seed yield of sesame (*Sesamum indicum* L.) in southern guinea savanna environment. *Tropical Oilseeds Journal*. **1:** 35-42.

Alegbejo, M.D (2003). Sesame: a potential industrial and export oilseed crop in Nigeria. *Journal of Sustainable Agriculture* **23** (1):59-76

Aliyu, L., Yusuf, Y and Ahmed, M.K (1996). Response of pepper to fertilizer: Growth, yield and yield component as affected by nitrogen and phosphorous levels. In proceedings of the 14th HORTSON Conference Agro- Iwoye. Pp 45-50

Anonymous (2004). Sesame production in Texas USDA http//nisu.edu/crop profiles/docs/ussesame.html.

Anonymous (2007); PROTA. *Sesamum indicum* L in PROTA 14: Vegetable oils/ Oleagineux. Record display.

Anonymous (2008). World Sesame situation. American sesame growers association. Html: file://C:\ world statu of sesame. mht (15/01/08)

Arunachalam, L., (1989). Effect of planting dates and population levels on the yield of sesamum (*Sesamum indicum* L.). *Madras Agricultural Journal*, **76** : 98-101

Ashgar, M.M, M. Farrukh., S.M., Muntaz, A.C and Shamim,A. (2003). Influence of different Nitrogen levels on Productivity of sesame under Varying planting patterns. *International Journal of Agriculture and Biology* 5(**4**) 490 - 492

Batera, A.K; Mishra,S.K and Sha, H.S. (1994). Response of summer sesame (sesamum indicuml) to row spacing and phosphorus. *Orrissa Journal of agricultural research* 7(supplementary) 99-100.

Bhan. S and Singh, A (1973). Respond of rainfed sesame (*Sesamum indicum* L.) to Row and plant spacing's and fertilizer levels. *JNKVV Research Journal* (**1/2**)61-62 (1973).

Bonsu, O. K. (2003). Effect of spacing and fertilizer application on the growth, yield and yield components of sesame (sesamum indicum L). *Journal of Sustainable Agriculture* 23 (1)40-49

Bouyocos, G. J. (1962). Hydrometer method improved for making particle size Analysis of soils. *Agronomy journal*, 54, 464 - 465

Bray R.H. and Kurtz, L.T (1945) Determination of Total Organic and Available forms of phosphorous in soils. Soil Sci. Volume 59. Issue 1- pg. 39 - 46

Bremner, D.C, and Malvaney J.M. (1982) total nitrogen in page, A.L. Ed, methods of soil Analysis part 2 chemical and microbiological properties, pg. 595 - 624

Caliskan, S; Arstan, M; Atiogle, H. And Isler, N. (2004). Effect of Planting Method and Plant Population on Growth and Yield of Sesame (*Sesamum indicum* L) in a Mediterranean

type of Environment. *Asia Journal of Plant Sciences* **3**(5) 610- 613.

Chimanshette, T.G and Dhoble (1992). Effect of Sowing Date and Plant Density of Seed Yield of Sesame (*sesamum indicum* L.) varieties. *Indian Journal of Agronomy*, **37**: 280-282.

Dabir, J.D. (2000) Cytogenetic studies of inter-specific hybrids between (*Sesamum indicum* L) and Wild relatives. M.Sc thesis, Botany Department, University of Jos, Plateau State, Nigeria. (unpublished)

Das, N.R. (2009). Practical Manual on Basic Agronomy with Theory. Published by scientific publishers, India. Pp 164

Delgado, M.and Yermanos, D.I.M. (1975). Yield components of sesame (*Sesamum indicum* L) under different population densities. Economic Botany, **29**: 69-78

Duncan, B.D. (1955). Multiple Range and Multiple F test. Biometrics 11: 1-42. http://dx.doi.org/10.2307/3001478

Engin, Y, Emre, K, Seynus, F and Bulent, U. (2010). Assessment of selected criteria in sesame by using correlatio coefficient, path and factor analysis. Australian journal of crop science. **4(8)** 598-602.

FAO (2012). Food and Agricultural Organization of the United Nation: Faostat Database".Available on line. http; fao.org.site,567: default.aspx.

Fathy, S.E., and Mohsmmed, A.S (2009). Response of seed yield, yield components and oil content.to the sesame cultivar and nitrogen fertilizer rate diversity. *Electronic J. Envir.Agri. Food Chem*. 8, 4, 287-293

FAO (2005) Food and Agriculture Organization of the United Nation FAOSTAT Database (http:/apps.fao.org)

Gnanamurthy, P., Xavier, H. and Balasubramanian, P. (1992). Spacing and nitrogen requirement of sesame (*sesamum indicum* L.). *Indian journal of Agronomy* 37(4): 857-
859.

Gomez, K.A and Gomez, A.A (1984). Statistical Procedures for Agricultural Research. 2 Ed. John Wiley and Son Inc. Singapore. pp 680.

Gopalkrishna, S. eta/. (1971). *Madras Agric. J*. 58: 859-860

Guar, B.H. and Trehan, K.B, (1973) The effect of different level of nitrogen and phosphorous on yield of sunflower. Indian journal of Agronomy. 110

Gupta, T.R (1982). Effect of plant density on yield and yield components in sesame (sesamum
indicum L.) *Madras Agriculture Journal*. 69 (9);569-572.

Haggai, P.T (2004). Effect of nitrogen and phosphorus application on yield attributes and seed yield of sesame (*Sesamum indicum L.*) in northern guinea savanna of Nigeria. Proceeding of 38th annual conference of Agricultural society of Nigeria (ASM). Lafia, Nasarawa State. PP 150-157.

Haruna I.M (2011a). Dry matter partitioning and grain yield potential in sesame (*sesamum indicum* L.) as influenced by poultry manure, nitrogen and phosphorous at Samaru, Nigeria. *Journal of Agricultural Technology* Vol. 7(6): 1571-1577

Haruna I.M (2011b). Growth and yield of sesame as influenced by nitrogen and intra row spacing in Lafia, Nasarawa State of Nigeria. *Elixir International Journal of Agriculture*.
41(2011): 5685 – 5688

Haruna, I.M; Maude, S.M and Rahman,B.A (2009) Effect of nitrogen and phosphorus fertilizer rates on the yield and economic returns of sesame (*Sesamum indicum L.*) in the northern guinea savanna of Nigeria. Electronic *journal of Environmental Agricultural food chemistry*. ISSN - 1579-4377. EJEAFche. http – ejeafche.uvigo.pdf-Adobe reader

Hussein, M.A; Hamid, A and Nasreen, S (2007). Effect of nitrogen and phosphorus fertilizer on and P uptake and yield performance of sesame. *Journal* of Agricultural Research **45**(2): 119-127

Joshua, S.D, Turaki, Z.G.S and Isa A. (2008) Evaluation of performance of sesame varieties in the Semi – Arid Zone of Nigeria. LCRI (2009). In house Review meeting and North East Zonal Refils Workshops. 5th- 8th may, 2009.

Kamel, M.S. *et al*. (1983). Zeitschrift fi. .Acker-Und pfkJanzenbau. 152: 252-259

Kanton, R.A.L, Yirzagla, J, Asungre, P.A, Lamini, S, Ansoba, E, Cornelius K and Alebkia, M

(2013). Contribution of plant spacing and N- fertilizer application to growth and yield of sesame (sesamun indicum L.). *Journal of Advance in Agriculture Science and Technology*. Vol. 1 (1): pp 009-013

Katung, P.D. (1987). Effect of sowing date and plant population on yield and yield components of sesame. (*Sesamum indicum* L). M.sc thesis, Department of Agronomy, ABU Zaria (Unpublished) pp 66

Kumar, K. and Upadhyaya, S.N (1996). *Indian fmg J.* 19: 25-26

Loomis, M.S; William, W.A and Hall, A.E (1971). Agricultural productivity. Annual Review of plant Physiology **22**, 431 - 468

Majumdar, D.K and Roy, S.K (1992). Respond of Seame (*Sesamum indicum* L.) to irrigation, row spacing and plant population. *Indian Journal of Agronomy*, **37**: 758-762.

Malik, A.M; Salem, M.F; Cheema, M.A and Ahmed, S. (2003). Influence of nitrogen levels on productivity of sesame (*Sesamum indicum* L.) under varying planting patterns. *International Journal of Agriculture and Biology* **4:** 490-492.

Mankar, D.D; Santao, K.K (1995). Influence of nitrogen and phosphorus on growth, yield and yield attributes of *sesamum*. *PKV Research Journal* **19** (1); 79-80

McLEAN, E.O. (1965) Aluminium in Black, C.A. (Ed) Methods of soil Analysis: part 2 chemical methods, Madison ASA 1965. Pg. 978 – 99

Mkamilo, G.S; Badigan, D. (2007) *Sesamum indicum* L. in Vegetable oils. PROTA 14: Wageningen Netherlands.

Muhamman, M.A; Gungula, D.T and Sajo, A.A (2009). Phenological and yield characteristics of sesame (*Sesamum indicum* L.) as influenced by nitrogen and phosphorus rate in Mubi, Northern Guinea Savannas ecological zone of Nigeria. Emirs: *J food and Agriculture*. 2009. 21(1): 01-09. http.//cfa.uaeu.ac.ae/ejfa.shtml.

Nandita, Roy, S.M. Abdullah Mumun and Md. Sarwar Jahan (2009). Yield performance of sesame (*sesamum indicum* L.) Varieties at Varying Levels of Row Spacing. *Journal of*

Agriculture and Biological Sciences, **5**(5): 823-827.

NCRI, (2002). Oilseed Research Program Report. NCRI Annual Review Meeting 22-28 June 2002.

NCRI, (2005). Technology for Beniseed (Sesame) production. 3rd edition, Oilseed Research Programme, NCRI, Badeggi (**Vol**. 3. March 2005).

NCRI, (2008). Oilseed Research Division Report. 2008 Research Review and Planning National Cereals Research Institute Badeggi. Workshop 26-30 May 2008.

Ngala, A. L, Dugje, I. Y. and Yakubu, H (2013). Effect of inter-row spacing and plant density on performance od sesame (*Sesamun indicum* L.) in a Nigerian sudan Savanna. *Sci, Int*. Lahore 25 (3): 513-519

Okpara,D.A; Muoneke, C.O, and Ojifpong,T.O (2007). Effect of nitrogen and phosphorus fertilizer rates on the growth and yield of sesame (*Sesamum indicum* L.) in the South eastern mainforest belt of Nigeria. *Agricultural Journal* **38**:1-8-11

Okuruwa, V.O., Obasdaki, F.O. and Ibrahim, G. (2005). Profitability of beef cattle fattening in the cosmopolitan city of Ibadan, Oyo state. *Moor Journal of Agricultural Research* (1): 45-51

Olowe, V.I.O and Busari, L.D (1996). Evolving optimum rates of nitrogen and phosphorus application for sesame in southern guinea savanna of Nigeria. *Tropical Oilseed Journal* pp 75-85.

Olowe,V.I.O and Busari, L.D (2000). Response of sesame (*Sesamum indicum* L.) to Nitrogen and Phosphrus application in Southern Guinea Savanna of Nigeria. *Tropical oilseed journal* pp 30-37

Onginjo, E.O and Ayiecho, P.O(2009). Genotypic variability in sesame mutant lines in Kenya.*African crop science journal* vol.**17 no.2** 2009. Pp 101-107

Oplinger, (1990). Alternative Field Crop Manual (Sesame). Dept. of Agronomy and Soil Science College of Agriculture and life Sciences and Cooperative Extension Services, University of Wisconsin-Madison W1 53706.

Osman, H.E. (1993). Response of sesame cultivars to plant density in the Sudan central Rain lands. Arab Gulp *Journal of Scientific Research* **11**(3):365-376.

Owuna, O.D. (2006). The Productivity of Sesame (*Sesamum indicum* L.) as Influenced by Rates of Nitrogen Fertilizers and Stand Density. An unpublished PGD thesis Submitted to Department of Agronomy ABU Zaria. Nigeria

Page,A.L. Miller,R.H and Keeney, D.R. (1982). Methods of Soil analysis part 2. Chemical and Minerological properties, Agronomy monograph No 9 ASA –SSSA Madison

Purseglove, J.W. (1974). Tropical Crop Dicotyledons. Longman London. pp : 430 435

Radford, P.J. (1967). Growth Analysis formula, their uses and abuses. *Crop Science* **3**:171-173.

Rahnama A. and A. Bakhshandeh. 2006. Determination of optimum row-spacing and plant density for uni-branched sesame in Khuzestan province. *J. Agric. Sci. Technol*., 8:25-33.

Roy, S.K; Rahaman, S.M.L; Salahudin, A.B.M. (1995). Effect of nitrogen and potassium on growth and seed yield of sesame (*Sesamum indicum* L.) *Indian Journal of Agricultural Sciences*. **65** (7); 509-511.

Samson, T. C (2005). Effect of Inter and Intra Row Spacing and form of Arrangement on the Productivity of Sesame (*Sesamum indicum* L.). An unpublished PGD Thesis submitted to Department of Agronomy ABU Zaria. Nigeria

Seegeler, C.J.P. (1989). *Sesamum orientale* L. (*Pediaceae*): Sesame correct name. Taxonomy

36: pp 657-659.

Shah, M.S, Md, Aminul Islam, Nizamul, H.P, Abdullah, Md. S.M. Hossein (2015) Determin ation of optimum doses of nitrogen for higher growth and yield of sesame. *International Journal of Applied Research* **2** (1): 10-15

Shehu, H.E; Kwari, J.D; Sandabe, M.K (2010). Effect of NPK fertilizer on yield, content and uptake of NPK by Sesame. International *Journal of Agriculture and Biology*. ISSN print 1560-8530; ISSN on line 1814-9596. 01-060/DNK/2010/12-6-845-850

Shehu, H.E (2014). Uptake and Agronomic efficiencies of nitrogen, phosphorous and Potassium in sesame (*Sesamum indicum* L.). *American Journal of plant Nutrition and fertilization. Technology*, 4: 41-56

Singh, P.P and Kaushal, P.K (1975). Respond of rain fed sesame (*Sesamum indicum* L.) to Row and plant spacing's and fertilizer levels. *JNKVV Research Journal* (**1/2**) 61-62.

Subramaniyan, K; Arulmozi, N. and Mohammed, N. (2000). Fertilizer for *sesame*. In "Hindu"Tranlated on Lin edition of Indians national newspaper, Thursday Sept. 07, 2000. PP 34.

Subramanian, S. and Subramanian, M.(1994). Correlation studies and path coefficient analysis in sesame (sesamum indicum L). *Journal of agronomy and crop science*. Vol. **173 issue 3-4**. Pg 241-248. October 1994.

Umar U.A, M. Mahmud, I.U Abubakar, B.A. Babaji and U.D Idris (2010). Performance of sesame Varieties (Sesamum indicum L.) As influenced by nitrogen fertilizer level and intra-row spacing. *International Journal of Agronomy and Plant Production*. Vol., 3(4), 139-14

Umar,U.A., Mahmud, M., Abubakar,I.U., Babaji, B.A., and Idris, U.D. (2012). Effect of nitrogen fertilizer level and intra row spacing on growth and yield of sesame (*sesamum indicum* L.) varieties. *Tech J. Eng. Appl. Sci*. 2,1, 22-27

Uzo, J.O (1998). Beniseed: A neglected oil wealth of Nigeria. In Proceedings of the first National Workshop on Beniseed (*Sesame*), 3-5 March, 1998, Badeggi. Nigeria.

Uzun, B, and Cagirgan, M.I.(2006). Comparision of determinate and indeterminate lines of *sesame* for agronomic traits. *Field Crops Research*. **96**:13-18.

Van Rheenen, H.A. (1973). Major Problems of Growing Sesame (*Sesame indicum* L.) In Nigeria. Mededelingen Landbouhoge School, the Netherlands.**PP** 81-84

Walkley, A. J and Black, I.A. (1934) Estimation of Soil Organic Carbon by chromic acid Titration methods. Soil Sci. 37, 29 - 38

Yadava T.P; Kumar, P; Yadav, A, K (1980). Association of Yield and its Components in Sesame. *Indian Journal of Agricultural Sciences* **50(4)** 317-319

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 50-66 (August, 2021)
www.iarcj.org, www.arcnjournals.org

Analysis of Risks Associated with Production Inputs and Technical Inefficiency Among Smallholder Rice Farmers in Borno State, Nigeria

Tijani, B. A.
Department of Agricultural Technology, Ramat Polytechnic Maiduguri, Borno State, Nigeria | Email: abiso06@gmail.com

Abstract: *This study analyzed risks associated with production inputs and technical inefficiency among smallholder rice farmers in Borno State, Nigeria. Descriptive statistics and Stochastic Frontier (SFA) Model with Flexible Risk Specification were used as analytical tools. Survey research design was employed to collect primary data from smallholder rice farmers using structured questionnaire. Multi-stage sampling technique was employed to collect data in two senatorial districts – Borno Central and Borno South using purposively technique. A total sample size of 500 smallholder rice farmers were randomly and proportionately selected using simple random sampling technique from the list of smallholder rice farmers obtained from their association in 20 wards of four (4) Local Government Areas in the study area for the analysis. The result of the mean production function indicates that coefficients of cultivated area, rice seed and hired labour were all positive and significant at 1% while coefficients of fertilizer, family labour and chemicals were negative but only fertilizer and family labour were significant at 10% and 1%, respectively. The finding of the variance function shows that rice seed, chemicals, hired labour, family labour and age of rice farmers were found to be risk-increasing inputs and factor respectively while cultivated area, fertilizer and education were risk-decreasing inputs and factor respectively. The finding of the technical inefficiency model shows that household size, rice farming experience, off-farm income and fertilizer were positive and significant at 1%, 5% and 10% respectively while age of farmers, contact with extension workers and membership of rice smallholder farmers' association were negative and significant at 5% and 1% respectively. It was recommended that risk-averse smallholder rice farmers should use less of rice seed, chemicals, hired labour and family labour; and more of cultivated area and fertilizer as compared to a risk-neutral smallholder farmers in the study area.*

Keyword: *Risks, Production Inputs, Technical Inefficiency, Smallholder, Rice Farmers, Borno State, Nigeria*

INTRODUCTION

Agriculture remains a key source of livelihood for most households and the leading engine of economic growth in developing countries and Nigeria inclusive. The development of agricultural sector is therefore a public priority. The Nigeria Gross Domestic Product (GDP) at basic constant price (real GDP) grew by 2.27 per cent year-on-year from ₦69.80 trillion in 2018 to ₦71.39 trillion in 2019 compared to 1.91 per cent in 2018 (Asunloye, 2020). The growth was largely due to the agricultural sector's contributions of ₦10.50 trillion, with 25.2 per cent shares of the total GDP respectively in 2019 (Asunloye, 2020). In Nigeria, agriculture is the largest economic activity in the

rural area where almost 50% of the population live (Umeh & Adejo, 2019). The state of agriculture in Nigeria remains poor and largely underdeveloped and the sector continues to rely on underdeveloped techniques to sustain a growing population with little efforts to add value. This has negatively reflected on the productivity of the Nigeria agricultural sector, its contributions to economic growth as well as its ability to perform its traditional role of food production among others. This state of the agricultural sector has been blamed on heavy dependence on oil and its consequences on several occasions (Umeh & Adejo, 2019; Falola & Haton, 2008).

Nigeria is the largest rice producer in Africa and it currently produces about 8 million tonnes of rice out of the Africa's average of 14.6 million tonnes of rice annually (Anonymous, 2020). The Federal Government of Nigeria is aiming at 18 million tonnes of rice production by 2023 (Anonymous, 2020). It is projected that Nigeria's rice consumption will rise to 35million metric tonnes by 2050, increasing at the rate of 7% per annum due to the estimated population growth (Umeh & Adejo, 2019; Central Bank of Nigeria (CBN), 2015). *Rice is among the three leading food crops of the world, with maize (corn) and wheat being the other two. All three food crops directly provide no less than 42% of the world's required caloric intake* (Klynveld Peat Marwick Goerdeler (KPMG), 2019). Globally, rice is a staple food to over 50% of people, providing over 19% of global human per capita energy (KPMG, 2019). Human consumption accounts for about 78% of global production while the balance serves other uses such as feed (KPMG, 2019).

Rice is one of the major staple foods in Nigeria, consumed across all geo-political zones and socioeconomic classes in Nigeria. Only about 57% of the 6.7 million metric tonnes of rice consumed in Nigeria annually is locally produced, leading to a supply deficit of about 3 million metric tonnes (KPMG, 2019). With rapid growth in the country's population which is estimated to exceed 200 million by 2019, it is expected that the demand for rice will be sustained and increased in the foreseeable future.

In Agriculture, risk is an inherent part of the production process (Asche & Tveteras, 1999). Even more so in developing countries such as Nigeria where subsistence agriculture predominates, production risk is an issue of great concern. Any production related activity or event that is uncertain is characterized as production risk. Agricultural production implies an expected outcome or yield. Variability in outcomes from those expected yield creates risks to the producer's ability to achieve financial goals. Reducing variability in expected yields has been a major focus of farm managers. Agricultural risk can be categorized into two main types namely, production risk which is characterized by high variability of production outcomes and price risk resulting from volatility of the prices of agricultural output and inputs. The effect of risk and uncertainty is more significant in developing countries such as Nigeria due to market imperfections, asymmetric information and poor communication networks (Fufa & Hassan, 2003; Wanda, 2009). The stochastic nature of agricultural production is in most cases a major source of risk, because, variability in yield is not only explained by factors outside the control of the farmer such as input and output prices, but also by controllable factors such as varying the levels of inputs. (Antle, 1983).

Encouraging increase in agricultural production particularly in the rice industry is a strategic goal of the Nigerian government. ''The smallholder farmers mostly apply smaller amount of farm inputs than they would if they maximized anticipated profits. These farmers in some cases do not use or only partly use improved innovations, even when these improved innovations would provide more revenues on labour and land than some pre-existing technologies'' (Guttormsen & Roll, 2014). The unique possible justification for this unwillingness amongst smallholders in most developing countries of the world might be the observed risk profile related with these technologies. According to Just & Pope (1979) input such as fertilizer can increase the anticipated yield but in turn increase risk. The use of fertilizer and other farm inputs among smallholders in developing countries is lesser mainly due to

high cost and probably the smallholder's inability to acquire credit (Evenson & Gollin, 2003). Therefore, the anticipated increase in fertilizer use could increase farm output. The risk related with increased use of fertilizer and other farm inputs is closely associated to the smallholder's know-how and experience in farming. As a result, farmers with more years of experience in farming may possibly have the ability to reduce risk related with improved technologies.

According to Byerlee *et al.* (1998), a farmer that is educated would, for example, apply fertilizers and other farm inputs properly, thus decreasing the variability of production. These practices would result in improving well-being of the farmers who are risk-averse. In case of the risk-neutral farmers, this is a precise specification. Though, studies by Bromley & Chavas (1989), Ramaswami (1992), Fafchamps & Pender (1997) and Groom *et al.* (2008) showed that smallholder farmers are risk averse. This study thus analyzed production risk and technical inefficiency among smallholder rice farmers in the study area. The analyses in this study shows how rice smallholders used farm inputs to increase yield and decrease the variability in yield. One of the major significant typical of agricultural production procedures is that random production tremors can be observed merely after inputs decision. Therefore, inputs level influence the anticipated output level and level of output risk (Guttormsen & Roll, 2014). Although in the researcher's anticipation all production inputs were expected to increase yield, according to Shankar *et al.* (2008) ''some among the production inputs could decrease the level of output risk, while others may possibly increase it''.

Efficiency measurement was introduced by Farrell (1957), known as technical competence. This efficiency is determined through efficiency score for each firm. Firms could be analyzed and evaluated and then compared with suitable corresponding firm. There is scope for additional increase in smallholder's rice output from existing hectares, if resources are properly harnessed and efficiently allocated. Hence, this study becomes crucial in examining the risks associated with production inputs and technical inefficiency among the smallholder rice farmers in Borno State, Nigeria.

Objectives of the Study

The main objective of this study was to estimate risks associated with production inputs and technical inefficiency among smallholder rice farmers in Borno State, Nigeria. The specific objectives were to: estimate production risk associated with inputs used in the smallholder rice production in the study area; and estimate the determinants of technical inefficiency among the smallholder rice farmers in the study area.

Hypothesis of the Study

The following hypotheses were postulated for testing; i) H0: there is no technical inefficiency effects in the Cobb-Douglas stochastic frontier production function model of the rice smallholder farms without risk specification; ii) H0: there is no technical inefficiency effects in the Cobb-Douglas stochastic frontier production function model of the rice smallholder farms with risk specification; iii) H0: there is no risk associated with the use of production inputs by the rice smallholder farmers; iv) H0: the determinants of technical inefficiency have no influence on rice production among the smallholder farmers.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Production Theory

Production can be considered as a procedure where farmers make use of a given amount of inputs (represented by input vector x) to produce an amount of output (represented by y) (Hokkanen, 2014). The farmers transform a given amount of farm inputs into outputs using some technology of production, which could be characterized either by set-theoretic notions or the accustomed production

function method. The explanation of production theory can begin by introducing the sets of input and output along with the technology set for a particular production technology. The set of technology Ψ can be well-described as the set of achievable production systems, which could be produced with definite technology of production particular to the unit of production observed (Hokkanen, 2014): This can be expressed as follows:

$$\Psi = \{(y, x) : x \text{ , this can yield } y\}$$

The border of this set is instinctively the production frontier, which re-counts maximum output producible for any given input vector. The sets of input of the same production technology are therefore described as the sets of inputs vector that are achievable for each component of the output vector y .

$$\varphi(y) = \{x : (y, x) \in \Psi\}$$

Also, the border of this set forms isoquants of the input for the technology of production. Lastly, the output set can be described as the set of achievable outputs, for every likely input vector x.

$$\rho(x) = \{y : (y, x) \in \Psi\}$$

Similarly to the sets described above, the border of the output set describes isoquants of the output for a particular output y . According to Coelli *et al.* (2005), the technology and output sets have overall properties that include non-negativity, weak essentiality, non-decreasing in input and also concave in input. In contrast to the set depiction, production can as well be considered by the accustomed production function as a parametric description of the production procedure for a particular farmer. According to Kumbhakar & Lovell (2003), this depiction though necessitates that the process of production is single output or as an alternative the output vector can be sum up to a compound output vector by means of some optimum weights. The production function provides the association between inputs and outputs, with particular properties that depend on the functional form preferred. The production function permits for the consideration of multiple number of inputs and outputs

Theoretical Framework for the Study

For the purpose of this research, the Stochastic Frontier Analysis (SFA) was extended by examining the risk associated with the use of production inputs by the rice smallholder farmers since it is more robust following Bokusheva & Hockmann (2006) as:

$$y_i = f(x_i; \alpha)\ e^{v_i}\ TE_i$$

Where:

y_i = output of the i-th rice smallholder farm;

x_i = vector of rice production inputs used by the i-th smallholder farmer;

α = vector of technology parameters;

i = 1, 2, 3,……., rice smallholder farmers;

$f(x_i; \alpha)$ = production frontier;

TE_i = output-oriented technical efficiency of the i-th rice smallholder farmer; and

v_i = producer-specific random component.

The technical efficiency (TE) is the ratio of observed output to maximum feasible output in a state of nature represented by exp(v_i):

$$TEi = \frac{yi}{f(x_i;\alpha)e^{v_i}}$$

Though, the conventional specification of a stochastic production function has a feature that could extremely limit its potential to portray production technology properly (Bokusheva & Hockmann, 2006). One of the major significant drawback of the traditional multiplicative stochastic specification of production technology is the implicit assumption that if an input has a positive effect on output, then a positive effect of this input on output variability is also imposed (Bokusheva & Hockmann, 2006). According to Just & Pope (1978), the effect of an input on output should not be tied *a priori* to the effect of input on output variability. As an alternative, Just & Pope (1978) suggested a more general stochastic production function specification that comprises two general functions: one that specifies the effects of the input on the mean of the output and another that specifies the effect of input on the variance of the output:

$$y_i = f(x_i; \alpha) + g(x_i; \beta)\, v_i$$

Where:

$f(x_i; \alpha)$ = mean production function

$g(x_i; \beta)$ = variance production function.

α = vector of the mean production function parameters

β = vector of the variance production function parameters

v_i = stochastic term assumed to be independently and identically distributed standard normal random variable. N (0, 1), therefore, E(y) = f(x), and $V(y) = g^2(x)$. Consequently, the effect of inputs has been divided into two effects, that is, the effect on mean production and the effect on variance production. Since the variance of y is specified as a function of the production inputs $g(x_i; \beta)$, the Just & Pope (1978) production function thus, exhibits heteroscedasticity. The marginal production risk is expressed as:

$$\frac{\partial \operatorname{var}(y)}{\partial x_k} = 2g(x; \beta)\, g_k(x; \beta)$$

The marginal production risk could be positive, negative or zero depending on the signs of $g(x_i; \beta)$ and $g_k(x_i; \beta)$, where the latter is the partial derivative of g with respect to production input k. There are usually some chances for incorporating technical inefficiency (u) into the Just & Pope (1978) production function. These are: a) in additive form suggested by Battese *et al.* (1997), ''in this situation, the technical inefficiency term is attached to the variance production function, together with the random term representing production uncertainty''. It is expressed as:

$$y = f(x; \alpha) + g(x; \beta)(v - u)$$

b) In multiplicative form proposed by Kumbhakar (2002), where the technical inefficiency term is attached to the mean production function. It is expressed as:

$$y = f(x; \alpha)(1 - u) + g(x; \beta)\, v$$

At this point an additional assumption expressed as: exp (-u) = 1-u has to be introduced. c) In the more flexible form proposed by Kumbhakar (2002), here an additional function q(x) for explaining technical inefficiency is further introduced: It is stated as:

$$y = f(x; \alpha) + g(x; \beta)\, v - g(x; \gamma)\, u$$

Hence, models under (a) and (b) are exceptional cases of the model under (c). Based on the selections of the q(x) function, the model in (c) can be reduced to model under (a) when q(x) = g(x) or to model under (b) when q(x) = f(x).

Empirical Studies on Production Risks and Technical Inefficiency

Some earlier studies investigated the effect of risk on agricultural production by directly incorporating a measure of risk in the traditional production functions. Just and Pope (1979) study focused on production risk, determining it by variance of output. They also recommended the use of the production function specifications satisfying some desirable properties. The key focus in their specification is to allow inputs to be either risk increasing or risk decreasing. The Just-Pope framework, however, does not take into account producer's attitude towards risk (Kumbhakar, 2002). Love & Buccola (1991) extended the Just-Pope function to consider producer's risk preferences in a joint analysis of input allocation and output supply decisions. Similarly, Wan & Battese (1992) suggested an alternative stochastic frontier production function which permits the estimation of technical efficiency to account for production risk. In their study, the influence of production risk was investigated by directly incorporating a measure of risk in the traditional production function.

Moser & Mußhoff (2017) compared the use of risk-increasing and risk-reducing production inputs with the experimentally measured risk attitudes of farmers. They employed the Just-Pope production function that indicates production inputs' influence on output risk, and a Holt-Laury lottery was used to measure farmers' risk attitudes. They tested whether more risk averse farmers use more risk-reducing and less risk-increasing production inputs. They used a unique data set which includes 185 small-scale rubber farmers on the Island of Sumatra, Indonesia. The result of the Just-Pope production function indicates that higher fertilizer usage had a risk-reducing effect, whereas higher herbicide usage had a risk-increasing effect. Comparing this with their outcome of the Holt-Laury lottery, they found that more risk averse farmers used more fertilizer (risk-reducing) and less herbicides (risk-increasing).

Guttormsen & Roll (2014) examined production risk in a subsistence agriculture in the Kilimanjaro region of Tanzania using Just & Pope (1978) framework for modeling risk. The data for their study was based on a 2002 survey data of subsistence farmers in the Kilimanjaro region of Tanzania. Their result indicated that extension services do not increase the mean production of the farmers, it could reduce production risk. Furthermore, Guttormsen & Roll (2014) asserted that in the past, agricultural extension and subsidized conventional inputs such as high-yielding seed varieties, fertilizer and pesticides, have become essential element of agricultural aid programs in developing countries. Though, results of this form of aid were rather uncertain, and numerous donor nations have decreased their supports in rejoinder. Risk-averse smallholder farmers would tend to consider both the variance in output and the expected mean. They could hence choose inputs levels that differ from the optimal input levels of risk-neutral producers, who consider only the expected mean.

Roll *et al.* (2006) investigated how production risk could influence the way a risk averse producer like a subsistence farmer chooses optimal input levels. The data for their study was based on a dataset obtained from a survey on smallholders in the Kilimanjaro region in Tanzania.

Risk averse producers will take into account both the mean and the variance of output, and thus farmers are expected to choose input levels which differ from the optimal input level of risk neutral producers. Production risk is of paramount importance in developing countries (Roll, Guttormsen & Asche, 2006), since variance in production might have severe consequences for the farmer. To model the production decision problem under such circumstances, they have made use of the reason that production risk can be treated as heteroskedasticity. Their finding revealed that there was presence of output risk in inputs. They re-estimated the mean and variance function using a maximum likelihood estimator, and correct the standard errors to provide valid inference.

Bokusheva & Hockmann (2006) analyzed production risk and technical inefficiency in Russian agriculture. Their study investigated production risk and technical inefficiency as two possible sources of the production variability. A production function specification accounting for the effect of inputs on both risk and technical inefficiency was used to describe the production technologies of the Russian farms. They used panel data from 1996 to 2001 on 443 large agricultural enterprises from three regions in central, southern and Volga Russia. The findings indicate that there were significant differences in production technologies in the three investigated regions.

Ogundari & Akinbogun (2010) modelled technical efficiency with production risk: A study of fish farms in Nigeria. Data from a total of 64 fish farms randomly sampled from Oyo State, Nigeria. Their study used the stochastic frontier model with flexible risk specification. The findings indicates that the mean fish output is significantly influenced by labour, fertilizer, and feed. They further revealed that fertilizer and feed were found to be risk-increasing inputs, whereas labour was a risk-reducing input. The result also revealed that labour, farming experience, education, and access to market significantly decreases technical inefficiency of farmers.

METHODOLOGY

Study Area

Borno State is one of the largest States in Nigeria, covering a total land area of 69,435 square kilometer, about 7.67% of the total land area of the country (Ministry of Land & Survey, 2019). The State lies approximately between latitudes $10^0$02'N and $13^0$04N and between longitudes $11^0$04^{0}E and $14^0$04E (Ministry of Land & Survey, 2019). It shares boundaries with Adamawa State to south Gombe State to South east and Yobe State to the east. It also shares International boundaries with the Republic of Chad northwest and Cameroon to the southwest. According to the 2006 census figures, Borno State has a population of 4, 151,193 with a population density of approximately 60 persons per square kilometer (National Population Commission (NPC), 2006). The state is presently structured into 27 Local Government Areas that include: Maiduguri, Jere, Bama, Gowza, Kala Balge, Ngala, Mafa, Marte, Monguno, Guzamala, Bayo, Kuya Kusar, Biu, Shani, Kaga, Askira Uba, Hawul, Gubio, Kukawa, Abadam, Mobbar, Magumeri, Nganzai, Konduga,

The State, which is predominantly agrarian, is characterized by three natural agro-ecological zones which include the Sahel savannah in the extreme north, the Sudan savannah in the central part and the northern Guinea Savannah in the southern part (Folorunsho, 2006). The climate of the area is characterized by dry and wet season. The wet season lasts from March to October, while the dry season is from October to April. The average annual temperature is about 30^0C with a maximum of 45^0C in March and a minimum of 15^0C during the dry harmattan season. The annual rainfall ranges from 400mm to 700mm in the north and 500mm to 900mm in the southern part (Folorunsho, 2006). The soil types are clay, sandy loam, clay loam, sandy etc. With common weeds such as Sudan grass, spear grass *pennisetum spp*, gamba grass *striga spp* etc, with herbs and shrubs. Major crops grown in the area include millet, sorghum, groundnut, rice, wheat, cowpea bambaranut, etc. Vegetables such as tomatoes, okro, onion, pepper, etc. and livestock such as cattle, sheep, goat, pigs, camel, horse and

donkey. The major occupations of people in the area are farming, cattle rearing and fishing. The principal ethnic groups are kanuri, Shuwa/Arab, Bura, Marghi, and Gwoza. Others include Fulani, Hausa, etc.

Research Design and Sampling Technique

The research design employed for this study was the survey research design. In which structured questionnaire was used during the survey process. Multi-stage sampling technique was employed for the study. In the first stage, two (2) senatorial districts – Borno Central and Borno South – were purposively selected out of the three (3) senatorial districts in the State. This was because most of the rice producing areas in Borno North were not accessible by farmers due to insecurity. In the second stage, two (2) Local Government Areas (LGA) were purposively selected from each of the (2) senatorial districts. These LGAs include Dikwa, Jere, Askira Uba and Biu LGAs, making a total of four (4) LGAs for the study. These were major rice producing LGAs in the selected senatorial districts of the State. While in the third stage, five wards were randomly selected from each of the four (4) LGAs, making a total of 20 wards for the study. Finally, a total sample size of 500 smallholder rice farmers were randomly and proportionately selected using simple random sampling technique from the list of smallholder rice farmers obtained from their association in the 20 wards for the analysis.

Sample Size for the Study

A sample size of 500 smallholder rice farmers were randomly and proportionately from the 20 wards of Dikwa, Jere, Askira Uba and Biu LGAs across the two (2) senatorial districts using simple random sampling technique. According to Krejcie & Morgan (1970) and Yamane (1967), a sample size of 500 smallholder rice farmers was adequate for a study of this nature. The formula for the determination of the sample size is therefore expressed as:

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

Where:

n = Sample size

N = Population size (sample frame)

e = Level of significance = 5%

1 = constant

Sources of Data

Data for the study were collected from both primary and secondary sources of information. The primary data were collected using structured questionnaire that was designed and administered to 500 smallholder rice farmers in the study area. The secondary sources of information included journal, bulletins, textbooks, internet, conference papers, past projects, dissertation etc.

Method of Data Collection

Primary data were collected by employing survey instruments via face-to-face interview using structured questionnaire. The questionnaire were administered by the researcher alongside trained enumerators (extension agents) of the Borno State Agricultural Development Programme (ADP). Qualitative information were also recorded from selected smallholder rice farmers with a view to

having the right output from the survey work. To ensure validity of the data, information were triangulated through conducting discussions with extension agents and other staff of the zonal agricultural offices in the study area. Data were collected on rice output, production inputs, age of farmers in years**,** education measured in years spent in school**,** household size in numbers**,** rice farming experience in years**,** off-farm income and rice income both in naira; access to credit, 1 if rice smallholder farmer has access to credit and 0 otherwise**;** contact with extension workers, 1 if frequent contact with extension agents and 0 otherwise; and membership of rice smallholder farmers' association, 1 member and 0 otherwise.

Analytical Technique

The analytical tools employed for this study includes descriptive statistics and stochastic frontier Analysis (SFA) with flexible risk specification. Descriptive statistics such as frequency, percentage and mean were used to organize and summarize the findings to achieve specific objective (i). The risk associated with the use of production inputs and technical inefficiency of the rice smallholder farmers were estimated using the Cobb-Douglas functional form which gave the best functional form that adequately represented the data. Though, other forms such as translog and quadratic functional forms were also employed to determine the best functional form that adequately represents the data. The Cobb-Douglas functional form was used to achieve specific objective (ii) and (iii). The reduced form of the Cobb-Douglas model is specified as:

$$\ln Y_i = \alpha_0 + \alpha_{1i} \ln X_{1_i} + \alpha_{2i} \ln X_{2i} + \alpha_{3i} \ln X_{3i} + \alpha_{4i} \ln X_{4i} + \alpha_{5i} \ln X_{5i} + \alpha_{6i} \ln X_{6i} + V_i - U_i$$

Where:

lnY= rice output in kg/ha;

α_0 = slope of the intercept;

$\alpha_1 - \alpha_6$ = parameter estimated;

$\ln X_1$ = cultivated area in ha;

$\ln X_2$ = rice seed in kg/ha;

$\ln X_3$ = fertilizer in kg/ha;

$\ln X_4$ = chemicals in liters/ha;

$\ln X_5$ = hired labour measured in man-days/ha;

$\ln X_6$ = family labour proxy by opportunity cost of labour measured in man-days/ha;

i = number of rice smallholder farms;

The Cobb-Douglas functional form imposes serious restrictions on the technology by restricting the production elasticities to be constant and the elasticities of input substitution to be unity (Villano & Fleming, 2004). The translog functional form model is expressed as:

$$\ln Y_i = \alpha_0 + \sum_{i=1} \alpha_i \ln X_i + \frac{1}{2} \sum_{i\leq} \sum_{k} \alpha_{ik} \ln X_i \ln X_{ki} + \alpha_6 X_{6i} + \frac{1}{2} \sum_{i\leq} \sum_{k} \alpha_{ik} \ln X_i X_{6i} + V_i - U_i$$

Where: k = number of variable inputs and other variables as previously defined. The quadratic functional form is specified as follows:

$$Y_i = \alpha_0 + \sum_{i=1} \alpha_i X_i + \frac{1}{2}\sum_{i\leq}^{6} \sum_{k}^{6} \alpha_{ik} X_i X_{ki} + V_i - U_i$$

Having specified the functional forms above, the model for technical inefficiency following Battese & Coelli (1995) is expressed as:

$$\mu_i = \delta_0 + \sum_{i=1} \delta_i Z_i$$

Where:

Z_1 = age of farmers in years**;**

Z_2 = education measured in years spent in school**;**

Z_3 = household size in numbers**;**

Z_4 = rice farming experience in years**;**

Z_5 **=** off-farm income in naira**;**

Z_6 = rice income in naira;

Z_7 = access to credit, 1 if rice smallholder farmer has access to credit and 0 otherwise**;**

Z_8 = contact with extension workers, 1 if frequent contact with extension agents and 0 otherwise; Z_9 = membership of rice smallholder farmers' association, 1 member and 0 otherwise;

Z_{10} = fertilizer in kilogram.

RESULTS AND DISCUSSION

Production Risk Associated with Inputs Use in the Smallholder Rice Production

The findings of mean production, variance and technical inefficiency functions in table 2 were estimated based on Cobb-Douglas production function. The Cobb-Douglas functional form is highly restrictive according to Bokusheva & Hockmann (2006), though the study tried other functional forms such as translog and linear-quadratic for robustness check which provided poor estimates. Most of the estimated coefficients of the translog and linear-quadratic functional forms were negative and insignificant, monotonicity and quasi-concavity were generally not achieved. That is, the first-order coefficients estimates of all inputs in the quadratic functional form which is interpreted as marginal products of the inputs calculated (Ogundari & Akinbogun, 2010; Bokusheva & Hockmann, 2006), were not positive, meaning absence of non-negative production elasticities.

The likelihood ratio (LR) test statistics in table 2 reveals that the coefficients of the production variance function were different from zero, meaning that the Cobb-Douglas stochastic frontier production model with risk specification was the best representation of the data. The null (H0) is thus rejected. The value of lambda (λ) 232876.600, implies that the variation in sigma (u) was more pronounced than the variation in the random component sigma (v). The null (H0) is thus rejected. The lambda (λ) represents Cobb-Douglas production model with a risk specification, implying technical efficiency difference among smallholders rice farms were the main causes for variation of rice yield.

The null (H0) is thus rejected. This still emphasizes on the variance associated with the technical efficiency estimates when the production risk constituent is left out in stochastic frontier production model specification. The coefficients of cultivated area, rice seed and hired labour were all positive and significant at 1%. This is consistent with the production theory (Tijani, 2017). While coefficients of fertilizer, family labour and chemicals were negative but only fertilizer and family labour were significant at 10% and 1%, respectively in the mean production function. The result further indicates that cultivated area and hired labour had the highest elasticity of 0.3592 (35.92%) and 0.1418 (14.18%) followed by 0.1227 (12.27%) for rice seed.

Analysis of the coefficients of the production variance function in table 2 indicates that rice seed, chemicals, hired labour, family labour and age of rice farmers were positive while cultivated area, fertilizer and education were negative. This implies that rice seed, chemicals, hired labour, family labour and age of rice farmers were found to be risk-increasing inputs and factor respectively while cultivated area, fertilizer and education were risk-decreasing inputs and factor respectively. A risk-increasing inputs increases production variability while risk-decreasing input decreases production variability among smallholder rice farmers (Tijani, 2017). This suggests that a risk-averse smallholder rice farmer uses less rice seed, chemicals, hired labour and family labour; and more of cultivated area and fertilizer as compared to a risk-neutral rice smallholder, which could have effect on rice production. Generally, since rice smallholders receive some assistance from government in form of anchor borrowers loan, subsidies, improved seeds, training workshops etc, it is likely that these might influence their behaviour/propensity towards more risk-taking activities, such as the use of more production inputs which are risk-increasing.

Table 2: Production Risk Associated with Inputs Use in the Smallholder Rice Production

Items	Estimated Parameters	Coefficients	Standard Error	Z- Statistics
Mean Production Function:				
Constant	$\ln X_0$	7.891578	0.7099317	11.12***
Cultivated area (ha)	$\ln X_1$	0.3592006	0.096316	3.73***
Rice seed (kg/ha)	$\ln X_2$	0.1226834	0.0318754	3.85***
Fertilizer (kg/ha)	$\ln X_3$	-0.260335	0.2059459	-1.26**
Chemicals (liters/ha)	$\ln X_4$	-0.0287505	0.0431459	-0.67
Hired labour (man-days/ha)	$\ln X_5$	0.1417381	0.030901	4.59***
Family labour (opportunity cost of labour) (man-days/ha)	$\ln X_6$	-0.1134322	0.0305235	-3.72***
Production Variance Function:				
Cultivated area	β_1	-4.027221	2.70786	-1.49**
Seed	β_2	0.3729317	0.2832945	1.32**
Fertilizer used	β_3	-1.06072	0.2127306	-4.99***
Chemicals	β_4	0.0954834	0.2185442	0.44

Hired labour	β_5	0.1882831	0.3650607	0.52
Family labour	β_6	0.453763	0.1545788	2.94***
Age of Rice farmers	β_7	0.1034902	0.0296536	3.49***
Education	β_8	-8.513203	5.015558	-1.70**
Variance Parameters:				
Lambda	λ	232876.600		
		(23792537.65***)		
Sigma Squared	σ^2	0.0287		
		(8.660***)		
Sigma u	σ_u	0.1695		
Sigma v	σ_v	7.28		
Log likelihood		-311.72265		
Wald chi-square (6)		77.74		
		(0.0000***)		

Source: Computed using field survey data, 2021, Figures in parentheses represents z-value,

*** = Significant at 1%, **= Significant at 10%

Determinants of Technical Inefficiency among the Smallholder Rice Farmers

The finding of determinants of technical inefficiency estimation based on Cobb-Douglas production frontier function with risks specification in table 3 shows that household size, rice farming experience, off-farm income and fertilizer were positive and significant at 1%, 5% and 10% respectively while age of farmers, contact with extension workers and membership of rice smallholder farmers' association were negative and significant at 5% and 1% respectively. The positive coefficient of household size implies that oil palm smallholders with large number of persons in their households tend to be technically inefficient. The reason could be due to the fact that an increase in number of persons in the household leads to an increase in household consumption expenditure, which would carry away some proportion of the household income meant for the procurement of modern farm inputs and other farm operations that can lead to technical inefficiency (Daniel *et al.,* 2015).

The positive coefficient of rice farming experience also suggests that as the smallholder rice farmer's experience increases technical inefficiency would likely increase, which sounds illogical. This might be due to the effect of age of the farmer (Reddy & Sen, 2004). The reason could probably be due to the fact that farmers with more years of farming experience are older (Tijani, 2017). The positive coefficient of off-farm income suggests that rice smallholders who earn higher income from off-farm activities were likely to be technically inefficient than low income earners. The reason could be due to the fact that smallholder farmers with greater responsibilities tend to exert more pressure on their meager incomes obtained from off-farm activities than those with less responsibilities.

Table 3: Determinants of Technical Inefficiency among the Smallholder Rice Farmers

Determinants	Estimated parameters	Coefficients	Standard error	Z-value
Constant	Z_0	1.351859	0.5916679	2.28**
Age of farmers (years)	Z_1	-0.014087	0.0062797	-2.24**
Education (years spent in school)	Z_2	-0.0423105	0.0401049	-1.05
Household size (numbers)	Z_3	0.1213203	0.0388325	3.12***
Rice farming experience (years)	Z_4	0.0119757	0.0086924	1.38*
Off-farm income (naira)	Z_5	0.0000304	0.0000129	2.36**
Rice income (naira)	Z_6	-5.16e-07	8.40e-07	-0.61
Access to credit (dummy)	Z_7	0.1813548	0.2506858	0.72
Contact with extension workers (dummy)	Z_8	-2.125821	0.2708532	-7.85***
Membership of rice smallholder farmers' association (dummy)	Z_9	-1.587515	0.2291034	-6.93***
Fertilizer (kilogram)	Z_{10}	0.0003755	0.0002165	1.73*

Source: Computed using field survey data, 2021, Figures in parentheses represents z-value,

*** = Significant at 1%, **= Significant at 15%, *= Significant at 10%

The positive coefficient of fertilizer in table 3 implies that technical inefficiency likely increases with increase in the amount of fertilizer used by the rice smallholder farmers. The reason for the inefficiency might be due to over utilization of fertilizer in rice production. Hence, the more the amount of fertilizer used the higher the level of technical inefficiency among the rice smallholders. The negative coefficient of age of farmers implies that older rice smallholders are likely to be technically efficient than their younger ones. The reason for decreased in technical inefficiency among older rice farmers than their younger counterpart could be due to the experience they have acquired over the years.

The negative coefficient of contact with extension workers implies that smallholders who associates with extension agents were likely to be more efficient than those who do not have contacts. This is plausible because smallholders who had contacts with extension agents obtain information on recommended farming technologies and useful information that could improve their production efficiency and make them more efficient (Reddy & Sen, 2004). The negative coefficient of membership of rice smallholder farmers' association, implies that technical inefficiency likely reduces with rice smallholder being a member of farmers' association. The significance of membership of rice smallholder association cannot be overemphasized (Tchale, 2009), because farmers who are members of an rice farmers' association would get advantage from the mutual knowledge among themselves in the areas of new farming techniques, have more access to agricultural information, credit and economies of scale in accessing production inputs, as well as more improved ability to adopt innovations (Bhatt & Bhat, 2014). Thus member smallholders tend to be likely technically efficient than non-members.

Conclusion

In agriculture, risk is an inherent part of the production process. Even more so in developing countries such as Nigeria where subsistence agriculture predominates, production risk is an issue of great concern. Any production related activity or event that is uncertain is characterized as production risk. The study concluded that rice seed, chemicals, hired labour, family labour and age of rice farmers were found to be risk-increasing inputs and factor respectively whereas cultivated area, fertilizer and educational level were risk-decreasing inputs and factor respectively. The finding of the study further concludes that household size, rice farming experience, off-farm income and fertilizer were positive and significant at 1%, 5% and 10% respectively while age of farmers, contact with extension workers and membership of rice smallholder farmers' association were negative and significant at 5% and 1% respectively.

Recommendations

The following recommendations were made based on findings of the study:

i. The government should re-strategies the extension service program for effective monitoring and supervision of the rice smallholder farmers for proper use of farm inputs that would enhance their efficiency levels.
ii. There need to improve the quality of adult education extension program to educate the rice smallholder farmers
iii. The risk-averse rice smallholder farmers should use less of rice seed, chemicals, hired labour and family labour; and more of cultivated area and fertilizer as compared to a risk-neutral smallholder. These would have effect on rice production in the study area.
iv. There is need for the theoretical framework for examining technical efficiency among rice smallholder farmers in the study area to be extended to take account of production risk.

ACKNOWLEDGEMENT

The researcher wish to acknowledge support received from the Tertiary Education Trust Fund (TETFUND) in form of research grant for the study.

REFERENCES

Anonymous (2020). Strengthening Local Rice Production. https://www.thisdaylive.com/index.php/2020/01/30/strengthening-local-rice-production. Posted January 30, 2020 12:51 am, accessed on 21/7/2020 by 3:07pm.

Antle, J. M. (1983). Testing the Stochastic Structure of Production: A flexible moment based approach. *Journal of Business and Economic Statistics*, 1(3): 192-201.

Asche, F., & Tveteras, R. (1999). Modeling Production Risk with a Two-Step Procedure. *Journal of Agricultural and Resource Economics* 24(2):424-439.

Asunloye, A. (2020). The leading contributing sectors to GDP in 2019. https://businessday.ng/research-reports/article/the-leading-contributing-sectors-to-gdp-in-2019/ Feb 28, 2020. Accessed on 18/7/2020 by 2:43pm.

Battese, G. E., & Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic production function for panel data. *Empirical economics*, *20*(2), 325-332.

Battese, G. E., Rambaldi, A. N., & Wan, G. H. (1997). A stochastic frontier production function with flexible risk properties. *Journal of Productivity Analysis*, *8*(3), 269-280.

Bhatt, M. S., & Bhat, S. A. (2014). Technical Efficiency and Farm Size Productivity-Micro Level Evidence From Jammu & Kashmir. *International Journal of Food and Agricultural Economics*, *2*(4), 27.

Bokusheva, R., & Hockmann, H. (2006). Production risk and technical inefficiency in Russian agriculture. *European Review of Agricultural Economics*, *33*(1), 93-118.

Bromley, D. W., & Chavas, J. P. (1989). On risk, transactions, and economic development in the semiarid tropics. *Economic development and cultural change*, *37*(4), 719-736.

Byerlee, D., Pingali, P. L., & Hossain, M. (1998). Knowledge-intensive crop management technologies: concepts, impacts, and prospects in Asian agriculture. *Impact of rice research.* 113-133.

Central Bank of Nigeria (CBN) (2015). Guideline of the Anchor Borrowers' Programme. Sharpemann Limited, Garki, Abuja.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Springer Science & Business Media.

Daniel, A. I., Oyakhilomen, O., & Zibah, R. G. (2015). Technical Efficiency-Food Security Nexus in Kaduna State, Nigeria: A Case Study of Poultry Egg Farmers. *Consilience: The Journal of Sustainable Development*, *14*(2), 244-259.

Di Falco, S., Chavas, J. P., & Smale, M. (2007). Farmer management of production risk on degraded lands: the role of wheat variety diversity in the Tigray region, Ethiopia. *Agricultural Economics*, *36*(2), 147-156.

Evenson, R. E., & Gollin, D. (2003). Assessing the impact of the Green Revolution, 1960 to 2000. *Science*, *300*(5620), 758-762.

Fafchamps, M., & Pender, J. (1997). Precautionary saving, credit constraints, and irreversible investment: Theory and evidence from serniarid India. *Journal of Business & Economic Statistics*, *15*(2), 180-194.

Falola, T. & Heaton, M. (2008). A History of Nigeria. New York: Cambrige University Press. pp 183.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General)*, *120*(3), 253-290.

Folorunsho, O. A. (2006). Agriculture Development in Borno State: Problem and Prospects. An Invited Paper Delivered at the First Borno State Economic Submit held at International Conference Centre, Musa Usman Secretariat, Maiduguri May 6 – 11, 2001. Pp. 1 – 17.

Fufa, B. & Hassan, R. M. (2003). Stochastic Maize Production Technology and Production Risk Analysis in Dadar District, East Ethiopia. *Agrekon*, 42 (2), 116-128.

Groom, B., Koundouri, P., Nauges, C., & Thomas, A. (2008). The story of the moment: risk averse cypriot farmers respond to drought management. *Applied Economics*, *40*(3), 315-326.

Guttormsen, A. G., & Roll, K. H. (2014). Production Risk in a Subsistence Agriculture. *The Journal of Agricultural Education and Extension*, *20*(1), 133-145.

Hokkanen, T. (2014). Estimating technical efficiency in Finnish industry: A stochastic frontier approach.

Just, R. E., & Pope, R. D. (1978). Stochastic specification of production functions and economic implications. *Journal of econometrics*, *7*(1), 67-86.

Just, R. E., & Pope, R. D. (1979). Production function estimation and related risk considerations. *American Journal of Agricultural Economics*, *61*(2), 276-284.

Klynveld Peat Marwick Goerdeler (KPMG) (2019). Rice Industry Review - Klynveld Peat Marwick Goerdeler (KPMG) - Nigeria- KPMG-Internation, 21 October 2019 https://home.kpmg/ng/en/home/insights/2019/10/rice-industry-review.html, Accessed 25/6/2020 by 2:00 pm.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610.

Kumbhakar, S. C. (2002). Specification and estimation of production risk, risk preferences and technical efficiency. *American Journal of Agricultural Economics*, *84*(1), 8-22.

Kumbhakar, S. C., & Lovell, C. K. (2003). *Stochastic frontier analysis*. Cambridge university press.

Love, H.A. & Buccola, S.T. (1991). Joint Risk Preference-Technology Estimation with a Primal System. *American Journal of Agricultural Economics* 73, 765-774.

Ministry of Land & Survey (MLS) (2019). Ministry of Land and Survey, Borno State Office Memo File.

Moser, S., & Mußhoff, O. (2017). Comparing the Use of Risk influencing Production Inputs and Experimentally Measured Risk Attitude: Do the Decisions of Indonesian Small scale Rubber Farmers Match?. German Journal of Agricultural Economics, 66(670-2020-980), 124-139.

National Population Commission (NPC) (2006). National Population Commission, Census Data Borno State, Nigeria. Federal Republic of Nigeria Official Gazette, National and State Provisional Totals Census. Printed and Published in 2007 by the Federal Government Printer, Lagos, Nigeria. No. 21, Vol. 94, pp. 175 – 198.

Ogundari, K. & Akinbogun, O.O. (2010). Modelling technical efficiency with production risk. A study of fish farms in Nigeria. *Marine Resource Economics* ,vol 25.

Ramaswami, B. (1992). Production risk and optimal input decisions. *American Journal of Agricultural Economics*, *74*(4), 860-869.

Reddy, A. R., & Sen, C. (2004). Technical inefficiency in rice production and its relationship with farm-specific socio-economic characteristics. *Indian Journal of Agricultural Economics*, *59*, 259-267.

Roll, K. H., Guttormsen, A. G., & Asche, F. (2006, August). Modelling production risk in small scale subsistence agriculture. In *Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August* (pp. 12-18).

Shankar, B., Bennett, R., & Morse, S. (2008). Production risk, pesticide use and GM crop technology in South Africa. *Applied Economics*, *40*(19), 2489-2500.

Tchale, H. (2009). The efficiency of smallholder agriculture in Malawi. *African Journal of Agricultural and Resource Economics*, *3*(2), 101-121.

Tijani, B. A. (2017). Technical Efficiency Associated with Production Inputs According to Crop Age Among Oil Palm Smallholders in Johor, Malaysia. *Thesis submitted* to the school of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy, January, 2017. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=TECHNICAL+EFFICIENCY+ASSOCIATED+WITH+PRODUCTION+INPUTS+ACCORDING+TO+CROP+AGE+AMONG+OIL+PALM+SMALLHOLDERS+IN+JOHOR%2C+MALAYSIA&btnG= Accessed on 2/7/2021 by 11:12 pm.

Umeh, J. C., & Adejo, M. A. (2019). Assessment of central bank of Nigeria's anchor borrowers' programme effects on rice farmers in Kebbi state, Nigeria.

Villano, R., & Fleming, E. (2004). Analysis of technical efficiency in a rainfed lowland rice environment in Central Luzon Philippines using a stochastic frontier production function with a heteroskedastic error structure. *Asian Econ. J*, *20*(1), 29-46.

Wan, G.H. & Battese, G.E. (1992). *A stochastic Frontier Production function incorporating flexible risk properties*. Paper presented at the Australasian Meeting of the Econometric Society, Monash University, Melbourne, 6 -8 July 1992.

Wanda, O. (2009). *Production risk and input use in Banana Production in Uganda* MSc. Thesis, Makereke University.

Yamane, T. (1967). *Problems to Accompany Statistics: An Introduction Analysis*. Harper & Row.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 67-75 (August, 2021)
www.iarcj.org, www.arcnjournals.org

Constraints to Rural Women's Livelihood Activities in Maiduguri Metopolitan Area, Borno State, Nigeria

Alkali*, A., Tijjani, H. and Kura, M.A.
Department of Agricultural Technology, Ramat Polytechnic, Maiduguri, Borno State,Nigeria
*Email: abdullahialkali35@gmail.com, Mobile Phone: 08038343070

Abstract: *The study examined constraints to women's livelihood activities in Maiduguri Metropolitan Area of Borno State, Nigeria. The specific objectives of the study were to describe the socio-economic characteristics of the respondents in the study area, examine the types of livelihood activities engage in by the respondents in the study area and identify constraints affecting livelihood activities of the women in the study area. Data for the study were obtained from both primary and secondary sources. Primary data used for the study were obtained through the use of structured questionnaires and interviews. A proportionate and random selection was used, spreading over 15 political wards of the Local Government. A total of l50 respondents were selected for study. The analytical tools used was descriptive statistics such as the frequency distribution and percentages in categorizing the respondents on the basis of their socio-economic characteristics, types of livelihood activities as well as constraints affecting livelihood activity among women. Results of the study revealed that majority (80.6%) of the respondents were between the ages of 20 and 40. Majority of the respondents were married 68.7% and had Qur'anic education 44.7% respectively. Most of them are civil servant and occupied by business activities (42.7%) and the household size of 6 - 10 (62.7%) engage in livelihood activities. It was also evident from the study that about 33 of the respondents earned between N1000 to N2000 as weekly income. The result showed that 59% were into petty trading as a livelihood activity. It was revealed by the study that majority (96.7%) of the women indicated that lack of capital was their major constraint. Other serious constraints include unavailable credit, access to market among others. The study recommended that enlightenment programme should be pursued so that women can be educated on the importance of participating in livelihood activities that are available within their locality.*

Keyword: *Women, Constraints, Livelihood, Activities*

Introduction

Women perform many tasks in the home which include income generating activities such as petty trading, hair plaiting, weaving of mat and baskets, selling cooked food, tailoring among others and at the farm level women generate income from agricultural activities such as keeping poultry, animal husbandry, crop processing and as well as trading of agricultural produce. According to Kwaghe (1999), a large proportion of rural traders in West Africa are women. They are involved in the trading of mainly food items and other household livelihood activities such as plaiting, selling cooked food etc in the rural open market or in confined compound, depending on their religion and socio-cultural beliefs. Women are in livelihood activity which ranges from farm to off-farm enterprises, earning vital income for themselves and their families. These activities include crop production, harvesting, threshing of the crops, food processing, weaving of mats and baskets, crafting and trading to meet up their livelihood needs in the same vein Ogunbameru *et al.,* (2006) found that women were

involved in agricultural activities such as food processing, marketing, milking of cow and keeping of poultry in order to combat poverty and as source of income, for home consumption, recreation and hobby. On their part Njoku and Adesope (2007) reported that livelihood activities for rural women include petty trading, tailoring, thrift saving, farming, cooking at occasion and hair plaiting. They further stressed that pressure on the income and assets of rural farm families have forced them to diversify into non-agricultural activities as a way of improving livelihood.

Livelihood activities according to Ellis (1999), is the activities assets and the access that jointly determine the living gained by the rural households and this livelihood can be summarized into four headings, location, assets, substitution and options. Women in Maiduguri Metropolitan Area are involved in a wide range of livelihood activities whereby they take advantage of the water body around the town as well as crop and livestock that survive within the geographical location, hence leading to the engagement in wide range of income generation activities such as animal husbandry, crop processing, weaving of mats and basket, threshing of farm produce and so on.

Olawoye (2002) observed that presently there is an upsurge of female - headed household in the rural areas of most regions. This is to say that theoretically, women's activities in the informal sector enable them effectively combine their productive and reproductive roles because hours of work are flexible, permitting them to care for their children and engage in livelihood activities (Emmanuella, 2009). Informal economic sector today is being dominated by women who are faced with a lot of constraints such as lack of capital, lack of knowledge on marketing, lack of access to land and extension services among others (Onyenechere, 2009). Mate (2005) observed that migration of male counterpart, wage cut, male or husbands being killed are other constraints affecting women which make them diversify their livelihood for family sustenance. This study therefore analyzed constraints to women livelihood activities in Maiduguri Metropolitan Area of Borno state Nigeria.

Methodology

The study was conducted in Maiduguri Metropolitan Council (MMC) of Borno State, Nigeria which is one of the twenty-seven (27) local government areas of the state. It has a population of about 521,492 (census, 2006). The area is situated between 11 50N and longitude 14.45 E. It shares boundaries with Konduga local Government to the north and north –west and Jere local government to the south. The vegetation is typically sahel savannah, consisting mainly of grasses and drought resistance trees. Maiduguri Metropolitan is inhabited by the Kanuri, Shuwa, Babur, Marghi, Hausa, Chibok etc. Climate for most part of the year is hot and dry with maximum temperature 45 C and minimum temperature of 25 C. It has short rainfall duration with precipitation range of 500mm-600mm per year falling between the month of June and September. The area is usually covered with shrubs, herbs and shale grasses. The crops that are mostly cultivated include millet, cowpea, guinea corn, groundnut and maize. In the Local Government Area, women engage in a variety of livelihood activities essential to support the development of their family and the Local Government as a whole. They are involved in agricultural activities (food crop processing and livestock production) and non-agricultural activities (tailoring, trading, weaving of basket and mats, plaiting, milking and pottery) among others (Ministry of Women Affairs and Social Development, 2019). Data for this study was obtained from both primary and secondary sources. A proportionate and random selection was used in selecting the respondents. A total

of one hundred and fifty (l50) respondents were selected for study. The analytical tools used was descriptive statistics such as the frequency distribution and percentages

Results and Discussion

Socio - Economic Characteristics of Respondents

Socio - economic characteristics of respondents vary significantly depending on the variables the study wants to find. Such differences play important role in influencing their engagement in livelihood activities. The result of the socio-economic characteristics considered for this study is presented in Table 1

Age: The result in Table 1 shows that 2% of the respondents fell below 20 years old. This group constituted the lowest percentage. One reason for the small number of the respondents in this category could be that the teenagers are still under the care of their parents and have no felt -need struggle for livelihood. All their needs are being met by their parents, guardians and/or anybody to whose household they belong as dependent.

The age classes 20-30 and 31-50 constituted 47.3% and 33.3% of the respondents in respectively. When added together, the respondents in these age categories constituted the majority (80.6%) are in their productive and energetic age bracket. Therefore, the fact that the largest number of the respondents was found to be within these age classes is an indication those women were active enough to participate in livelihood activities to earn a living. The results of this study agrees with that of Vosanka *et al,* (2010) which showed that most of women were between 20 - 50 years of age, meaning they are in their economical active age to undertake various livelihood activities. This finding also agrees to the findings of a study by Bzugu and Hayatu (2007) where it was showed that smallest farmers in Mubiregion were in their active ages and can engage in activities that generate funds for their livelihood activities with women inclusive.

Marital Status: This study revealed that 68% were married, 5.3% were single, 10.7% were divorce and 15.3% were widowed (Table 1). Married people have enormous responsibilities by virtue of their status, which could make them engage in livelihood activities to generate funds specially to cater for their family and especially their children. This finding is in agreement with that of Okoro and Odebode (2009) who examined that rural women who were engage in livelihood activities majority (68%) were married women this implies that there is a significant relationship between marriage and engagement in livelihood activity particularly among the rural women.

Education level: Results on Level of Education Table 1 shows that most (44.7%) had Qur'anic Education, 33.3% had no formal Education. 16.7% had gone through primary Education whereas only 2.7% had completed secondary Education and 2.7% completed tertiary Education. This disagrees with the observation made by Okoro and Odebode (2009) that education play a vital role in formal orientation on livelihood activities; a condition which could create better insight in livelihood activities. Wanyama *et al* (2010) found in their studies that education has a negative significant relationship with livelihood diversification. The reason for this could be that women to some extends are not allow furthering their education beyond some certain age limit.

Table 1 Distribution of Respondents Based on Socio-Economic Characteristics (n=150)

Socio-economic Variables	Frequency	Percentage
Age		
<20	3	2
20-30	71	47.3
31-40	50	33.3
41-50	14	9.3
51-60	8	5.3
Above 60	4	2.7
Marital status		
Married	103	68.7
Single	8	5.3
Divorce	16	10.7
Widow	23	15.3
Educational qualification		
Non formal school	50	33.3
Qur'anic education	67	44.7
Primary education	25	16.7
Secondary education	4	2.7
Tertiary education	4	2.7
Occupation		
Business	45	30
civil servant	64	42.7
Civil servant and business	41	27.3
Household size		
<5	7	4.7
6- 10	94	62.7
11-14	36	24
Above 15	13	8.7
Weekly income		
<1000	16	10.7
1 000-2000	33	22.0
2001-3000	16	10.7
3001 -4000	11	7.3
4001-5000	16	10.7
Above 5000	58	38.7

Source: Field survey 2019

Occupation: Table1 shows that 42.7% of the respondents were engaged in Business/Agricultural production as their occupation. These occupations include petty trading selling of weaved mats and basket, selling of farm produced/animal products as well as other activities. 30% of the respondents were civil servants while 27.3% of them were both civil servant and were into business. This implies that major occupation of most of the women in the study area was business like activities. Due to the nature of the norms and values of the

locality, respondents had to engage themselves in mostly petting trading which can be done indoors by the women. This agrees with the examination made by Olawoye (2002) that in developing countries like Nigeria (inclusive) livelihood can only be met by engaging in diverse livelihood activities.

Household Size: Table 1 shows the result on household size where the highest frequency was between six to ten consisting a total of 62.7%, about 24% were household size between eleven to fourteen. Whereas those with the least 4.7% and 8.7% respectively were household size less than five, this indication implies that a large household size was those mostly engaged in livelihood activities since the needs of each members of the family has to be met. This conclusion is in line with the result of studies carried out by Olawuyi and Rahji (2012) on analysis of livelihood strategies of household heads and where they observed that those households with more than six members in the family were those mostly engage in livelihood activities. Similarly, Ayanwuyi and Akintode (2011) on their studies on income generating activities among rural women in ensuring household food security in ill local government area who indicated that larger family size and larger number of children in the family increase the rate of involvement in livelihood activities. This could be because of feeding, health, Education and other basic needs of life.

Income: Table 1 shows that a good portion (38.7%) had their income above N5000 weekly, followed by N1000 – N2000 (22%) then 10.7% got income of N2000-3000 and N4000-N5000 respectively weekly. Those who earn between N3000 – N4000 constitute 7.3%. This implies that the more the respondents diversify the more the chances of increase in income among women. The result is in collaboration with what Raufu *et al* (2012) found in their studies on economic analysis of rural women's income from non-timber forest product in life, Osun state Nigeria revealed that respondents get income from the non-timber livelihood activities of different types which earns them a reasonable income.

Table 2 Distribution of Respondents Based on Types of Livelihood Activities Engaged in.

Livelihood Activities	Frequency	Percentage*
Petty trader	89	59.3
Hair plating	81	54.0
Weaving of mats and basket	67	44.7
Poultry keeping	45	30.0
Animal Husbandry	45	30.0
Crop Production	98	65.3
Dairy/milk processing	36	24.0
Tailoring	32	21.3
Food processing	16	10.7
Civil servant	32	21.3
Others	16	21.3

Source: Field Survey, 2019
Percentage are based on multiple response

Table 2 present the distribution of the respondents based on the types of the livelihood activities in which they were engaged in. The distribution shows that majority (59.3%) of the respondents were found to be engaged in petty trading. This implies that most women get their source of income from petting trading which include selling of both farm and non-farm goods so that they can cope with natural disasters and theft. 54% of the respondents were involved in hair plating as a source of income. It is an indoor livelihood activity that requires less capital and requires no labour. About 52.3% were involved in crop production which includes farming of crop such as Okra, Sorrel, Sesame seed as well as Cowpea. Tailoring is another important livelihood activity that most women get their income from. This is due to the facts that it is an indoor livelihood activity. Some women combine both farming and indoor activities. This is in agreement with Kabir *et al* (2012) where they observed that most housewives in rural and urban areas combine both farm and nonfarm livelihood activities in order to meet their family needs.

Table 3 Distribution of Constraints Affecting Livelihood Activities of the Respondents

Constraints	Frequency	Percentage*	Rank
Lack of adequate capital	145	96.7	1
Lack of access to working asset	78	52.0	4
Gender disparity	67	44.7	5
Lack of knowledge on change on price of produce	67	44.7	5
Difficulty in access to market	98	65.3	3
Unavailability of credit	102	68.0	2
Low sales	41	27.3	6
Poor harvest/yield	23	15.3	7
Norms and religious values that exclude women	41	27.3	6

Source: Field survey 2019
Percentage are based on multiple response

In Table 3 various constraints encountered by the respondents were shown, where majority (96.7%) of the respondents indicated lack of adequate capital as one of the serious constraints that makes it difficult for them to engage in multiple livelihood activities was ranked the first. The respondents were aspiring to engage in more than one activity, but they cannot do so because of lack of capital or fund. Also 68% of the respondents indicated that lack of access to credit facilities is a problem to them. This has been a decade's problem most credit aimed at assisting women do not get into the right channel, it is being diverted to the other counterpart. Since women do not have access to credit it has posse a problem in involving in livelihood activities. This agrees with Ayanwuyi and Akintonde (2011) in Iba local government area of Ogun State it was reported that constraints affecting women's livelihood

activities includes: poor access to credit was the major problem (81.1%) other like poor access to farm input (45.6%) and food scarcity (52.2%). Mutaingadura (2010) and Ashimolowo and Otufule (2012) found that women do not have enough and access to money to participate in income generating activities.

Table 3 also showed that the third ranked was 65.3% of the respondents found it difficult to access market places and this has been a great constraint to the rural women. They argued that the roads leading to a better market where they will either sell their produce and product at the village markets are mostly bad and threaten by rubber.

Other constraints found in the studies are lack of access to working asset 52%, as the forth lack of awareness in new skills 27%, lack of knowledge on change on prices of produces, low sell, poor harvest yield 44.7% and gender disparity are 44.7% respectively were ranked fifth among those constraints affecting women participation of engagement in livelihood activities. These agree in similar studies conducted by Eboh and Ocheoha (2002); Franklin (2007); Eze (2002) and ogunlela and Muktar (2009). Also the Table shows that 27.3% indicated that norms and religious values excuse women from participating in certain livelihood activities, rural women sometimes are in purdah restricting women's contact with outside society and this has led to lack of support for new income generating activities while the least of all was poor harvest with 15.3%.

Conclusion and Recommendations

It was observed that rural women were in their active and productive age, therefore, they were able to engage in livelihood activities that generate income to support their basic needs. Majority of the women were married, mostly were self-employed through engaging in various types of occupation, only few combine livelihood activities and government employment. The Educational backgrounds of the respondents were mostly Qur'anic education. The study also showed that most rural women can only record what they earn per week than monthly because it is easier to remember and calculated, livelihood activities that is lucrative and requires less capital as well as less labour are that the rural women preferred, all these are to increase their income so that they can meet up with the family necessity hence reducing poverty condition one can conclude that the more the livelihood activates, the more the possibility of increase in unit income of the household. A number of constraints affected the women in the study area, among them, the difficult constraints were lack of adequate capital, unavailable credit facilities and difficulty in accessing market. The study recommended that enlightenment programme should be pursued so that women can be educated on the importance of participating in livelihood activities that are available within their locality.

References

Ashimolowo, O.R. and Otufule, G.A. (2012). Effect of Domestic Violence on Women partners livelihood activities in Ogun State Nigeria. Prime Journal of Social Science, 1 (2): 31-42 www.primeiournal.org/piss.

Ayanwuyi, E. and Akintonde, J.O. (2011). Income Generating Activities among Rural Women in ensuring Household food security in 111 Local Government Osun State. Nigeria world Young Researchers, (5): 66-70.

Bzugu, P.M and Hayatu Y. W (2007). Savings mobilization and Agricultural Production among Small Scale Farmers in Mubi Region, Adamawa state. Nigeria. In Global Approaches to Extension Practice: A Journal of Agricultural Extension Vol.4 No. 2.pp 26-31.

Eboh, E.G. and Ocheoha, K.N. (2002). Determinants of Rural Non-Farm sector potential in reducing income-poverty: Evidence from Enugu State, Nigeria. Proceedings of 36l Annual Conference of Agricultural Society of Nigerian FUT, Owerri, 20-24 October 2002, pp. 160-164.

Ellis. F. (1999) Rural Livelihood Diversity in Developing Countries: Evidence and Policy Implications-ODI. Natural Resource Perspectives, Number 40.

Emmanuella. C. O, (2009). The Constraints of Rural Women in informal Economic activities in Imo State Nigeria: Council for the Development of Social Science Research in Africa. 83 -101

Eze, S. O. (2002). Post-harvest plantain technology Dissemination and Agricultural extension Implication for poverty eradication among rural women in Anaocha Local Government Area of Anambra State Proceeding of the 36th Annual conference of Agricultural Society of Nigeria PUT, Oweri, 20- 24 October 2002pp. 201- 204.

Franklin, S. (2007). Gender inequality in Nigeria. Taking 11 Global Online Publication, 31 May, 2007.

Kabir, M.S., Xuexi, H., Rahima, A. Jing, W. and Lijia, W. (2012). Impact of small Entrepreneurship on sustainable livelihood asset of rural poor women in Bangladash.International Journal of economics and finance, 4 (3): 265-280.

Kwaghe, P.V. (1999). Women feed the world: prospects, problems and solutions for sustainable agriculture. In Undiandeyeet al.(eds) Sustainable Agricultural Development, Principles and case study. Mainasara Publishing Company Borno State, 86-98.

Mate, R. (2005). Making Ends meet at the Margins?: Grappling with economic crisis and Belonging in Beitbridge Town, Zinbabwe, Dakar CODESRIA.

Ministry of Women Affairs and Social Development (2019) Report

Mutaingadura, G. (2010). Achieving Gender Equality, Women's Empowerment and Ending Violence against Women in Africa: A policy and Social Protection.

Njoku, E.C. & Adesope, O.N. (2007). Livelihood Diversity Strategies of Rural Women in Local Extension, vol. 10. 17-23.

Ogunbameru, B. O., Gwary, M.M., Idrissa, Y.L., Ani, A. O. and Yero, A. (2006). Empowerement of Women through Urban Agricultural Development in Maiduguri Metropolitan, Borno State. Proceeding of 11th Annual National Conference of Agricultural

Extension Society of Nigeria (AESON) 3RD -6TH April, pp. 147-156.

Ogunlela, Y.I. and MukhtarA.A. (2009), Gender issues in agriculture and rural development in Nigerian: The role of women. Humanity and Social Science Journal, 4(1): 63-77.

Okoro, G.I. and Odebode, S.O. (2009). Challenges to livelihood activities of women in eastern Obodo, Niger Delta region, Nigeria-International Journal of Agricultural Economics and Rural Development IJAERD2 (2): 7-13.

Olawoye, J. (2002) Women and forestry in Nigeria: Final Report for Nigeria Forestry Action Plan (NFAP)

Olawuyi, S.O. and Rahji, M. A.Y. (2012.) Analysis of Livelihood Strategies of household is heads in Ode-omi Kingdom Ogun-waterside Ogun State Nigeria International Journal of Agricultural Economics and Rural Development 11(2): 337-345.

Onyenechere, E.G. (2009). The constraint of rural women in information on economic activities in Imo State, Nigeria. Council for the Development of Social Science Research in Africa, (CODESRIA 34(1): 83-101.

Raufu, M.C., Akinnira, T.N., Olawuyi. S.D. and Akinpelu. M.O. (2012). Economic analysis of rural women income from Non-Timber forest product in Ife South Local Government Area of Osun State, Nigeria Global Journal of science Frontier Research Agricultural & Biology, 12(1): 215-225.

Vosanka, I.P., Tari, B., Musa, H.Y. and Hammangabdo, .T. J.(2010). Analysis of The Socio-Economic Impact and Sustainability of Livelihood diversity of Rural Women in Zing

Local Government Area of Taraba State Nigeria. Journal of Agricultural and Veterinary Science 2(1): 17-24.

Wanyama, M. Mose L.O, Odendo M. J. O, Owuor G. and Mohammed, 2. (2010). Determinants of income diversification strategies among rural households in Maize Based Farming of Kenya Africa Journal of Food Science Vol. 4 No. 12, pp. 754- 763.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 76-87 (September, 2021)
www.iarcj.org, www.arcnjournals.org

Response of Broiler Birds to Dietry Inclusion of *Leptadenia hastata* Leaves as an Additional Source of Vitamins and Minerals in a Semi-Arid Environment

Murtala A. Labbo, Kabiru Y. Muhammad Sa'adu Usman, Sanusi M. Bello
Department of Animal Health and Production technology Umaru Ali Shinkafi Polytechnic Sokoto, Nigeria.
Mukhtar S. Sanyinna
Ministry of Animal Health, Sokoto State, Nigeria
Corresponding Author: yypoutry@gmail.com

Abstract: *An experiment was designed to study the effect of Laptadenia hastata leaf meal (LHLM) on performance, and carcass characteristics of broiler chicken. A total of two hundred and forty day-old broiler chicks of the Agrited strain were randomly assigned to 4 dietary treatment groups of 60 chicks each replicated four times (15 chicks per replicate) in a complete randomized design (CRD) arrangement. The birds were fed similar diets at both starter and finisher phases of growth containing varying quantity of LHLM. Birds in Group 1 served as the control and were fed diets without LHLM. Those in Groups 2, 3, and 4 were fed 250,500, and 750g/100kg diets respectively. Parameters measured include body weight, body weight gain, feed intake, water intake, feed conversion ration (FCR) and mortality. Results showed no significant (P >0.05), was observed for birds fed diet 3 compared to 2.79, 2.65 and 2.40 for those fed Diets 1,2, and 4 respectively. No significant (P>0.05) difference was observed among the carcass parameters except for the dressed weight, dressing percentage and neck weight. On the organ relative weight, there were no significant effects (P>0.05) on heart. On the organ relative weight, there was no significant effects (P< 0.05) affected proventiculus and gizzard weights. It was concluded that Laptadenia hastata leaf meal can be included up to 500mg in broiler diet for improved growth performance and carcass characteristics.*

Keyword: *Leptadenia hastata, Broiler Chicken, Stator, Finisher*

INTRODUCTION

The poultry industry in Nigeria in the last decade has been greatly affected by high cost of feed. The provision of feed alone has been reported to account 60-80% of the total cost of livestock production in developing countries such as Nigeria (Igboeli, 2000; Esonu, 2000). In view of this, there is increased interest by Nigerian livestock farmers to harness unconventional feed ingredients. The use of unconventional feedstuff is gaining more recognition in the field of animal nutrition. This is basically due to the high cost of conventional feeds which is a contributory factor to high cost of livestock production in Nigeria (Obh, 2006). Hence, widely cultivated vegetables in the tropics and sub-tropics need to be exploited. The leaves of these vegetables can contribute protein and vitamins, there complementing the inadequacies of most feedstuffs (Ifon and Bashir, 1980).

The rapid growth of broilers demands that they be supplied with high quality diets to sufficiently cater for their nutrients requirements. The principal constituents of broilers are soft tissues which are mainly proteins. The protein required by depends primarily on the amount needed for maintenance of health, tissue integrity and for productive for purposes (Olomu and Offiong, 1980). Broiler chicken production is an important source of income and employment. Meat from broiler chickens has become important dietary component of the People in Nigeria. Chicken meat is an important source of high quality protein; it is easily digested and contains all essential amino acids. It is also an excellent source of Vitamin A, thiamine, riboflavin and niacin (Roberts et al., 1999).

Although dietary vitamin and mineral requirements for birds have been periodically re-established NRC (1984;1994). Some aspects of these requirements are continuously questioned. The requirement are normally determined in young birds by using purified diets and in thermoneutral conditions; however, the actual requirement can be quite different in poultry production system, as the birds are subjected to stressful situations that can be avoided during experimental trials (Lesson and summer 1997). Vitamin or mineral supplements in diets have been evaluated in the last few years as a way of reducing the cost of broiler chicken production (Skinner *et al.,1992).* Several reports have show the effect of vitamins or minerals during the finisher period on the performance of broiler chickens (Deyhim and Teeter, 1993).

Vitamin-mineral premix is the combination of vitamins and minerals which is added to the formulated diet to meet-up the requirements of at least few vitamins and minerals that are deficient in the formulated diet. Inclusion of vitamin-mineral premix in the formulated diet has become indispensable practice because feed ingredient do not contain all essential vitamins and minerals at the right amounts needed for the requirement of chickens (Bhowmik, 1996). Critiacal vitamins (Choline, Folic acid, pantothenic acid, pyridoxine, riboflavin, vit-A, vit-D3 and vit-E) and minerals (calcium, phosphorus, copper, iodine, iron, manganese, sodium and zinc) should be checked carefully in the diet. It is not unusual to add all vitamins in poultry diets. Minerals and vitamins contribute only 10 percent of the total cost of feed (Singh and Panda, 1988). Reducing safety margin of these vitamins and minerals can restrict performance of birds with heavy losses.

Several medicinal plants have been used as dietary adjunct and in the treatment of numerous diseases without proper knowledge of their function. Ethnobotanical information obtained from traditional medical practictioners in northern Nigeria revealed that *L. hastate* is used for the treatment of diabetes mellitus. The antibacterial and antimicrobial effect of L. hastate would have been reported (Aliero and Wara, 2009) and the result of its toxicity studies show that plant is relatively safe to use (Tambuora et al., 2005).

MATERIALS AND METHODS

Study Area

The study was conducted at the Poultry Production and Research Unit of Animal Health and Production Technology Department, Umaru Ali Shinkafi Polytechnic, Sokoto, Sokoto State. The experiment lasted for eight weeks.

Sokoto State is located between latitudes 12^{o} and 13^{o}N and between longitudes 4^{0} and 6^{0}E in the northern part of Nigeria at an altitude of 350m above sea level (Mamman et al., 2000). The state falls within the Sudan Savannah Vegetation zone to the south and Sahel Savannah to the north while alternating wet and dry seasons. The hot dry spell extends from March to May and sometime to June in the extreme northern part. A short cool, dry period (Harmattan) occurs and last between late October and late February (Malami et al., 2001). Mean annual temperature is 34.9^{o}C with the highest in April ranging from 38 to 40^{o}C and the lowest in January ranging from 13 to 16^{o}C (SEPP, 1996).

Sources of Ingredients for Experimental Diet

The major feed ingredients (maize, ground-nut cake, wheat offal, blood meal, bone meal and lime-stone) used for the study were sourced from the Sokoto central market while methionine, lysine and premix were sourced from vendors within Sokoto metropolis.

Sources and Processing of *Laptadenia hastata* Leaves

Fresh leaves of *L. hastata*were collected from the wild usually at river banks and lowlands where they thrive better. The leaves were dried under shade and then ground to powder using motar and pestle and preserved in airtight plastic container, until they were required for use.

Experimental Birds, Diets and Procedure

A total of 240 day-old broiler chicks (*Arbor acre strain)*, were divided into 4 treatment groups. Each group of 60 chicks were divided into 4 groups of 15 chicks to serve as replicates using complete randomized design (CRD). Similar diets were formulated and fed to the birds at starter phase of growth (0-4 weeks of age), except that brids on the control diet contained no LHLM added to it. Diet 2 had 250g LHLM, Diet 3 and 4 contained 500 and 750g LHLM, respectively. The composition for the starter diets is shown in Table 1.1 Similarly, during the finisher phase of growth, diets fed to birds in treatment groups 1,2,3, and 4 and 0, 250, 500 and 750g LHLM, respectively. The composition of the diets fed at the finisher phase of growth is shown in Table 1.2, Table 1.3, shows the calculated nutrient composition of the starter and finisher diets.

Table 1.1: Percentage composition of broiler starter diets

	Dietary treatments			
Ingredient	**1**	**2**	**3**	**4**
Maize	57.00	57.00	57.00	57.00
Groundnut Cake	30.00	30.00	30.00	30.00
Wheat Offal	5.00	5.00	5.00	5.00
Blood Meal	4.00	4.00	4.00	4.00
Bone Meal	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00
Vitamin-Mineral Premix	0.30	0.30	0.30	0.30
Methionione	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**
Laptadenia hastate leaf meal	0	250g	500g	750g
Calculated analysis				
Metabolize Energy (Kcal/kg)	2956	2956	2956	2956
Crude Protein (%)	23.25	23.25	23.25	23.25
Crude Fibre (%)	3.11	3.11	3.11	3.11
Ether Extract (%)	4.32	4.32	4.32	4.32
Calcium (%)	1.17	1.17	1.17	1.17
Phosphorus (%)	0.43	0.43	0.43	0.43
Methionine (%)	0.49	0.49	0.49	0.49
Lysine (%)	1.26	1.26	1.26	1.26
Cost of Feed Per kg (₦)	**75.79**	**77.04**	**78.29**	**79.54**

Table 1.2: Percentage composition of broiler finisher diets

	Dietary treatments			
Ingredient	**1**	**2**	**3**	**4**
Maize	60.00	60.00	60.00	60.00
Groundnut Cake	22.00	22.00	22.00	22.00
Wheat Offal	10.00	10.00	10.00	10.00
Blood Meal	3.00	3.00	3.00	3.00
Bone Meal	2.50	2.50	2.50	2.50
Limestone	1.50	1.50	1.50	1.50
Vitamin-Mineral Premix	0.30	0.30	0.30	0.30
Methionione	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**
Laptadenia hastata leaf meal	0	250g	500g	750g

Calculated analysis				
Metabolize Energy (Kcal/kg)	2913.70	2913.70	2913.70	2913.70
Crude Protein (%)	20.00	20.00	20.00	20.00
Crude Fibre (%)	3.18	3.18	3.18	3.18
Ether Extract (%)	4.12	4.12	4.12	4.12
Calcium (%)	1.52	1.52	1.52	1.52
Phosphorus (%)	0.51	0.51	0.51	0.51
Methionine (%)	0.47	0.47	0.47	0.47
Lysine (%)	1.10	1.10	1.10	1.10
Cost of Feed Per kg (₦)	**71.61**	**72.86**	**74.11**	**75.36**

Table 1.3: Proximate composition of dried leaves of *Laptadenia hastata leaf meal*

Nutrients	**Content**
Dry Matter (DM%)	92.67
Protein (%)	**9.61**
Carbonhydrates (%)	**58.56**
Lipids (%)	**58.56**
Fibre (%)	**11.33**
Ash (%)	**13.83**
Ca (%)	**0.12**
Mg (%)	**1.27**
P(%)	**0.54**
K(%)	**1.131**
Na (%)	**1.29**

Source: Hassan et al., (2007)

Management of Experimental Birds and Data Collection

The experimental birds were first kept for three days after transport to take care of stress due to transportation. During the three days they were administered anti stress drug (Vitalyte). They were later weighted and randomly allotted to their respective treatment groups. Routine management practices including feeding, supply of water; medication and vaccination were carried out as described by (Oluyemi and Roberts, 2000). This birds were housed on deep litter. Before the arrival of the birds, the pens were cleaned and disinfected with germicide solution (Izal).

Data were collected on feed intake, initial weight, weekly final body weight. Weight gain and feed intake, weekly weight, final body weight.

Weight gain and feed intake values were determined and used to compute feed conversion ration. Mortality was recorded as it occurred.

Results and Discussion

There were no significant differences (P> 0.05) in final body weight gain (g/bird), body weight gain (g/bird) and weight gain (g/bird/day) among broilers in the treatment groups (Table 2.1). The higher weight gain of birds fed 500g LHLM at the end of trial could be as a result of higher digestion of that nutrient consumed by birds and greater efficiency in the utilization of feed which resulted in enhanced growth Kamal (2001). Alcicek et al. (2004) and Zhang et al. (2005) had reported that plant leaf meals posses digestion stimulating properties. The performance of broilers in this study was similar to, (1898.33, 1892.09, 1871.68, 1884.67) and 1881.14g) reported by Nwogu *et al.* (2007) and Obun *et al.* (2008) because all the values of final body weight gain and feed conversion ration were statistically the same.

The average feed intake of birds did not differ significantly (P>0.05) between treatment groups even though birds fed 500g of LHLM consumed slightly more feed compared to those fed 250, 700g LHLM and the control based diets. The average daily feed intake of (61.73, 71.89, 76.02 and 74.26/bird/day) recorded across the treatments was statistically similar to values reported by (60.43, 6971, 74.14 and 67.86g/bird/day) Ani *et al.* (2008) when they fed raw Bambara nut waste and supplementary enzymes to broilers from 0-8weweks. However, Obun et al. (2011) reported higher value 101.67, 100.00, 96.67 and 91.66g/bird/day. Although the increase in feed intake between birds was higher as the amount of LHLM added to the diet increased.

Feed conversion ration differed significantly (P< 0.05) between treatments as the additive levl of LHLM increased from Og in diet 1 to 500g in Diet 3. The birds in Treatment 3 had better feed conversion ration (2.33) than the others 2.40, 2.65 and 2.79 for 0,250 and 750g LHLM, respectively. The additive level of 500g might be the most optimum for effective feed conversion ratio in broiler as increase in additive level up to 750g worsened the feed conversion ration. Feed conversion ration obtained in this study compared favourably with those recorded by Olabode and Onyekwere (2010) for broilers chicks fed three different commercial poultry feeds. Feed conversion ratio is among the important factors to consider when making statement on cost of production (Sonaiya *et al.,* 1986); Ukachukwu and Anuguwa, 1995). Lower body weight gain was recorded in the birds fed 250g of LHLM and the poor feed conversion ration was observed in birds served 750g of LHLM.

Morality was not influenced by dietary treatments during the trial period. There was no significant differences (P>0.05) between birds in the treatment groups. Since mortality was similar across the treatment groups, it could be concluded that mortality was not as a result of the additive inclusion of the test ingredient in the diet of the birds. It could be due to other factors that equally affected the birds in all treatment groups and therefore did not agreed with the reports of Doyle (2001), Biu *et al* (2006) and Durrani *et al.*(2008) that the application of medicinal plant reduces the number of

mortality. Mortality of broilers in this study was considerably higher than the 5% allowable proportion suggested by Oluyemi and Roberts (2000).

There were significant difference ($p<0.05$) in feed cost per kg gain among the treatments. This could be due to the increase in level of inclusion of *Laptadenia hastata* leaf meal in the diet. Ani et al., (2012) reported increase in feed cost per kg gain might be attributed to increase in average daily feed intake. Better significant cost of feed per kg gain was obtained from bird fed diet 1.

Live weight value of 2136.20g was obtained for birds that were fed 750g LHLM based diet and the least value of 1838.30g for birds fefd 250g LHLM (Table 6). To the facat that *Laptadenia hastata contained* some medicinal properties Aliero and Wara (2009). This support by the report of Doyle (2001) and Lucy (2002), who stated that application of medicinal plants allowed chicken to grow strong and healthy. The dressing percentages obtained in this study was significantly ($P<0.05$) different among the treatments. The dressing percentage obtained for diets 1,3 and 4 (74.67,74,19, and 73.65% were higher than the range of 66.56-68.49% obtained by Omojola et al. (2004).it appeared that the additive levels of the inclusion of the test ingredient did not have impact on the carcass characteristics of broilers fed the treatment diets. This is because most of the parameter did not differ significantly between birds in the four treatment groups.

The slight increase in organs weights with increasing LHLM the diets might have resulted from their heavy live weight as reported by Broadhent (1981) since the surface area and the live weight determine the amount of feathers and visceral organs required. The increase in the size of liver and gizzard could be related to increase activity to overcome the effect of toxic anti-narrative compound in the leaf meal and other ingredient. The significant differences ($P< 0.05$) that existed between the treatments in terms of gizzard and proventiculus may be as result of this. The relative weight values of the organs obtained generally are in agreement with the report of Fanimo et al. (2005) and Isikwenu et al. (2010), who noted no morphological changes in the organs weight of birds fed diets compounded from other ingredients. Hermandez et al (2004), Durani et al. (2008) and Machebe *et al* (2010) reported no effect of feeding plant leaf meal on liver (1.88, 1.72, 1.97, 2.03 and 1.98) and gizzard weight (2.07, 2.13, 2.13, 2.21 and 2.18) whereas, Fairley et al. (1985) associated an increase in the relative weight of gizzard for the broilers given antimicrobial agents in their diets.

Performance of Broilers Fed Laptadenia hastate LM (0-8 weeks of age).

Results of their performance characteristics of Broilers fed LHLM from 0-8 weeks of age is presented in Table 4.1.

Table 2.1: Performance of Broilers fed *Laptadenia hastata* leaf meal from 0-8weeks of age

	Diets				
Parameter	**Control**	**(250g) LHLM**	**(500g) LHLM**	**(750g) LHLM**	**SEM±**
Initial body weight (g/b)	40.89	40.40	40.97	41.00	0.62
Final body weight (g/b)	1943.94	1819.64	2017.61	1861.53	99.63
Today body weight gain (g/b)	1905.61	1779.41	1977.41	1820.53	99.63
Average Weight gain (g/b/d)	1905.61	1779.74	1977.41	1820.53	99.54
Average Feed intake (g/b/d)	34.71	32.47	36.03	33.24	1.78
Average Water intake (g/b/d)	61.73	71.89	76.02	74.26	3.99
Feed conversion ration (FCR)	2.40^{a}	2.65^{ab}	2.33^{a}	2.79^{b}	0.23
Morality (%)	45.00	41.67	38.33	46.67	9.53
Feed Cost/kg gain (₦/b)	130.71^{a}	160.70^{b}	166.22^{c}	173.63^{d}	0.069

abcd: Means within same row with different superscripts are significantly different (P<0.05)

Table 2.2: Carcass characteristics and weight of parts relative to dressed weights of broiler chickens fed diets containing *Laptadenia hastata* leaf meal (LHLM).

	Diets				
Parameter	**Control**	**(250g) LHLM**	**(500g) LHLM**	**(750g) LHLM**	**SEM±**
Live weight (g)	2085.65	1838.30	2017.13	2136.20	102.79
Dressed weight (g)	1558.25	1311.93	1497.00	1576.13	85.29
Dressing percentage (%)	74.67^{a}	71.24^{b}	74.19^{a}	73.65^{a}	0.69
Prime Cuts expressed as percentage of dressed weight					
Back	11.76	11.94	11.94	11.62	0.22
Breast	32.86	33.49	34.39	34.59	0.77
Wing	10.86	11.81	11.00	10.65	0.34
Head	3.42	3.86	3.81	3.38	0.17
Neck	6.82^{a}	6.45^{ab}	5.64^{b}	5.94^{b}	0.27
Shank	5.95	6.39	5.66	5.59	0.37
Thigh	28.33	23.07	27.55	28.23	0.82

Abc: Means within same row with different superscripts and significantly different (P<0.05).

Table 2.3: Organ characteristics relative to carcass weight of broiler chickens fed diet containing *Laptadenia hastata leaf* meal (LHLM).

	Diets				
Parameter(%)	**Control**	**(250g) LHLM**	**(500g) LHLM**	**(750g) LHLM**	**SEM±**
Gizzard	2.89[a]	2.78[a]	2.26[b]	2.53	0.17
Liver	2.39	2.76	2.71	2.83	0.27
Spleen	0.17	0.21	0.18	0.18	0.02
Kidney	0.19	0.22	0.22	0.20	0.02
Lungs	0.56	0.76	0.61	0.67	0.07
Proventiculus	0.48[b]	0.65[a]	0.54[ab]	0.60[ab]	0.04
Intestine	3.55	4.15	4.22	4.09	0.25
Heart	0.55	0.54	0.53	0.55	0.02
Fats	1.82	2.08	1.72	2.19	0.34
Crop	0.41	0.34	0.39	0.39	0.07

abc: Means within same row with different superscripts and significantly different ($p< 0.05$).

Conclusion and Recommendation

It could be concluded that *Laptadenia hastata* leaf meal included at 500g in broiler diet improved the growth performance without adverse effect on haematology and carcass. Therefore, LHLM can be used as an additive in the broiler diets.

Based on the observation and findings from the study, the following recommendations were offered;

- Since the test ingredient *Laptadenia hastata* is abundant in the study area, there is need to utilize it is an additional source of vital phytochemicals.
- Higher concentration of the LHLM could be tried in other experiments to see if the efficacy can be increased for better growth and performance of broiler production and disease prevention.
- *Laptadenia hastata*leaf meal is potentially useful for broiler production. It will be worthwhile to continue investigations into the use of this plant for other poultry species

References

Alicek, A., Bozkurt, M. and Cabuk, M. (2004). The effect of mixture of herbal essential oils, on organic acid or a probiotic on broiler performance. *South African Society for Animal Sciences,* 34(4); 217-222.

Aliero, B.L. Umar, M.A., Suberu, H.A. and Abubakr, A. (2001). A hand Book *Common Plants in North Western Nigeria.*

Ani, A. O., O. D. Omeje and L. C. Ugwuowo (2012). Effects of raw bambara nut

(Voandzeia subterranean 1) waste and enzyme complex on growth performance and apparent nutrient retention in broiler chickens. *African Journal of Biotechnology.* 11 (56), 11991-11997.

Bhowmik, L. (1996). Use of green leafy vegetables (Radish and Spinach) in layer diet as alternatives to vitamin-mineral premix. Bangladash. *Journal of Animal Science.,* 21:41-45.

Broadbent, L.A., Wilson, B.J. and Fisher, C. (1981). The composition of broiler chicken at 56 days of age: Output components and chemicals composition. *British Poultry Science.* 22: 4-10.

Deyhim, F., and R.G. Teeter (1993). Dietary vitamin and/or trace mineral premix effects on performance, humoral mediated immunity, and carcass composition of broilers during thermo-neutral and high ambiet temperature distress. *Journal of Applied Poultry Research* 2:347-355.

Doyle, E. (2011). Alternative to antibiotic use for growth promotion in animal husbandry. *Food Research Institute.* 2:102-15.

Durani, F.R., Sanaullah, N., Chand, Z.D. and Alchtar, S. (2008). Using aqueous extract of Noe agel as anticoccidial and immunostimulant agent in broiler production. *Sarhad Journal of Agriculture*, 24(4); 665-669.

Esonu, B. O. (2000). *Animal Nutrition and Feeding:* A functional approach. Rukzeal and Rukson Association Memory Press, Owerri, Nigeria.

Fanimmo, A. O., Bangbose, A.M., Abida, M.O. Aediran, M. and Olaniyan, A.I. (2005). Carcass yield and blood parameters of broiler chicken fed melon husk diets supplemented with yeast. Proceeding of the1st Nigerian Poultry Summit (NIPS), 20th -25th February, Otta, Ogun State, Nigeria; 120-124.

Hermandez, F., Madrid, J., Garcia, V., Orengo, J. and Megias, M.D. (2004). Influence of two plant extracts on broiler performance, digestibility and digestive organ size. *Poultry Science, 83;169-174.*

Ifon, E.T. and O. Bashir, (1980). The nutritive value of Nigeria leafy vegetables, particularly vitamin and mineral contents. *Food Chemistry.* 4:263-267.

Igboeli, G. (2000): Animal Production and Agriculture in the new *millennium. Book of proceedings 25th annual (NSAP) conference. Pp- 1-3.*

Isikwenu, J, O., Akpodiete, O.J., Omeje, S.I. and Okagbare, G.O. (2010). The effects of replacing groundnut cake with urea-treated and fermented brewer's dried grains on nutrient digestibility, retention and carcass characteristics of broiler finishers. *Journal of Animal Production.* 37:1-12.

Kamal, C. (2001). Tracing modes of action and the roles of plant extracts in non ruminants, in Recent advances in Animal Nutrition, P.C. Gams worthy and J. Wiseman, Eds.; 135-150. Nottingham University Press, UK. Pp135-150.

Lesson, S., and J.D. Summers. (1997). *Commercial Poultry Nutrition 2nd* Edition. University Books, Guelph, ON. Canada.

Lucy, T. (2002). Plant extracts to maintain poultry performance. *Feed international. Pp26-28.*

Machebe, N.S., Agbo, C.U. and Onuaguluchi, C.C. (2010). Performance of finisher broilers served *Gongronema lactifolia.* Benth leaf extracts as supplementary source of vitamins and minerals. *In proceeding of the 15th Annual Conference of animal Science Association of Nigeria* (ASAN), 13-15 September, 2010, University of Uyo, Nigeria. Ogunji, et al. (EDs) 179.

Malami, B. S., U.G. Rambo and M. Nasirudeen (2001). A note on indigenous knowledge on treating camel *Camelus dromedary)* disease among farmers in Sokoto State, Nigeria. *Journal of Agriculture and Environment* 2(1): 159-163.

Mamman, A.B., J.O. Oyebaniji and S.W.. Peters (2000). Nigeria A people united, a future assured (survey of state). Gabumo Public Company Calaba. Pp6-7.

NRC (1984) *Nutrient Requirements of Domestic Animals Nutrient Requirements of Poultry.* 8th Revised Edition National Academy of Science. Washington DC.

NRC (1994) *Nutrient Requirements of Domestic Animals. Nutrient Requirements of Poultry.* 9th Revised Edition National Academy of Science. Washington DC.

Oboh, G. (2006). Nutrients enrichment of cassava, peels using mixed culture of *Sachnonyers Cerevisae and Lactobaccilus spp* solid media fermentation techniques. *Electrical Journal of Biotechnology 4:98-104.*

Obun, C.O. Olafadeham, O.A. Ayanwale, B.A. and Inuwa, M. (2011). Growth, Carcass and Organ weight of finisher broilers fed differently processed *Detarium microcarpum* (Guill and Sperr) seed meal. *Journal of livestock research for Rural Development,* 20(8): 1-7.

Olabode, A.D. and Onyekwere, M.U (2010). Growth performance and carcass characteristics of broilers fed three commercial produced diets. In: Babayemi, O.J. ABU, O.A and Ewuola E.O (Editors*). Proceedings of the 35th Annual Conference of Nigeria Society for Animal Production (NSAP),* March 14-18th 2010, University of Ibadan, Oyo State, Nigeria. Pages 292-294.

Olomu, J.M. and S.A. Offiong (1980). Effect of protein and energy levels and time of change from starter to finisher ration on the performance of broiler chicks in the tropics. *British Poultry Science* 59: 828-835.

Oluyemi, J.A. and Roberts, F.A. (2000). P*oultry production in warm wet. Climate 2nd edition,* Macmillan publishers London U.K Pp 77-80.

Roberts K., Prenzter P.D., Tucker G., Swatsitang and Glover W., (1999) Phonelic Compounds and their role in oxidative processes in fruits, *Food Chemistry* 66:401-436.

SEPP. (1996). Sokoto Environmental protection program, Metrological Data, Sokoto State Government, Sokoto, Nigeria (Unpublished).

Singh, K.S and B. Panda (1988). Nutrition and Quality of Poultry product. *Journal of Poultry Nutrition*, Pp 4:159-161.

Skinner, J.T., A.L. Waldroup and P.W. Waldroup (1992). Effects of removal witamin and trace mineral supplements from gower and finisher diet on live performance and carcass composition of broilers. *Journal of Applied poultry Research 1:280-286.*

Sonaiya, E.B. Williams, A.R. and Oni, S.A. (1986). Abiological appraisal of broiler production up to 16 weeks. *Journal of Animal Science Reseasrch, 6:115-125.*

Tamboura, H.H., Bayala, B., Lampo, M., Guissou, I.P. and samadogo, L. (2005). Ecological distribution, morphological characteristics and acutetoxicity of aqueous extracts of Holarrhena floribunda (G.Don) Durrand and Schniz, *Leptadenia hastata* (Pers.) Decne and Cassia Sieberaiana (dc) used by veterinary healers in Burkina Faso. *African Journal Traditional* CAM, 2:13-24.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 88-92 (October, 2021)
www.iarcj.org, www.arcnjournals.org

Replacement of Conventional Feed with Morning Glory as a Strategy for Reducing Cost of Feeding Rabbits for Increasing Employment in Nigeria

Lawal, S. M.,* Abdullahi, R. K/Bai, Lawal, M., Mukhtar, M. G.
Department of Agricultural Education, Federal College of Education Katsina, Katsina State.
*Corresponding Author +2348036139147, saidumuhdlawal@gmail.com

Abstract: *Rabbit production has numerous advantages, which has led to its increased production Rabbit can supply the needs of an average family and is a suitable and cheaper alternative to some protein sources. Rabbits have also been used as a means of reducing poverty in developing countries. However, feeding costs represent up to 60% of the total cost of rabbit production. Therefore, the use of available and cheap ingredients to feed rabbits is highly recommended to reduce production costs Morning glory (Ipomea asarifolia) is a plant found in abundance in different parts of Nigeria with no monetary value attached to it. Morning glory appears to be consumed by rabbits without any detrimental effect. However, its effect on the production performance of rabbits is not known. Therefore, this study aims to investigate the effect of replacing groundnut hay with morning glory hay on the weight gain of rabbits. Eighty-four (84) weaner rabbits were divided into four groups, each having seven (7) rabbits. Four treatments, T1, T2, T3 and T4, were assigned to each group, with each group being replicated three times. Data were analysed using one-way ANOVA with Tukey's HSD as the post hoc lest. There was no significant difference in weight gain of rabbits between treatments except T2, which was significantly ($p<0.05$) lower than the other treatments. It was concluded that morning glory hay could be conveniently used to replace groundnut hay without affecting the production performance of rabbits, thus lowering production costs.*

Keyword: *forage, Ipomea asarifolia. morning glory, rabbits, weight gain.*

Introduction

Rabbit production has numerous advantages, which has led to its increased awareness to reduce food shortages (Baruwa, 2014). Among the numerous advantages of rabbits include a high rate of reproduction; early maturity; small body size; rapid growth rate comparable to that of broiler chicken (Rao et al., 1977), high genetic selection potential: efficient feed and land space utilisation, limited competition with humans for similar food: and high-quality, nutritious meat (Cheeke, 1980; Arijeniwa et al., 2000). Rabbit can supply the needs of an average family and is a suitable and cheaper alternative to some protein sources, increasing the protein consumption of households in Nigeria (Ogbonna, 2015). Rabbit is a micro-livestock that can produce about 47 kg of meat per doe per year, which is enough to solely meet the animal protein requirements of a medium-sized family under small scale rural farming systems (Adedeji et al., 2012; Hassan and Owolabi, 1996). Besides, rabbit meat is rich in vitamin B and extremely low in cholesterol and sodium levels (Jithendran, 2000;

Omole et al., 2005). Rabbits have also been used to reduce poverty in developing countries (Oseni and Lukefahr, 2014). They have been used in development and poverty reduction programmes due to their low investment and early benefits, and subsistence on renewable resources for feeding, housing and general management

Feed accounts for the most significant part of the production costs in animal production and could reach up to 70% of total costs of production. Feeding costs represent up to 60 of the total cost of rabbit production in France (Coutelet, 2015) and Sierra Leone (Franck et al., 2016). Therefore, using available and cheap ingredients to feed rabbits is highly recommended to reduce production costs. Rabbit can turn forage into high protein yet remains within the investment ranges of the poorest families (Smith, 1991).

Rabbits are commonly fed with forages like groundnut hay and cowpea hay, but these feedstuffs are becoming more expensive because of their utilisation as feeds in ruminant production. There is a need to identify cheap alternative feedstuffs which can be used to feed rabbits to lower their production cost. Morning glory (*Ipomea asarifolia*) is a plant found in abundance in different parts of Nigeria. The plant is mainly considered a weed and seldom grazed by ruminants; hence, it has no monetary value. Morning glory, however, appears to be consumed by rabbits without any detrimental effect. However, the effect of utilising Morning glory as forage on rabbits' production performance is not known. Therefore, this study seeks to investigate the effect of replacing groundnut hay with morning glory hay on the weight gain of rabbits.

Materials and Methods

The study area is Katsina state, and the experiment was conducted in Federal College of Education Katsina. The research animals were kept in hutches in the College rabbit house. Eighty-four (84) weaner rabbits were divided into four different treatments, and each treatment with three replications containing seven research animals each. The treatments are given in Table 1 below. The research was conducted using a completely randomised block design (CRBD). Morning glory was collected from the local environment, chopped and dried under shade and then fed to the research animals. Cowpea hay, wheat bran and cottonseed cake/groundnut cake (ONC) were purchased from the market. Cowpea hay, morning glory and water were fed ad libitum while ONC and wheat bran were fed twice a day, i.e. morning and evening.

Table 1: The research animals were fed according to the following feeding ratio:

Treatments	T1	T2	T3	T4
Cowpea hay (%)	100	75	25	0
Morning glory (%)	0	25	75	100

The initial weight of the rabbits was taken before treatment allocation, and weighing continued weekly throughout the experiment. Average weight gain was calculated by subtracting the initial weight from the final weight of rabbits. Data were analysed using one-way ANOVA (IBM SPSS version 22) with Tukey's HSD as the post hoc test.

Results and Discussion

Table 2: Weight gain of rabbits fed with various levels morning glory

Parameters	T1	T2	T3	T4	SEM	P-Values
Mean initial weight (kg)	1.19[a]	2.03[b]	1.23[a]	1.18[a]	0.096	<0.05
Mean final weight (kg)	3.38[a]	3.30[a]	3.20[a]	3.28[a]	0.039	NS
Average weight gain (kg)	2.19[b]	1.27[a]	1.97[b]	2.10[b]	0.95	<0.05
Average daily weight gain (g)	26.1[b]	15.1[a]	23.5[b]	25.0[b]	1.125	<0.05

[ab] across columns indicates a significant difference using Tukey's HSD

The experimental rabbits at T1 (0%), T3 (50%), and T4 (100%) had similar initial weights of l.l9 kg, 1.23 kg, and 1.18 kg, respectively. The initial weight of T2 (2.03 kg) showed a significant difference ($P<0.05$) between the remaining treatments. The final live weights of the experimental animals were 3.38 kg, 3.30 kg, 3.20 kg, and 3.28 kg for T1 (0%), T2 (25%), T3 (50%), and T4 (100%) levels which showed no significant difference ($P>0.05$) between the treatments. The average weight gain of T1, T3, and T4 were significantly different ($P<0.05$) from that of T2, but rabbits in control (T1) had the highest average weight gain. The average daily weight gain of T1, T2, T3, and T4 are 26.1kg, 15.1kg, 23.5kg and 25.0kg respectively. This showed that T1, T3, and T4 were significantly ($P<0.05$) different from T2. This suggests the rejection of T2 (25%) as it has the highest initial weight (2.03 kg) but ends with the least weight parameters. This shows that the level of morning glory inclusion at that treatment was abnormal. This finding is inconsistent with Esonu et al. (2002), who revealed that *Microdesmis purberula* at 15% inclusion level depressed growth. Conversely, Iyayi (2001) reported that supplementing cassava leaves up to 20% improved feed intake and weight gain of pigs. These findings indicated that the higher the level of inclusion of morning glory in the diet, the higher the performance. This will reduce the cost of production on feeds as advocated by Esonu et al. (2002) to use the available non-conventional and indigenous feed sources which are not competed for between man and animals. However, these findings disagree with Ekenyem (2006), who reported that the inclusion of *Ipomea asarifolia* leaf meal beyond 5% reduced the growth rate of grower pig.

Conclusion

The study reveals that morning glory is a good forage that can conveniently replace more expensive forages like groundnut hay while maintaining the same level of performance in rabbit production. It is suggested that a standard feeding package for rabbits using morning glory as the main forage be developed and produced as feeding guidelines for farmers.

Recommendations

- Morning glory hay can be conveniently used to replace groundnut hay without affecting the production performance of rabbits.
- Morning glory appears to be consumed by only rabbits without detrimental effects. It can therefore be judiciously utilised.

- ❖ Morning glory has no monetary value attached to it. Therefore it can be used in place of groundnut hay to reduce the cost of production.
- ❖ More research needs to be carried out on the haematological effect of Morning glory on its feeding to the rabbits.

References

Adedeji, L. A., I. O., Adejumo, and K. S. Obaniyi. (2012). Information needs of farmers in rabbit production in Sagamu Local Government Area of Ogun State. *Continental Journal of Agricultural Economics* 6 (1): 23 - 27, 2012.

Arijeniwa, A, Otaikhian S. O. and J. A. Imaseun. (2000). "Performance of weaner rabbit feed: Poultry Grower marsh supplemented with different grass-legume rations." Proceeding of 5th Animal Conference of Animal Science Association (ASAN) September, 19 - 22.2000 Pp 103 - 105.

Baruwa, O. I. (2014). Profitability and constraints to rabbit production under tropical conditions in Nigeria. *Journal of Livestock Scie*nce (ISSN online 2277-6214), 5, 83-88.

Cheeke, P. R., (1980). 'The potential role of rabbit in meeting World food needs."J. Applied Rabbit Research. 3(3): 3-5.

Coutelet, G., 2015. Resultats technico-economiques des eleveurs de lapins de chair en France en 2014. In: Bolet, 0. (Ed.), l oemes 1 Rech. Cunicoles. ITAVIpubl Paris, Le Mans, France, pp. 193-197.

Ekenyem, B. U. (2006). An Assessment of Ipomoea asarifolia Leaf Meal as Feed Ingredient in Grower Pig Diet. *Pakistan Journal of Nutrition* 5 (1): 39-42.

Ekenyem, B.U., (2004). Non-ruminant livestock responses to varying dietary inclusion levels of Ipomoea asarifolia leaf meal Ph.D Thesis, Department of Animal Science, lmo State University. Owerri, Nigeria.

Esonu, B. 0., F. C. lheukwumere, O. O. Emenalorn, M. C. Uchegbu and E. B. Etuk, (2002). Performance Nutrient Utilisation and Organ Characteristics of broilers fed Microdesmis puberula leaf meal. Livest. Res. Rural Dev., 4 (6) 2002.

Franck, Y. K., Athanase, O. K., Flavienne. W. L. R. M., Anselme, K. K., & Sebastien, N. (2016). Growth Parameters. Protein Digestibility and Health Status of Rabbit Oryctolagus Cuniculus Fed With Palatable Leafy Vegetables. *European Scientific Journal* 12(27).

Hassan, W. A, and R. 0, Owolabi, (1996)." Production performances of domesticated Rabbits in the semi-arid zone of Nigeria." Proceedings of the 6th World Rabbit Congress, Tonbuse. France. 3: 359 - 363.

Iyayi, E. A., (2001). Cassava leaves as supplement for feeding weaner swine. Tropical Animal Production Investment, 4: 141-150.

Jithendran, K. P., (2000). "Nutritive value of rabbit meat". Envis Bulletin. *Himalayan Ecology and Development,* 8(1).

Ogbonna, O. 1. (2015). Role of Households in Rabbit Production in Enugu-North Agricultural Zone of Enugu State. *Journal of Agricultural Extension*, 19(1), 49-56.

Omole, A. I., Omueti, O. and O. J., Ogunleke, (2005). "Performance characteristics of Weaned rabbits fed graded levels of dry cassava peel fortified with soy corn Residue based diet'. *Journal of Farm Agriculture and Environment* 3: 36-38.

Oseni, S. 0., & Lukefahr, S. D. (2014). Rabbit production in low-input systems in Africa: situation, knowledge and perspectives-A review. In World Rabbit Science (Vol. 22, No.2, pp. 147-160). Editorial Universitat Politecnica de Valencia.

Rao, D. R., G. R., Sunki, W. M., Johnson, and C. P., Chen, (1977). "Postnatal growth of Newzealand white rabbit". *Journal of Animal Science* 44: 10 - 21.

Smith, 1. A., (1991). "Livestock Volume Technical Centre for Agricultural and Rural Development," Macmillan Press Netherlands.

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 93-105 (October, 2021)
www.iarcj.org, www.arcnjournals.org

Frame Survey and Fish Species Composition of Hadejia Jama'are Komadugu River Basin, Northern, Nigeria

Wakil, Umaru Buba[1] Onyia, L.U[2]; Hassan, M. Z[3]., Musa, M[4]. AJI, A.M[5], Gadaka, Y.M[6]
University of Maiduguri[1],
Modibbo Adama University, Yola[2],
Corresponding author Email Address: ubwakilgza@ yahoo.com

Abstract: *A frame survey with a complete census based approach and fish composition assessment were carried from August to December 2019. The objective of the study was to provide information on the number of fishing unit, fishers, fishing boats, and number of fishing Gourds and the fish composition and distribution some selected fishing communities' in Hadejia Jama'are Komadugu Yobe (HJKY)in Northern Nigeria. Purposively selection of some fishing communities and canoes from landing sites were adopted. A total of sixty two (62) landing sites, (3320) fisherfolk, (1365) of fishing boats, (20) non-fishing boats,1414 gourds and (2353) fish assistance were identified in 32 fishing communities. The highest number of fishing unit, fishers, fishing boats, and number of fishing Gourds were recorded in Hadejia river basin, followed by Komadugu Yobe River basin while, Jama'are river recorded the least numbers of landing sites, fisher, fishing boats and gourds respectively. Fishing traps of different design and size (Mali traps, Sankiya Ndurutu) were the most important gear type used by the fisherfolk with the 51%, followed by gill net (kalli) which pooled 22.5%. Hooks and line (Kujiya) of various size ranged from number 1-14 were also commonly used in all the fishing communities with18%. While, cast net (Birigi), beach seine nets and clap nets recorded (2.8, 2.5 and 1.7 %) respectively. A total of (4312) fish belonging to fifteen (15) families, twenty-five genera and thirty-four (34) species were observed in the course of this study with Orechromis niloticus the most abundance fish species. The fish biodiversity in HJKY River basin has seriously decline and urgent measures are required. Harmonization and enforcement traditional fish law and straightening the fishing committee to patrol illegal fishing is vital to improve the biodiversity of fisheries of Hadejia Jama'are Komadugu Yobe basin.*

Keyword: *Frame Survey, Fish Composition, River Basin*

Introduction

The importance of fisheries as a source of food and nutrition cannot be overstated, especially in the face of population growth and increasing demand for animal protein (Adewole and Olaleye, 2014, FAO, 2016 and Azrita *et al*., 2020). Fish constitutes about 30-40% of animal protein component of the diets in the majority of communities in Nigeria.

The Hadejia Jama'are Komadugu-Yobe basin System (HJKY) is a sub-system of Lake Chad and one of the most extensive wetland areas in the Northern part of the Nigeria covering about six northern states which are Plateau, Bauchi, Jigawa, Kano, Yobe and Borno and has gained international recognition because of the regular presence of migrant birds (Ladu et al., 2013).

In Nigeria, several factor such as degradation of land over exploitation, Climate change, increasing demand for fish and inadequate management of the inland water bodies has attributed to decline in fish catch and abundance.

In a studies on fish and fisheries of Hadejia Jama'are Komadugu Yobe river basin, some commercially important species such as *Gymnarchus, Citharinus, Lates, and Hydrocynus etc.* are reported being threatened, due to improper management system, unregulated number of fishermen, unregulated and uncontrolled fishing methods, degradation of fish habitats associated with excessive inputs of nutrients and contamination, damming of river for non-fisheries purpose, degradation of wetland, infestation by the water hyacinth and overfishing (Ladu *et al.,* 2013).

For sustainability of these resources, an adequate knowledge of number of fishers and species composition is vital. The objective of the paper was to provide information on the number of fishing unit, fishers, fishing boats, and number of fishing Gourds and the fish composition and distribution some selected fishing communities' in Hadejia Jama'are Komadugu Yobe (HJKY)

Materials and Methods

Study Area

The Hadejia Jama'are Komadugu Yobe (HJKY) River Basin has a total area of about 84,000 km^2 and is situated in the Northern part of Nigeria. It traverses six States namely Bauchi, Borno, Jigawa, Kano, Plateau and Yobe. The main rivers of the basin are the Hadejia and the Jama'are, which meet in the Hadejia-Nguru Wetlands from where they continue as the Yobe Basin. Fisheries and aquaculture activities account for 50% of the livelihood and is being carried out throughout the year (Birdlife international, 2015).

The Hadejia Jama'are Komadugu Yobe (HJKY) River Basin has a total area of about 84,000 km^2 and is situated in the Northern part of Nigeria. It traverses six States namely Bauchi, Borno, Jigawa, Kano, Plateau and Yobe. The main rivers of the basin are the Hadejia and the Jama'are, which meet in the Hadejia-Nguru Wetlands from where they continue as the Yobe Basin. Hospitalia Consultaire (2017). The rivers Hadejia and Kano, arising in Kano state, and the Jama'are river's arising in Plateau and Bauchi states, drain into the Yobe, which flows into Lake Chad. The portion of the floodplain where the Hadejia and Jama'are rivers meet is known as the Hadejia- Jama'are wetlands. Most of the flow in the Hadejia River system is controlled by Tiga and Challawa Gorge Dams. The Jama'are River is presently uncontrolled but a controversial plan exists to build a dam on the river at Kafin Zaki (Ladu *et al.*, 2013: Hospitalia Consultaire, 2017).

The Komadugu-Yobe subsystem, which forms the border between Nigeria and Niger over the last 60km, is the only perennial river that flows into the Northern pool of the Lake Chad in North East Nigeria, contribute less than 2.5 percent of the total inflow into the Lake Chad. Solomon (2016).

According to Birdlife International (2015), Ladu *et al*. (2013) and Solomon *et al.* (2014) Hadejia Jama'are Komadugu Yobe basin is a major economic hob for pastoralists, fishing and farming. Blench (2013) reported that nineteen species of fish are the regularly caught in

the wetlands, but according to previous reports some forty-four species where found, this signify a decline the fish diversity. Fishermen and farmers in the HNW represent about 75% of the indigenous community population and the wetlands represent their entire source of livelihoods through farming and fishing activities. Fisheries and aquaculture activities account for 50% of the livelihood and this is carried out throughout the year (Birdlife international, 2015).

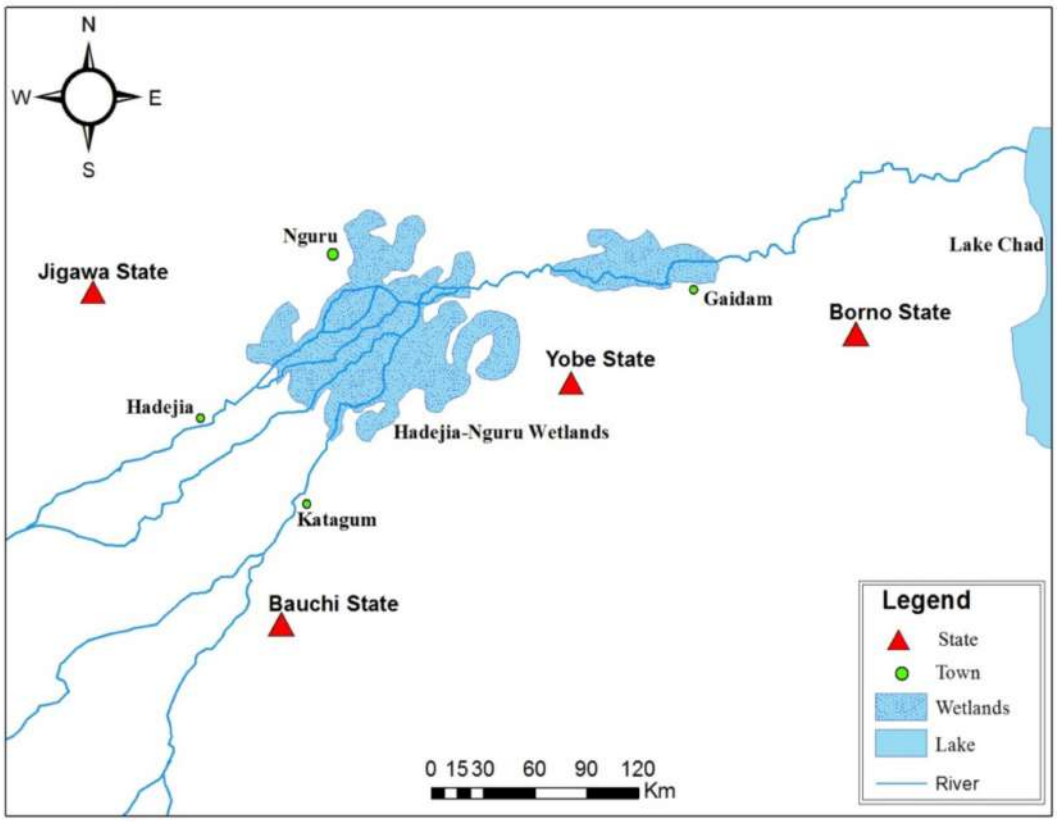


Figure 1. Location of Riparian State and Rivers

Source: Easton and Sarch (1993)

Sampling Technique

The study utilized a multi-stage sampling procedure. In the first stage, Purposive sampling of 32 fishing communities within the riparian river was Selected followed by random sampling of thirty (19) fishing villages. The criteria used in selection were based on the fact that all the fishing communities were within the Hadejia jama'are Komadugu Yobe river basin. Hence, a total of 19 fishing villages

Methods of Data Collections

A frame survey of fishing communities was carried out. A complete census technique of frame survey was carried out from August to December 2019. During the survey, all landing sites and the facilities available, fishers, fishing crafts and fishing gears by type along the entire length of the rivers (HJKY) basin were identified and counted. The number of fishermen and their assistance, fishing crafts (Canoes and Gourds), fishing gears were also counted, questions were asked verbally read in English and when necessary, translated into the major local language of the fishermen.

Catch assessment survey was conducted in each of the randomly selected fishing communities. During the catch assessment survey, fish catches at landing sites were assessed. The fish caught in each net were removed and transferred into container (bowls) and sorts out according to species and weighed using top loading weighing balance to determine the fish weight, while measuring board was used to take the standard length of the fish. The catches in terms of number were estimated. Fish were identified using identification keys provided Olaosebikan and Raji (2004) and Reed (1976).

Results

Distribution of Fishing unit, Fishermen and Fishing Crafts and their assistance

A total of sixty – two (62) number of landing sites or fishing units, three thousand three hundred and twenty (3320) fisherfolk, one thousand three hundred and sixty-five (1365) of fishing boats, twenty (20) non-fishing boats. One thousand four hundred and fourteen 1414 gourds with total of two thousand three hundred and fifty-three (2353) fish assistance were identified in 32 fishing communities within the studies area (Table1). Hadejia River basin constituted the highest number of fishing unit, fishers, fishing boats, and number of fishing Gourds, followed by Komadugu Yobe River basin, while Jama'are river recorded the least numbers of landing sites, fisher, fishing boats and gourds respectively.

The gear types found in this present study were gill nets, cast nets, hook and line, Traps Clap nets and. beach seine-net and other (Figure 1). Fishing traps of different designed and size (Mali traps, Sankiya Ndurutu) were the most important gear type used by the fisherfolk with the 51%. The second most popular fishing gear used among the fisherfolk was gill net (*kalli*) which pooled 22.5%. Hooks and line (*Kujiya*) of various size ranged from number 1-14 were also commonly used in all the fishing communities with18%. While, cast net (*Birigi*), beach seine nets and clap nets recorded (2.8, 2.5 and 1.7 %) respectively. Other fishing gear used but, occasionally by the fisherfolk in the study area were (rod and line, scoop net, spears, cutlasses, lift nets) 1.5%

A total of four thousand, three hundred and twelve (4312) fish belonging to fifteen (15) families, twenty-five genera and thirty-four (34) species were observed in the course of this study as shown in Table 2. These families include Bagridae, Characidae, Centropomidae, Clariidae, Cichlidae and Schilibedae among others. The family Clariidae and Mormyridae are the families with higher number of species (5 species) and followed by the family Cichlidae with four (4) species. The family Centropomidae, Distichodontidae, Citharinidae, Lepidosirendae, Polypteridae, Osteoglossidae and Malapteruridae were the family with least species of one (1) each in the Hadejia Jamare Komadugu Yobe river basin. The result showed

that *O. niloticus* and B. nurse are the most abundant species with a total number of seven hundred and twenty-eight (728) and seven hundred and twenty-four (724) individuals which accounted for 16.88% and 16.79% respectively of the total species observed in Hadejia jamare Komadugu Yobe river basin. The abundance of *C gariepinus* and *L. coubie* were also fairly high with a total number of two hundred and ninety-three (293) and two hundred and fifty-six (256) which accounted for 6.79% and 5.94% respectively. The abundance of *C. citharus, D. rostratus* and *C. nigrodigitatus* were found to be very low during the study with a total number of nine (9), thirteen (13) and twenty (20) and abundance percentage of 0.21%, 0.30% and 0.46% respectively. Other species with abundance percentage that is below 1 are *P. pellucid* (0.49), *A. occidentalis* (0.63%), *L. niloticus* (0.65%), *M. electricus* (0.65%), *H. longifilis* (0.67%), *S. galilaeus* (0.67%) and *H. bidorsalis* (0.81%)

Table1 Distribution of Fishing Unit, Fishers and Fishing Crafts in Hadejia Jama'are Komadugu Yobe River Basin

Parameters	Hadejia	Jama'are	Komadugu Yobe	Total
Number of fishing units	37(59.7)	10 (16.1)	15 (24.2)	62
Numbers of fisherfolk	1801 (54.2)	697 (21)	822 (24.7)	3320
Number of fishing boats	910 (66.7)	129 (9.4)	326 (23.9)	1365
Number of non-fishing boats	16 (80)	0 (00)	4 (20)	20
Number of gourds / calabash	730 (51.6)	293 (20.7)	391 (27.6)	1414
Number of assistance	1492 (63.4)	305 (13)	556 (236)	2353

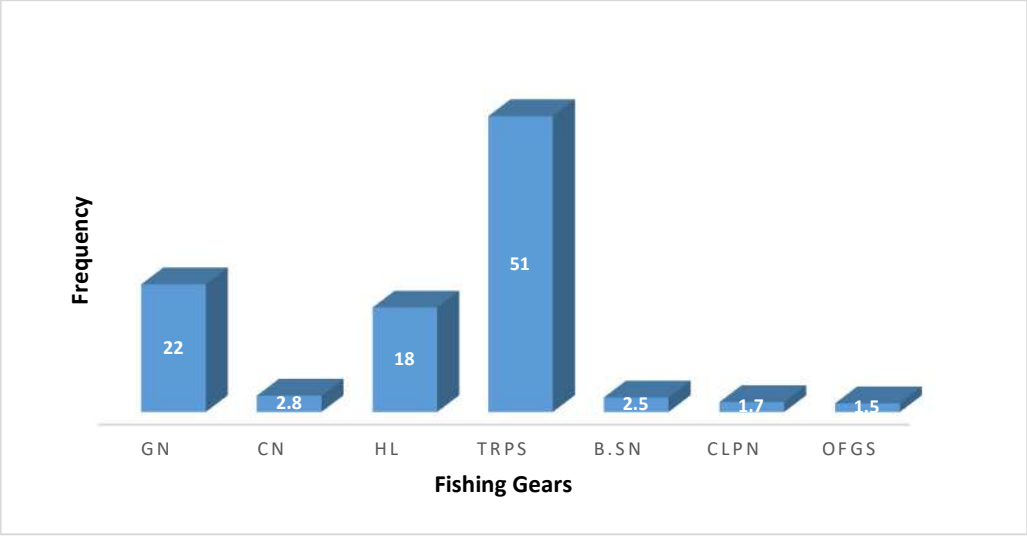


Figure:1 Fishing Gears Distribution in Hadejia Jama'are Komadugu River Basin

Keys:

GN=Gillnet,

CN=Cast-net,

H=Hook and line,

CLPN=Clap net

B.SN=Beach Seine net

OFGS= (Hand line, Scoop-net, Spear and cutlass lift nets).

Table 6: Total Fish Species Composition and Abundance in Hadejia Jama'are Komadugu Yobe River basin

FAMILIES	Genus	*SPECCIES*	Total Abundance	% abundance
Characidae	Brycinus	*Brycinus nurse*	724	16.79
	Hydrocynus	*Hydrocynus forskali*	108	2.50
Bagridae	Auchenoglanis	*Auchenoglanis occidntalis*	27	0.63
	Bagrus	*Bagrus bayad*	121	2.81
		Bagrus filamentous	134	3.11
		Chrysichthys nigrodigitatus	20	0.46
Centropmidae	Lates	*Lates niloticus*	28	0.65
Claridae	Clarias	*Clarias anguillaris*	156	3.62
		Clarias gariepinus	293	6.79
		Clarias macromystax	45	1.04
	Heterobranchus	*Heterobranchus longifils*	29	0.67
		Heterobranchus bidorsalis	35	0.81
Cichlidae	Hemichromous	*Hemichromisbinaculatus*	95	2.20
	Oreochromis	*Orechromis niloticus*	728	16.88
	Tilapia	*Tilapia zilli*	137	3.18
	Sarotherodon	*Sarothedon*	29	0.67
Cyprinidae	Labeo	*Labeo coubie*	256	5.94
	Barbus	*Barbus macrops*	174	4.04

Distichodontidae	Distichodus	*Distichodus*	13	0.30
Citharinidae	Citharinus	*Citharinus citharus*	9	0.21
Lepidosirendae	Protopterus	*Protopterus niloticus*	97	2.25
Polypteridae	Polypterus	*Polypterus*	68	1.58
Osteoglossidae	Heterotis	*Heterotis niloticus*	64	1.48
Malalapteridae	Malapterurus	*Malalapterus electricus*	28	0.65
Mormyridae	Gnathonemus	*Gnathonemus seneglensis*	106	2.46
	Hyperopisus	*Hyperopisus bebe*	52	1.21
	Mormyrop	*Mormyrop delicious*	95	2.20
	Mormyrus	*Mormyrus rume*	54	1.25
	Petrocephalus	*Petrcephalus*	52	1.21
Mochokidae	Synodontis	*Synodontis filamentous*	114	2.64
		Synodontis nigrita	119	2.76
		Synodontis clarias	120	2.78
Schilibedae	Schlibe	*Schlibe mystus*	161	3.73
		Parailia pellucid	21	0.49
Total			**4312**	**100**

DISCUSSION

Number of fishing unit, active Fishermen and Fishing Crafts and their assistance.

During the period of this study, a total of 62 landing sites were identified in HJKY basin, about 1374 fishing boat were counted out of which 9 are non-fishing boats. In addition, about 1414 gourds were also recorded. Three thousand three hundred and twenty (3320) and 1365 fishers employing various fishing gear/method in the study area gave an average of 4 fishers per boat (Table 1). The average of 4 fishers per boat observed in this study is higher than 2 and 3 fishers per boat reported by (Ita *et al.,*1984; Sikoki and Hart, 1999). The increased in number of fishing crafts within the basin could have been because of an increased in number of internally displaced person (fishermen) as results of insurgency in Lake Chad shore. The finding is similar to findings of Van der Knapp *et al*, (2014) who reported that, an influx of displaced peoples and refugees returned to the basin seeking their ancestral fishing grounds has increased the number of fisher in Lake Tanganyika.

The most popular fishing craft in the present study is the un motorized wood plank canoe with flat bottom designed which was built locally by the fisherfolk within the fishing communities. The flat bottom canoe is easy to paddle in shallow river and wetland and can last for more than three years if there is proper maintenance as confined by this study. Taabu *et al.,* (2012) also reported that, flat bottomed type called *Congo barque*, constituted 97% of the 6,216 fishing crafts operating on Lake Albert. This finding is contrary to NIFFR (2002) who reported the use of some V-bottom shaped crafts is more popular to fishermen.

Non fishing boats were also reported in negligible numbers in the present study, probably because of high cost of motorized boats and the shallow nature of the river and wetlands. This result substantiates the finding of Damilare (2014) who reported that, fishers in Kainji Lake lower basin are mainly not motorized probably, because of their low cost compare to the motorized ones. (NIFFR 2002; Ago and Tafida, (2005) also identified the problem of not using motorized craft as a result of high price of outboard engines. Kabiru *et al.,* (2017) also confirms high number of un motorized craft in Gurara dam in Kaduna state.

Another important fishing craft observed in this study is gourds. This craft is common among low earned fishermen. It is used as floats for subsistence fishing by fisher folk. Ago and Tafida, 2005; Bawa, *et al.,* (2018) also identified dug-out type and gourd/calabash craft at the lower basin of Kainji lake. The price of Gourd varies in size.

The study finds it difficult to obtained previous data on number of fishing units, number of boats and their assistance for comparison with the current finding. This finding confirmed the report of De Graff (2014) who reported chronic problems of insufficient human and financial resources allocated for data collection have often resulted in poor-quality information that has further led to non-use or limited use of statistics for fisheries management and policy development. Generally, the fishermen in the study area used (simple fishing gears and equipment, and they catch in small quantity, which is just enough for their subsistence purpose and small scale commercial purpose which is the characteristic of artisanal fisheries Tafida *et al*., (2011) confirmed that, the fishermen of Kainji Lake in New Bussa in Nigeria also belong to the group of artisanal fishermen.

Fishing Gears and fishing Crafts

The gear types found in the present study are gill nets, cast nets, hook and line (Long line), Traps, Clap nets and other gears such as rod and line, scoop nets, spears and lift net are also identified in negligible number. Those fishing gears fell under FAO (2010) checklist of 11 fishing gears. These gears are the commonest gear in Lake Alau (Bankole *et al*., 2003) and Lake Chad basin (Bene and Neiland, 2003). National institute of freshwater fisheries research (NIFFR), (2002) also acknowledged these fishing gears in Nigeria.

Assorted traps of different design, shape and size constituted the important fishing gear among the fishers in HJKY basin. The different fish traps observed during the period of this study include; ‘‘Sankiya, Ndurutu, Mali and Chakko. They are set in the flood plains, canals or river shores with or without bait.

The dominance of Mali traps in the study area may be attributed to the availability of construction materials, cost effectiveness and catching efficiency, especially when hundreds of Mali traps (Dumbas) were set across channels, rivers draining the floodplain areas, it catches variety of fish species. Another reason for use of Malian fishing trap according to

respondents, the gear can also be operated from shallow to large depth, marshy or open river and can be used for fishing on rough bottom distinctively from cast nets. This finding is in line with (De Graff, 2014) in base-line report of catch assessment survey of Lake Chad basin, he revealed that, Mali traps are gears used to catch a large variety of fish species in all the fishing seasons, due to their small mesh size they collect large numbers juveniles.in comparison to other fishing gear.

Gill net and hooks of various sizes are also important fishing gears found in this study. Gill net and Hook and line can be traced back to the mid-70s, as it has been earlier reported by Seisay, (1998). Gill nets are widely used in artisanal fisheries in developing countries because they are efficient, relatively inexpensive and capable of catching higher amount of economically valuable fish than other artisanal gears (Valdez-Pizzini, 1992). The prominent gillnet found in this study are monofilament gill net of small size range from ¾ to 2½ inch mesh size. However, gill net mesh sizes of (¾ to 2.5 cm) found in the present study fell short of the FAO, (2010) gill net mesh sizes of 3.17 cm - 7.62 cm. This might have contributed to the small size and immature ones caught thereby leading to growth over fishing in the area.

Another fishing net used in open water is seine-net and introduced by fishermen from Mali for catching clupeids along the Upper Niger. This gear is also common during the period of the study. This net, popularly called "Dala" net, is made of mosquito netting material with 3 mm mesh. It has a head rope of 100 – 150 metres with a depth of about 5 metres. The head rope is fitted with floats made of haffia bamboo poles at about 15 cm intervals. This gear is the common source of conflict among fishermen in the study area.

In addition to the major pre-dominant fishing gears such as traps, gillnets hook and cast nets, there are other occasional fishing gears and methods used by the fishers' folk. These includes; Clap nets, spears, Scoop nets, lift nets etc. Clap nets is occasionally used during receding and festival days (drying) periods in depressions (fadama) or residual pools in riverbeds.

In comparison, it has been noted that there is variation in type of gear uses and seasonality between the selected fishing communities in the study areas. For instance, Mali traps and fence are commonly used in Hadejia, Nguru-Gashua wetland than jama'are basin probably because of marshy nature of wetlands and open water of jama'are river. In other hand cast net is widely used in jama'are basin than Hadejia and Bade fishing communities of Komadugu. Another reason for low use of Cast nets in Komadugu Yobe may be attributed to the official ban of the use of castanets.

Similarly, beach seine nets are also predominately used in jama'are basin than Nguru –Gashua and Hadejia wet land, the predominant use of beach seine nets in jama'are might be due to open river system, suitable landing sites and Scanty of aquatic vegetation in comparison with marshy nature of landing sites for beach seine nets.

Due to seasonal variation, active gears such as cast net were used more commonly during the receding flood and during the low water (period rising). Cast nets, long lines (baited) and gillnets are used in permanent water bodies by professional fishermen in the study are.

In the present study, it was observed majority of the fishermen used multi gear, i.e., one fisherman could own one or more fishing gears such as, one cast net, one set of hook and line as well as some traps and any of them can be use anytime the fisher wants. According to reported by ago *et al*. (2011), different gears are used for targeting fish because of habitat

changes. According to Bankole (2003), fishers used different kind of fishing gear because of seasonal variations in species availability. 1 – 3 inches for gillnets.

Fish Species Composition and abundance

Species composition and diversity is a useful parameter for the comparison of communities under the influence of biotic disturbances or to know the state of succession and stability in the community (Olawusi-Peters and Ajibare, (2014). The thirty-four (34) species diversity encountered in Hadejia Jamare Komadugu river basin is an indication of good species diversity which is higher than the 27 families reported from Asejire dam by Ipinmoroti (2013); 25 from Oramiri-Ukwa river by Adaka (2014); 12 from Gbedikere Lake, Bassa, Kogi state by Adeyemi *et al*. (2010) and 18 from Geriyo lake by Adedeji *et al*., (2017).

However, Zira *et al* (2015) reported 47 species from Kiri dam while Mohammed *et al.* (2013) encountered 63 species from Halda river of Bangladesh. The fifteen (15) families encountered in this present study can be said to be fair when compared to family composition of water bodies of similar status. Adaka *et al*, (2014) reported twenty-one families from Oramiri-Ukwa River, southeast Nigeria. Mohammed also reported twenty-one families from Halda River of Bangladesh.

Changes in species composition and diversity has been discussed and reported to be influenced by biotic and a biotic factor, types of the ecosystem, age of the water body, depth and volume of the water, water level fluctuations (Sukhla and Singh, 2013), gradual and abrupt changes in physical parameters, river zonation and river continuum with increased human activities. The differences in the observed fish composition and diversity in this study compared to others in the same or different ecozones may be attributed to the extended period of investigation (Teugels *et al.*, 1992) as this study covers a period of twenty-four months. The number of efforts or researchers in the collection or sampling of species has also been reported to influence species distribution and composition (Teugels *et al.*, 1992) as only two (2) fishers per station were employed during this present study.

The fish species abundance in the present study was relatively lower to the earlier reports of (Tabor 1973; Matthes ,1990) who reported 46 fish species before construction of Tiga dam for the lower Yobe River and 40 species fish excluding about 30 unidentified species.

low species recorded may also be attributed to overfishing and alterations in the environmental condition e.g. the construction of dams (Challawa Gorge, Tiga, Hadejia and proposed Zaki dam) across river, invasion of aquatic weeds basin. Welcome, (2009) reported that construction of dams interferes with migratory pathway of species of fish that need to move within the channel to breeding ground or dry season refugia (an area in which a population of organisms can survive a period of unfavorable conditions).

Lemly *et al*., (2000) who reported that fishermen in Hadejia Jama'are basin have reported that catches are reducing significantly due to invasion of aquatic weeds (*Typhadomingensis)* which prevent fishermen from having access to other parts of the wetlands.

The dominance of *Oreochromis niloticus* (Cichlidae) may also be linked to their high reproductive capacity (Solomon *et al*., 2016). The prolific breeding of tilapia enables them to easily populate water bodies especially at locations of least abundance of predators (Ikpi and Okey 2010) This finding is also similar to findings of Solomon *et al.*, (2017) in kalgwai lake in Jigawa state; Stephen Dada (2015) in Dogon Kamuku national park, Birinin Gwari, Kaduna state.

Conclusion and Recommendations

The fish biodiversity in HJKY River basin has seriously decline and urgent measures are required. Issue to improve the sustainability of fish biodiversity such as harmonization and enforcement traditional fish law, development of community based fisheries management plan, establishment of protected area, straightening the fishing committee to patrol illegal fishing is vital to improve the sustainability of fisheries in Hadejia Jama'are Komadugu Yobe basin.

-REFERENCE

Adaka, G. S., Udoh, J. P., and Onyeukwu, D. C (2014) Freshwater Fish Diversity of a Tropical Rainforest River in Southeast Nigeria. *Advances in Life Science and Technology* 1 23.

Adeyemi, S. O., Akombu, P. M. and Adikwu, I. A. (2010) Diversity and Abundance of Fish Species. In Gbedikere Lake, Bassa, Kogi State. *Journal of Research in Forestry, Wildlife and Environment. Volume 2 No.1*

Ago, N. D. and Tafida, A.A. (2005) Marketing of fishing gear materials and fishing gear making in parts of Kainji Lake basin. In: 19th Annual Conference of the Fisheries Society of Nigeria (FISON), 29 Nov - 03 Dec 2004, Ilorin, Nigeria, pp. 73-77

Bankole, N.O., Raji I.A., Adikwu O.A, Okwundu E.C., (2003). Fishing gear survey of Lake Alau, In: A.A. Eyo and E.A. Ajao (Eds), Proceedings of the 16th Annual Conference of the Fisheries Society of Nigeria (FISON). Maiduguri, 4th-9th November, 2001, pp. 99- 103

Bawa, D.Y., Nurul Amin, S.M., A Arshad, F. Md. Yusoff, I. K. and Argungu, L.A. (2019). Socio economic characteristics of artisanal fishermen in inland waters of Kebbi state, North- West Nigeria. *International Journal of Fisheries and Aquatic Studies;* 7(4): 416- 421.

Damilare, Ibukun Ogundiwin (2014) Survey of Artisanal Fishing Gear and Craft A case study of Kainji Lake lower basin Nigeria. Master Thesis in International Fisheries Management

DE Graaf G.J and Garibaldi, L (2014) The value of African fisheries. *FAO Fisheries and Aquaculture Circular* 1093 76.

Eaton, D., and Sarch, T. M. (1997).*0T 0T*The economic importance of wild resources in the Hadejia- Nguru wetlands: Collaborative Research in the Economics of environment and Development (CREED)-London (International Institute for Environment and Development)*0T* (No. 13). *Working Paper*. Pp 10-19

Ipinmoroti, M. O. (2013). Ichthyofauna diversity of Lake Asejire: Ecological implications. *International Journal of Biodiversity and Conservation.*Vol..5 (10) pp 248-252 http://www.academicjournals.org

Ita, E.O. and E.K. Sado, (1984). Inventory survey of Nigerian inland waters and their fishery resources with special reference to ponds, lakes, reservoirs and major rivers: surface area survey and potential yield estimates. *Kainji Lake Research Institute 1983 Annual Report*, p.99–109.

Kabiru, H., Ibrahim, A., Yezeed, S., and Abiodun, J.A. (2017). Frame survey and catch assessment of the fisheries of Gurara Dam, Kaduna State, Nigeria. *International Journal of Fisheries and Aquatic Studies*. 5 (5): 292-2954

Lemly, A. D., Kingsford, R. T., and Thompson, J. R (2000). Irrigated agriculture and wildlife conservation: conflict on a global scale. *Environmental management*,25:5, 485-512.

Matthes, H. (1990). Report on the Fisheries Related Aspects of the Hadejia-Nguru Wetlands Conservation Project, Nguru, Nigeria. *Report to the Hadejia-Nguru Wetlands Conservation Project*, P. 42

Olawusi-Peters O.O and Ajibare A.O. (2014) Species richness, diversity and abundance of some Decapod Crustaceans in coastal waters of Ondo State, South West, Nigeria. *International Journal of Fauna and Biological Studies* 1 (5): 44-51

Tabor, J.G. (1973) A survey of the fisheries of the lower Yobe in North Western of Lake Chad basin. Annual report of Federal Department of Fisheries. Lagos

Taabu-Munyaho A., A. Bakunda, D., Mbabazi, J. I., Nyeko, H., Nakiyende, E., Rukunya, S., Bassa, E., Muhumuza, M., Nsega, R., Amiina, and Balirwa (2012). Report of the frame survey of lake albert conducted in May 2012.

Tafida, A. A. Adebayo, A. A. Galtima, M. Raji, A. Jimme, M. John, C. T. (2011). Livelihood Strategies and Rural Income: The case of Fishing Communities in Kainji Lake Basin Nigeria. *Agricultural Journal 6* (5): pp 259 – 263.

Teugels, G.G., Reid, G. Mc. R. and King, R. P. (1992). Fishes of the Cross River Basin (Cameroun - Nigeria), Taxonomy, zoogeography, ecology and conservation, *Annale Science Zoologique* 266:132

Seisay MDB, du Feu TA. (1997). The effect of long term exploitation, by gill net fishery on the multi-species fish stocks in Kanji Lake. Nigeria: Nigerian-Germany Kainji Lake Fisheries Promotion Project Technical Report. Series No.: 11- 58.

Solomon, S.G., Okomoda, V.T., and Aladi, S.L. (2012). Fish Fauna in Lower River Niger at Idah in Kogi State. *Journal of Agriculture and Veterinary Sciences.* Vol.4

Solomon, I. Ovie, and Belal. (2016). Impacts of and adaptations to climate change in the fisheries communities of the lake chad basin, Africa global conference on climate change adaptation for fisheries and aquaculture:*"* Bangkok, Thailand, august 8-10, 2016.

Solomon, S.G., Ayuba, V.O., Tahir, M.A., Okomoda V.T. (2017). Abundance Composition of Fish. In Lake Kalgwai Jigawa State, Nigeria. *Jordan Journal of Agricultural Sciences,* 13, No.1

Neiland, A. E. (2002). Fisheries of North East Nigeria and the Lake Chad. *A Compilation of Research Project Reports.* Volume l1993-1998 Ports mouths: IDDRA

National institute for freshwater fisheries Research (2002). National surveys of fishing gears and crafts on Nigerian inland water bodies. *NIFFR occasional paper* No.4.ix, pp 4.

Van der Knaap, Katonda, K. I and De Graaf, G. J (2014). Lake Tanganyika fisheries frame survey analysis: Assessment of the options for management of the fisheries of Lake Tanganyika. J*ournal of Aquatic Ecosystem Health and Management* 5: 4–13

Valdez-Pizzini, M. Acosta, A. Griffith, D.C. and Ruiz-peres, M. (1992). Assessment of the socio-economic impact of the fishery management options upon gill nets and trammel nets fishermen in Puerto Rico: An interdisciplinary approach (Anthropology and Fisheries biology) for the evaluation of management alternatives. *Final report* NOAA/NMFS, pp 96

Zira, J.D., Danba, E.P., Aliyu, B.A., Enoch, B.B. (2017). Fish Species Diversity and Abundance of Kiri Reservoir, Shelleng Local Government Area, Adamawa State, Nigeria. *International Journal of Research in Agriculture and Forestry* 4(10)2:24-30

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 106-113 (December, 2021)
www.arcnjournals.org

Use and Abuse of Herbicide for Management of Masakwa Sorghum Weed in Vertisol of the Shores of Lake Chad

[1*]Wali, A.S., [2]Kolomi, A.U., [3]Badiya A.U., [4]Buba, A. & [5]Sugun K.M.
[1,3,4]Department of Farming System Research, Lake Chad Research Institute, P.M.B 1293, Maiduguri, Nigeria
[5]Department of Cereal Research, Lake Chad Research Institute, P.M.B 1293, Maiduguri, Nigeria
[2]Department of Agricultural Education, Umar Ibn Ibrahim El-Kanemi College of Education Science and Technology, P.M.B 16, Bama, Borno State
*corresponding author: email: sherifwali@yahoo.co.uk
Tel;+2348066313147

Abstract: *Masakwa is a transplanted sorghum grown mostly in the vertisols of the shores of Lake Chad under residual moisture. Initial clearing of weed is among the most difficult activities. Introduction of herbicide has tremendously reduced the drudgery aspect and increased area for cultivation and output. This study was conducted to assess the knowledge, use and abuse of herbicides among Masakwa farmers in Mafa Local Govermnet of Borno State, Nigeria. Data was collected in 2021 using structured questionnaire administered to 120 masakwa farmers on socio-economic characteristics, knowledge of handling and usage of herbicides and safety measures applied. Data collected were analysed using simple statistical tool of means and percentage. The result shows majority (70.8%) of masakwa farmers are male, married (76.7%) with more than 50% older than 40 years of age. The educational level is dominated (45%) by Quranic education with only 15% completing secondary school. Household size of 6-10 members is the prevailing (40.8%) and solely (43.3%) rely on masakwa production as source of livelihood. Most (93.3 %) of the respondents use herbicide and most of them (81.7%) are educated on use of herbicides by marketers and retailers as the presence of ADP is zero. Application of herbicide is either by self (16.7%) or family members (38.3%). Introduction of herbicide and guide on usage is mostly (71.7 %) done by marketers/retailers. Farmers violets guide as (93.3%) do not wear protective and 82.5 % apply above recommended rates. They are of the opinion that higher rates give good results without minding the cost and heath consequence. However, majority (78%) consider wind direction when spraying. After spray, most (93.3%) farmers wash their bodies only and do not take bath (96.7%) nor change their cloths (84.2%) but display sign (71.7%) as warning after spay. Farmers are ignorant on proper disposal of herbicide as more than half the population either convert it as food (23.3%) or drinking (36.7%) containers. There is therefore the need to massively educate farmers through deployment of extension agents for effective weed control and wellbeing of the farmers and environmental safety.*

Keyword: *herbicide, safety, masakwa sorghum, Lake Chad Basin*

Introduction

In the inundation area - the basin of the former larger Lake Chad - a special type of sorghum is grown on the clay soils (*firgi*). This dry-season *guinea corn* is also called dwarf sorghum or *masakwa (*Zach *et al.* 1996). *Masakwa* sorghum is dry season sorghum cultivars which are cold, drought tolerant and photoperiod sensitive are commonly grown on heavy clay soils or Vertisols during harmattan period using residual soil moisture stored from the previous seasons' rainfall (Dugje and Odo, 2011; Dugje *et al.* 2014; Jada *et al*. 2017). There are about four million hectares of Vertisols or 'Firgi' heavy clay soils that occur mainly between latitudes 8°30' and 12°30'N and longitudes 10° and 14°E in Nigeria (Klinkenberg and

Higgins, 1968). The post rainy season sorghum is grown on an estimated area of 102,564 km^2 mainly in the Lake Chad Basin of Borno State, North-Eastern Nigeria (Dugje *et al*. 2014). The cool dry season offers opportunity for growing the *Masakwa* cultivars at a time when it is practically impossible to grow other grain crops without irrigation. The crop contributes immensely to the local economy of the major producing areas that include Dikwa, Bama, Ngala, Gwoza, Mafa, Kala Balge, Monguno and Marte Local Government Areas in Borno State, Nigeria (Dugje *et al.,* 2014; Gworgwor, 2001). *Masakwa* provides supplementary supply of grains and forage during the dry season for both human and livestock consumption.

Weed control in Masakwa sorghum is critical during field preparation as the crop is transplanted to receded flood plains and thrives exclusively on the residual moisture. Farmers expend more time and energy to clear weeds before transplanting Masakwa sorghum. Weeds also compete with sorghum plants and can reduce the sorghum yield (Tibugari *et al*., 2020). Yield loss due to weeds depends on the duration of weed infestation, the nature and intensity of weeds, the crop cultivars, and environmental conditions (Barber *et al*., 2015; Knezevic *et al*. 2002). The introduction of herbicide in masakwa production allows farmers to manage larger area with less effort and time. However, behaviours of farmers are diverse and needs to be investigated as reports indicate improper handling practices among users. Farmers interested in masakwa sorghum, should have access to scientific information in order to learn how to optimize chemical weed control management and improve the efficacy for safety and economy. The return of Internally Displaced Persons (IDPs) from Maiduguri to Mafa (Anon., 2018) and encouragement by the State Government to farm is encouraging and needs academic backing. The objectives of this study were to assess the socioeconomic status of the farmers and to determine the knowledge of use and handling of herbicide for the management weed among Masakwa sorghum farmers in the Shores of Lake Chad Basin of Nigeria.

Methodology

The study was conducted in 2021 in Mafa Local Government, Borno State, in Shores of Lake Chad. One hundred and twenty structured questionnaires were distributed at random to Masakwa sorghum producers with the assistance of trained interpreters. Data was collected on the socio-economic characteristics of the respondents, handling and usage of herbicides and safety measures used. Data collected were analysed using simple statistical tool of means and percentage.

Results and Discussion

The socio-economic characteristics of masakwa farmers in Mafa Local Government, Borno State, in Shores of Lake Chad is presented in Table 1. The result shows that 70.8% of the respondents were male while 29.2% were female. This shows that the business is male dominant and could be attributed to the culture of the people as the state is Muslim dominated State. The domination of crop production by male in northern Nigeria has been reported by (Sennuga *et al*. 2020a; Okeke-Agulu and Onogwu, 2014). It also shows that 10.9% of the respondents were of age 20-30 years, 23.3% were between 31-40 years, 34.28% were between of 41-50 years, 22.5% were between the ages of 51-60 while only 9.2% have 61 and above. The result indicates that the business is handled by people of older age of between 41-50 years (34.2%). Most youths of 40 years and below are seeking for white collar jobs, this collaborates with the studies of Dahiru (2012). Marital status indicated that (76.7%) of the

respondents were married, 4.2% were single, 8.3% were divorced and 10.83% were widow/er. This shows that majority of the business is done by married men as they are responsible and have to cater for the family. The educational level is dominated (45%) by Quranic education followed by primary, secondary and tertiary education with 22.5, 15 and 8.3, respectively. 9.2% of the respondent did not attend any kind of education. This suggests that the respondents in the study area obtained the basic education required for accepting new technologies. Sennuga *et al*. (2020b) reported that highly educated farmers tend to adopt relevant agricultural technologies better than illiterate ones. The household size shows that 6.7% of the respondents have less than 5 members, 40.8% have 6-10 members, 25% have 11-15, 15.8% have 16-20 while 11.7% have more than 21 household size. This is good as large family size influences adoption of technology to cater for the family as observed by (Okeke-Agulu and Onogwu, 2014; Sennuga *et al*., 2020a). Majority (46.7%) of masakwa farmers operate in less than 1 ha, 24.2% use 1.1-2 ha and only 7.5% have above 4.1 ha. Farmers in sub-Saharan Africa are mostly subsistent and operate on small farm size which are easily managed (Ncheuveu *et al.,* 2021). Majority Most of respondents (43.3%) do nothing apart from masakwa production, (`19.2%) engage in trading as other source of income, 16.7% are civil servants while 7.5 and 13.3 do fishing and livestock, respectively. Nearly half the population feed and sales part of their produce to cater for their other needs.

Table 1: Socio-economic characteristic of Masakwa farmers in Mafa Local Government, Borno State, in Shores of Lake Chad

	Number of respondents (N=120)	Percentage (%)
Sex		
Male	85	70.8
Female	35	29.2
Age		
20-30	13	10.9
31-40	28	23.3
41-50	43	34.2
51-60	27	22.5
61 and above	11	9.2
Marital status		
Single	5	4.2
Married	92	76.7
Divorced	10	8.3
Widow	13	10.8
Education level		
Quranic	54	45
Primary	27	22.5
Secondary	18	15
Tertiary	10	8.3
Others	11	9.2
Household size		
1-5	8	6.7

6-10	49	40.8
11-15	30	25
16-20	19	15.8
21 and above	14	11.7
Farm size		
Less than 1 ha	56	46.7
1.1-2 ha	29	24.2
2.1-3 ha	16	13.3
3.1-4 ha	10	8.3
Above 4.1 ha	9	7.5
Other source of income		
Trading	52	43.3
Civil service	23	19.2
Fishing	9	7.5
Livestock	16	13.3
Nothing	20	16.7

Source: Field survey, 2021

Table 2 shows knowledge and use of herbicide by masakwa farmers in Mafa Local Government, Borno State in Shores of Lake Chad. The result revealed that 93.3 % of the respondents use herbicide and most of them (81.7%) are educated on use of herbicides by marketers and retailers as the presence of ADP is zero. Application of herbicide in masakwa farming is gaining acceptance (Mbaya, 2010). Farmer to extension agent ratio is too wide in Nigeria (Okeke-Agulu and Onogwu, 2014) as such most innovative information reach farmers through other means. The population apply herbicide by themselves (16.7%) or family members (38.3%) while others engage labour (26.7%) or assisted by friends (18.3). The farming system is subsistence hence source of labour is always by self, family or friend and this is very common in northern Nigeria as reported by (Yusuf, 2018; Sennuga *et al*., 2020a). Masakwa farmers are guided (71.7 %) by marketers/retailers (49.5%) and not by ADP personel. However, most of them violets such guide as (93.3%) do not wear protective and 82.5 % apply above recommended rates. They are of the opinion that higher rates give good results without minding the cost and heath consequence. Nevertheless, majority (78%) consider wind direction when spraying to avoid much inhalation of the chemical as nearly half (43.3%) of the population have experienced or seen someone affected by the chemical. Farmers wash, drink milk or lime orange when side effects such as vomiting or dizziness are observed as they rarely go to hospital.

Table 2: knowledge and use of herbicide by Masakwa farmers in Mafa Local Government, Borno State, in Shores of Lake Chad

	Number of respondents (N=120)	Percentage (%)
Use herbicide		
Yes	93.3	112
No	6.7	8
Source of knowledge		

Friends/neighbours	19	15.8
ADP	0	0
Marketers/retailers	98	81.7
Others	3	2.5
Who sprays herbicide		
Myself	20	16.7
Family	46	38.3
Hire	32	26.7
Friends	22	18.3
Any guide on use of herbicide		
Yes	86	71.7
No	34	28.3
If yes, by who		
Friends/neighbours	20	16.7
ADP	0	0
Marketers/retailers	59	49.2
Others	7	5.8
Do you use protective		
Yes	6.7	8
No	93.3	112
At what rate do you apply		
Recommended dose	5	4.2
Below recommended dose	0	0
Above recommended dose	99	82.5
Based on experience	16	13.3
Do you consider wind direction		
Yes	94	78.3
No	26	21.7
Any experience of side effect		
Yes	68	56.7
No	52	43.3

Source: Field survey, 2021

Masakwa farmer's safety knowledge and practices after spray of herbicide in Mafa Local Government, Borno State, in Shores of Lake Chad is presented in Table 3. Most (93.3%) of masakwa farmers wash their bodies after spray but majority neither immediately take bath (96.7%) nor change their cloths (84.2%). They are of the opinion that toxicity of herbicide is insignificant on body and only effective on weeds. The smell is mild and does not kill insects or animal as such is not lethal to human. This is erroneous notion and farmers need to be educated on hazardous effects of herbicide and appropriate handling (Sule *et al*., 2020). 60.8% of the respondents do not clean sprayer nozzle after spray. They however clean sprayers when next application is not herbicide to avoid killing destruction by residual herbicide in the sprayer. Farmers usually (71.7%) display signs as warning after spay. This is to avoid animals graze on contaminated grasses. Farmers are ignorant on proper disposal of herbicide as more than half the population either convert it as food (23.3%) or drinking (36.7%) containers. Some (9.2%) store seed which they found to be effective or throw/burry

(6.7%) while others (24.2) sell, use for ablution or keep other liquids. The poor disposal practices observed in the current study was common in most developing countries (Ncheuveu *et al.,* 2021). These poor disposal practices can potentially pose environmental risks in the Chad Basin floodplain because herbicides may leak from the containers to pollute ground and surface waters and this necessitates proper enlightenment for the safety of the farmers.

Table 3: knowledge safety of herbicide after spray by Masakwa farmers in Mafa Local Government, Borno State, in Shores of Lake Chad

	Number of respondents (N=120)	Percentage (%)
Do you wash body after spray		
Yes	112	93.3
No	8	6.7
Do you change clothes after spray		
Yes	19	15.8
No	101	84.2
Do you take bath immediately after spray		
Yes	4	3.3
No	116	96.7
Do you clean sprayer nozzle after spray		
Yes	47	39.2
No	73	60.8
Do you display red flag as warning after spray		
Yes	86	71.7
No	34	28.3
What do you do with empty can after spray		
Drink container	44	36.7
Food container	28	23.3
Store seed	11	9.2
Throw/burry	8	6.7
Others	29	24.2

Source: Field survey, 2021

Conclusion

Use of herbicide in Masakwa sorghum producers is one of the technologies that has greatly reduce human drudgery and allow for cultivation of larger areas for more production. From the study, it could be concluded that farmers have accepted use of herbicide but do not adhere to recommended practices and safety protocols as most of the introduction and instructions is by marketers/retailers and not scientifically trained extension agents. There is therefore the need to deploy extension agents to fill the gap for wellbeing of the farmers and environment.

Reference

Anon. (2018). Local government area resettlement profiling mafa town, mafa lga borno state, Nigeria, April 2018, ocha, reach. www.https://reliefweb.int>report>nigeria.

Barber, T., Scott, B., & Norsworthy, J. (2015). Weed control in grain sorghum. In Arkansas grain sorghum production handbook (pp. 1–14). Division of Agriculture, Research and Extension, University of Arkansas.

Dahiru H. (2012). The Role of Literacy Education on the Adoption of Agricultural Innovations Among Rice (Oryza-sativa) Small-Holder Farmers in Yola South Local Government Area of Adamawa State, Nigeria *Journal of Agricultural Sciences and Policy Research* Volume 2, Number 2, 2012

Dugje, I.Y. and Odo, P.E. (2011). Response of *Masakwa* sorghum [Sorgum bicolor (L.,) Mooench] cultivars to row spacing on semi-arid vertisols in parts of north eastern Nigeria. *Journal of Arid Agriculture*, 20, 35-46.

Dugje, I.Y., Odo, P.E. & Grema, A.K. (2014). A survey of ethno-agronomic practices and constraints to *Masakwa* sorghum production in parts of north east Nigeria. *Nigerian Journal of Crop Science*, 2(1), 76-86.

Fai, P.B.A., Nkwatoh, T.N., Tchamba, M.N. & F. Ngealekeloeh (2019). Ecological risk assessment of agricultural pesticides in the highly productive Ndop flood plain in Cameroon using the PRIMET model. *Environ Sci Pollut Res*. 2019;26(24): 24885-24899.

Gworgwor, N.A. (2001). *Masakwa* production in northeastern Nigeria: A survey. *Noma*, 15, 8-19.

Jada, M. Y; Aji, M. B.,Maryam, A. Y. & Goni, S. M. (2017). Response of Masakwa Cultivars of Sorghum (Sorghum Bicolor) To Root Knot Nematode (*Meloidogyne javanica*) in the Nursery *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) Volume 10, Issue 8 Ver. I (August 2017), PP 66-70 e-ISSN: 2319-2380, p-ISSN: 2319-2372.*

Klinkenberg, K. and Higgins, G.M. (1968). An outline of northern Nigerian soils. *Nigerian Journal of Science,* 2, 91-111.

Knezevic, Stevan Z.; Evans, Sean P.; Blankenship, Erin E.; Van Acker, Rene C. & Lindquist, John L., (2002). "Critical period for weed control: the concept and data analysis" (2002). Agronomy and Horticulture Faculty Publications. 407. https://digitalcommons.unl.edu/agronomyfacpub/407

Mbaya, E. (2010). Survey of farmer practices for *masakwa* sorghum production in Bama Local Government Area, Borno State. Unpublished Final Year Project Report

Ncheuveu, N. T., P. B. A. Fai, M. Ngankam Tchamba & F. Ngealekeloeh (2021). Pesticide Use Practices and Effects on the Wetland Biodiversity of Ndop, North West Region of Cameroon *International Journal of Environment and Climate Change 11(5): 105-116, 2021; Article no.IJECC.70859 ISSN: 2581-8627.*

Okeke-Agulu, K.I. and G.O. Onogwu (2014). Determinants of farmers' adoption decision for improved pearl millet variety in Sahel Savanna zone of Northern Nigeria *Journal of Development and Agricultural Economics* Vol. 6(10), pp 437-442

Sennuga, S.O., Baines, R.N., Conway, J.S & Angba, C.W. (2020a). Awareness and Adoption of Good Agricultural Practices among Smallholder Farmers in relation to the Adopted Villages programme: The Case Study of Northern Nigeria, *Journal of Biology, Agriculture and Healthcare*, 10(6), 34-49.

Sennuga, Samson Olayemi1, Oyewole, Samuel Olusola & E. E. Merianchris (2020b). Farmers' Perceptions of Agricultural Extension Agents' Performance in Sub-Saharan

African Communities *International Journal of Environmental & Agriculture Research* (IJOEAR) ISSN:[2454-1850] [Vol-6, Issue-5, pp 1-12

Sule, H., Z.A. Haruna, M. Halliru, B.S. Wudil, N.B. Sanda & G. Abdullahi (2020). Research Article Pesticide Utilization and Associated Health Hazards in Kano Metropolis *Singapore Journal of Scientific Research* 10 (1):52-58ISSN 2010-006x DOI: 10.3923/sjsres.2020.52.58

Tibugari, H., C. Chiduza & A. B. Mashingaidze (2020). A survey of problem weeds of sorghum and their management in two sorghum-producing districts of Zimbabwe, *Cogent Social Sciences*, 6:1, 1738840, DOI: 10.1080/23311886.2020.1738840

Yusuf, Isah Maikudi (2018). Analysis of Family Labour Utilization in the Production of Selected Crops in Dry-Lands: Evidence from Kahutu, Katsina State, Nigeria *Agrosearch (2018) 18 (2): 15 – 27* https://dx.doi.org/10.4314/agrosh.v18i2.2

Zach,B., H. Kirscht, D. Löhr, K. Neumann & E. Platte (1996). Masakwa Dry Season Cropping in The Chad Basin *Berichte des Sonderforschungsbereichs 268, Band 8, Frankfurt a.M. 1996: 349-356*

International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 4
Pages 114-120 (December, 2021)
www.arcnjournals.org

Entrepreneurship in Agriculture: A Review of the Needs and Challenges for Development in Nigeria

[1*]Kolomi, A.U., [2]Wali, A.S. & [3]Mohammed, Y.
[1,3]Department of Agricultural Education, Umar Ibn Ibrahim El-Kanemi College of Education Science and Technology, P.M.B 16, Bama, Borno State
[2]Department of Farming System Research, Lake Chad Research Institute, P.M.B 1293, Maiduguri, Nigeria
[*]Corresponding author: email: alkolmi@gmail.com, Tel: +2348022862422

Abstract: *Agriculture is a primary production venture as such entrepreneur is key factor in the system. Agriculture especially in the sub-Saharan Africa (SSA), is regarded as the engine of economic growth and employment generation. Entrepreneurship in most developing countries of the world is considered key to economic growth and development because of its linkages to other sectors of the economy and provides employment to greater percentage of the populace. This paper highlights the concept of Entrepreneurship and need for entrepreneurship in Agriculture vis-à-vis the various subsectors of agriculture: Crop production, fishing, livestock and forestry, where the crop production contributed the largest segment and it accounting for about 87.6% of the sector's total output. This followed by livestock, fishing and forestry at 8.1%, 3.2% and 1.1% respectively. The low percentage contribution of livestock, fishing and forestry to Nigeria economy was stressed and called for full attention by the government to facilitate entrepreneurship. The basic areas that needed entrepreneurship development were enumerated in the study. Furthermore, challenges for Development of entrepreneurship, suggestions to overcome the problems and expected Outcome upon adherence to the recommendations were outlined. These will certainly cushion challenges faced by Nigeria for several years especially amongst the rural populace who make the bulk of the nation's population.*

Keyword: *Entrepreneurship, Agriculture, employment*

Introduction

Agriculture in most developing countries of the world is considered key to economic growth and development because of its linkages to other sectors of the economy and provides employment to greater percentage of the populace Oluwatoyese *et al*. (2015). In sub-Saharan Africa (SSA), agriculture is regarded as the engine of economic growth and a foremost way out from poverty; it provides employment to 65% of the region's population and 75% of its domestic trade (FAO, 2016).

Nigeria is the largest country in SSA in terms of size and rate of population growth. Its agricultural sector is the largest employer of labour and income-generating activity, World Bank (2020). With an estimated population of 212 million people, Agriculture accounts for 26.21% of the country's GDP and employs over 36% of the country's population, NBS (2020). According to FAO (2015), Nigeria is endowed with over 82 million square kilometres of land which are cultivable, of these, less than 10% are under permanent cultivation. There is enormous potential for the country to diversify its agricultural production activities and be self-sufficient in major staple crops, but the country fails to

judiciously utilize its agricultural sector to meet the demand of its growing population, enhance exportation and aid growth (Ajekwe and Ibiamke, 2020).

A study on poverty by IFPRI in 2014 as reported by Olomola *et al*. (2014) indicated that there is elevated level of poverty amongst households whose source of income and livelihood is agriculture. Most of these households live in the rural areas, yet the fact still remains that young people both in rural and urban areas do not show much interest in farming Babu et al. (2020). Hence, Nigeria's agricultural activities are often done by the elderly (50+) with limited or no formal education, Ajekwe and Ibiamke (2020). This, therefore, raises the need for the country to develop its agricultural sector by promoting Entrepreneurship in Agriculture for the development of the rural area, reduce poverty, increase income and bridge the lag between food production and population growth. Entrepreneurship in Agriculture have a huge scope and very rich potential for achieving rural economic development, however, according to Verma *et al*. (2018), problems like lack of awareness among the people, lack of entrepreneurial culture, poor infrastructural development, lack of adequate institutional support and government policy makes it not an easy path to walk. Despite these constraints, Verma *et al*. (2018), further added that there are so many avenues open for entrepreneurship development in agriculture. The major opportunities are in agricultural inputs, farming processes and technology, agriculture output processing and other agriculture allied sectors like dairy development, poultry, horticulture, and so on. Sustainable value addition is happening through activities like diversification, value addition, organic farming, high–tech agriculture, precision farming, marketing, etc. Agriculture Entrepreneurship's huge potential is not only in increasing living standards of the rural people, reduce poverty, increase income and bridge the lag between food production and population growth, but also in strengthening the national economy by making it globally competitive.

Entrepreneurship in Agriculture

Entrepreneurship is a key factor for the survival and development of small-scale farming in Nigerian. Small-scale farmers usually operate in a complex and dynamic environment which include suppliers, traders, transporters, processors and many others. Each of these, according to Kahan (2012), has a role to play in producing products and moving them through to the market – through the value chain. Entrepreneurship in Agriculture is the entrepreneurial process taken up in agriculture or the allied sectors. It includes the process of adopting, new methods, processes, techniques in agriculture for better output and economic earnings. By adopting new innovative ideas in agriculture, FAO (2012) stated that an agricultural entrepreneur becomes an innovator who drives the changes in rural economy; by taking risks and creating new ways of doing things and taps new markets opportunities. Dollinger (2003) defines entrepreneurship in agriculture as "the creation of innovative economic organization for the purpose of growth or gain under conditions of risk and uncertainty in agriculture". Verma *et al*. (2018) defined entrepreneurship in agriculture as a "generally sustainable, community oriented, directly marketed agriculture. Sustainable agriculture denotes a holistic, systems oriented approach to farming that focuses on the interrelationships of social, economic and environmental process". In this regard therefore, Kahan (2012) suggested that "successful farmer-entrepreneurs are those that are technically competent, innovative and plan ahead so they can steer their farm business through the stages of enterprise development – from establishment and survival to rapid growth and maturity".

Entrepreneurship in Agriculture: Why Needed:

Agriculture remains the largest sector in Nigeria contributing an average of 24% to the nation's GDP over the last 8 years (2013 - 2020), PwC (2021). In addition, the sector employs more than 36% of the country's labour force, a feat which ranks the sector as the largest employer of labour in the country NBS (2021). Although in terms of contribution to GDP Nigeria's agriculture is broadly divided into four sectors – Crop production, fishing, livestock and forestry, Crop production remains the largest segment and it accounts for about 87.6% of the sector's total output. This followed by livestock, fishing and forestry at 8.1%, 3.2% and 1.1% respectively, (FAO 2021). The low percentage contribution of livestock, fishing and forestry to Nigeria economy is an indication that these sectors have not yet been given full attention by the government.

Agriculture play an important role in the Nigerian economic is confirmed by the certainties that it contributed 26.21% of the country's GDP in 2021. For instance, according to NBS (2021), the annual growth rate for the agricultural sector stood at 16.73% in 2020, which is slightly higher than in 2019. The sector in the fourth quarter of 2020 grew by 3.42% (year – on - year) in real terms, an increase by 1.11% points from the corresponding period of 2019, and an increase of 2.03% points from the preceding quarter which recorded a growth rate of 1.39%. It grew on a quarter on quarter basis at – 3.93%. Real annual growth rate in 2020 was 2.17%. This performance is very meagre if we consider the size of the employment in this sector. In 2020 – 2021, the GDP contribution of the agricultural sector has been improved to26.21%. However, with two-third of Nigeria's rural populations depend on agriculture for their livelihood and income generation contributing only 26.21% to GDP; indicates the needs and potential for development of this area. By the analysis above and with reference to the 82 million square kilometres of land which are cultivable, favourable climatic conditions; well distributed rainfall and abundant natural resources such as fertile land, water resources (rivers), forests etc. it can be stated that the current performance of Nigeria's agricultural sector is not up to the mark. Hence there is clear need for the development of entrepreneurship in agriculture. Entrepreneurship in Agriculture is needed to develop because:

1. Agricultural and Horticultural products are locally available
2. Entrepreneurship in Agriculture development has huge potential of creating new employment opportunities for rural youth.
3. Entrepreneurship in Agriculture helps in checking migration of rural youth from villages to urban centres and helps in improving living condition of farmers by providing alternative source of income.

Challenges for Development of Entrepreneurship in Agriculture

Despite the huge potential for the development of entrepreneurship in agriculture in Nigeria, there are some important challenges which needs to be taken care of very seriously and timely. They are as follows:

Inadequate infrastructural facilities: Infrastructure is a pre-requisite for any kind of development. In Nigeria, the infrastructural facilities are very poor particularly with respect to facilities such as transportation, communication, power and marketing networks.

Lack of entrepreneurial culture among people: Often a culture of entrepreneurship is needed for farmers to achieve their entrepreneurial vision. In Nigeria, in many areas very poor entrepreneurial culture has been identified. Lack of education and awareness is causing a gap in the development of entrepreneurial culture among rural people.

Migration of skilled and talented workforce from rural to urban areas: People from rural area are migrating to urban area because of very poor infrastructure and facilities in rural areas. This migration is creating a gap in the rural talent. The lack of employment, skills, specialization and platforms for people to use their talent causes the migration. Even skilled, educated and trained in specific areas are seeking jobs with different areas (i.e.) NGOs in urban areas.

Poor technologies and equipment: lack of Information technology and knowledge on farm equipment and farm enterprise will have an adverse impact on the development of entrepreneurship in agriculture. This happens due to poor technological facilities and equipment creating challenge for information support for its development which is very critical for the smooth growth of the sector.

Problems in marketing of agricultural products: production has no value chain unless it is sold and consumed. Lack of proper transportation, warehousing facilities, lack of facility to promote the agricultural products, lack of market information, destabilized prices for agricultural products, uneven demand, influence of local mediators and many more are creating a lot of trouble for farmers in the process of marketing their products.

Inadequate institutional measure and Government Policies; Although there are a number of government policies, the implementation is felt not appropriate because of problems like corruption and bureaucracy. Because of illiteracy and ignorance, the rural people are unable to get the information of the policies of the government and get the benefit. The support from the government in agricultural sector is not much felt by farmers in the rural area.

Suggestions for Promoting Entrepreneurship in Agriculture in Nigeria

There is an urgent need for promoting entrepreneurial culture among the people in rural areas and to create a vibrant environment for the rural development.

1. Identifying promising agricultural and allied areas of business to promote entrepreneurial activity.
2. Providing area specific technical training programmes to develop the required technical competency among the potential entrepreneurs
3. Promoting the establishment of forum and platforms where organization concerned with entrepreneurial development in agriculture.
4. Extending support in terms of providing financial and marketing support.
5. Entrepreneurial education and training to the potential rural youth.
6. Improving infrastructural setup in rural areas.
7. Identification of important and specific areas of development across the stages of agriculture value chain of the agricultural process and designing appropriate strategies for the promotion.

Expected Outcome

The outcomes expected from the development of entrepreneurship in agriculture will include the following:

Social and Economic benefits: The standard of living of Agripreneurs will be increased with socio-economic empowerment. They can afford quality and quantity of nutritious food, better education, and medical facilities to their families. They are recognised with social status and prestige. It is a promising sector to build resources and mobilize local resources for community development.

Net Income: The process of value chain and agro processing manifolds the net income into many times than the conventional method of marketing produce.

Sustainability: Agripreneurs continue to learn and embrace sustainable farming methods, business opportunities through the cycle of agribusiness and overcome risks associated with agribusiness. They would always seek for more sustainable development of their enterprises.

Employment Generation: The most pressing advantage of entrepreneurship development in agriculture is huge employment opportunities for rural youth and farmers. Therefore, it helps in enhancing rural income and improving living standard of the rural people.

Reduce rate of migration of rural people to urban centres: Entrepreneurship development in agriculture creates lots of employments in rural areas, thus provide people with quality standard of living. This reduces the rate of migration of rural people particularly rural youth from villages to urban centres consequently reduce the population pressure on urban infrastructure.

Providing urban amenities in rural areas: The agripreneurial ventures will not grow alone but the supporting resources infrastructure will grow which will create urban like setup and facilities in the rural areas. It also helps in reducing unemployment and underemployment thus helps in alleviating poverty.

Conclusion

For many years now, Nigeria has been constantly struggling with the problem of unemployment, especially amongst the rural populace. Unfortunately, the country has failed to address this problem effectively. Considering the fact that two-third of Nigeria's rural populations depend on agriculture for their livelihood and income generation; providing viable and sustainable business opportunities in country's agricultural sector is imperative for generating employment in the country. The opportunities of value addition in farm produce has the potential to not only address the issues of unemployment but also carry forward the development agenda of the country in a more sustainable manner by balancing the growth requirement with the inherent strengths of the country. It will also help the economy to achieve self-sustainability in food production thereby achieving balanced economic growth.

Entrepreneurship development in agriculture is going to give an excellent result in rural development where agribusiness ventures can promote a job-led economic growth in rural areas. Agriculture can therefore be better positioned as a more profitable economic activity by integrating the same with processing, packaging and storage activities. There is therefore the need for government to make suitable policies and frameworks with action plans for

achieving the target of entrepreneurship development by establishment of several support systems to nurture the rural farmers become Agripreneurs.

Reference

Ajekwe, C.M., and Ibiamke, A., (2020). "Entrepreneurship through Agriculture in Nigeria" *Journal of Business and Management Research* Vol. 9(1)

Babu, S., Zhou, Y., Koever, L., & Srivastava, N. (2020). "Youth Entrepreneurship in Agribusiness", Nigeria Country Report. International Food Policy Research Institute (IFPRI).

Dollinger, M.J. (2003). *Entrepreneurship Strategies and Resources,* (3rd Edition), New Jersey: Prentice Hall.

(2016) AQUASTAT FAO's Information System on Water and Agriculture. Rome : FAO [Online] available at: http://www.fao.org/nr/water/aquastat/countries_regions/NGA [Accessed 24 October 2021]

FAO (2015). Nigeria Agriculture at a Glance. Rome. FAO [Online] Available at: https:// www.fao.org/nigeria /fao-in-nigeria/nigeria-at-a-glance/en/ [Accessed 24 October 2021]

FAO. 2021. World Food and Agriculture – Statistical Year Book 2021.Rome. [Online] available at: https://www.fao.org/ documents/card/en/c/cb4477en/ [Accessed 22 October 2021]

FAO (2012). Food Security Indicators. Rome. FAO [Online] available at: http://www.fao.org/ economies/ess/essfs/essfadata/en/#.WeOQ2FuPKU1 [Accessed 18 August 2021]

Kahan, D, (2012). "Entrepreneurship in Farming" Food and Agriculture organization of the United Nations [Online] available at: https://www.fao. org/3/i3231e/ i3231e.pdf [Accessed 17 October 2021]

NBS (2021). National Bureau of Statistics, "Nigerian Gross Domestic Product Report", (Q4, Full Year 2020). [Online] available at: https://www.nigerianstat.gov.ng [Accessed 30 October 2021]

NBS (2020). National Bureau of Statistics, "Labour Force Statistics: Unemployment and Underemployment Report", (Q2, 2020). [Online] available at: https://www.nigerianstat.gov.ng/pdfuploads/Q2_2020_Unemployment_Report.pdf [Accessed 30 October 2021]

Olomola, A., Mogues, T., Olofinbiyi, T., Nwoko, C., Udoh, E., Alabi, R., Onu, J & Woldeyohannes, S. (2014). "Analysis of Agricultural Public Expenditures in Nigeria", Examination at the Federal, State and Local Government Levels. Development Strategy and Governance Division, IFPRI, Washington. USA [Online] available at: http://www.ifpri.org/publication/analysis-agricultural-public-expenditures-nigeria

Oluwatoyese, O.P., Applanaidu, S.D.A. & Razak, N.A.A (2015). "Macroeconomic Factors and Agricultural Sector in Nigeria", *Procedia – Social and Behavioural Sciences,* vol. 219, pp. 562-570

PwC Nigeria, (2020). "Current State of Nigeria Agriculture and Agribusiness Sector", African Continental Free Trade Area (AFCFTA), working paper. [Online] available at: https://www.pwc.com/ng/en/assets/pdf/afcfta-agribusiness-current-state-nigeria-agriculture-sector.pdf [Accessed 30 August 2021]

World Bank (2020). Nigeria: Overview. [Online] available at:https://www.worldbank.org/en/country/nigeria/overview [Accessed 12 October 2021]