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Technical Efficiency and Rural Poverty Among Farmers in Nigeria: A Gender Perspective

By Job Olatunji Oladeebo
University of Swaziland,Southern Africa

Abstract - The purpose of this study was to investigate the effect of technical efficiency on rural poverty between female and male-headed farm families in southwestern part of Nigeria. The study also determined the policy variables that influenced technical efficiency of the poor rural female and male-headed households in the study area using the stochastic frontier methodology. Results of data analysis showed that poor male-headed households were more technically efficient than their poor female-headed households' counterparts (with mean technical efficiency estimates of about 91% and 82% respectively). Policy measures to reduce level of poverty and to improve efficiency which will lead to higher income were then suggested

Keywords : *Technical Efficiency, Rural Poverty, Farmers, Gender, Nigeria.*

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Job Olatunji Oladeebo

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I. Introduction

One of the central issues of development economics that government and policy makers are focusing attention on is how to improve the socio-economic well being of the people and thereby reduce poverty. The concept of poverty including its measurement is contested (Englama and Bamidele 1997). Thus, it has been defined using various indices. Schiller (1980) classified poverty into "absolute" poverty whereby a section of the population cannot meet their minimum standard of living in terms of basic needs like food, clothing and shelter due to lack of economic wherewithal. "Relative" poverty on the other hand is a situation whereby income earned by a person is significantly less than the average income of the population. In Nigeria, poverty has been established by past studies (World Bank 1997; FOS 1999; Etim and Edet 2007) as being more prevalent in rural areas. Rural areas in Nigeria house most of producers of livestock and crops.

Rural poverty refers to a situation in which rural inhabitants, groups, communities and societies at a given point in time experience a level of income below that which is needed to provide a desirable minimum living standard (Rahji 1999). Rural poverty in its most valid generalizations about the poor are that they are disproportionately located in rural areas, that they are primarily engaged in agricultural and associated activities, that they are more likely to be women and children than adult males, and that they are often concentrated among minority ethnic and groups and indigenous peoples (Todaro and Smith 2003).

Gender is the social differences between men and women. These differences vary from place to place and may change over time. Gender is a socio-economic variable used to analyze roles, responsibilities, constraints, opportunities and needs of men and women (Oladosu *et al* 2005). The relationship between gender and poverty has become an important topic in the poverty literature. Earlier literature on poverty focused on female-headed households and the problems they face (Buvinic and Gupta 1977; Appleton 1996). Gender is now being regarded as an essential concept for the analysis and eradication of poverty. While traditional conceptualizations consistently failed to delineate poverty's gender dimensions, resulting in policies and programmes which failed to improve the lives of poor women and their families (Beneria and Bismath 1996), it is now recognized that women are disproportionately represented among poor households and that poverty is being increasingly feminized (Ijaiya 2000).

Rural women have less access to resources necessary to generate stable incomes and are frequently subject to laws that further compromise earning potential. Laws often prohibits women from owning property or signing financial contract without a husband's signature, and women are typically ineligible for institutionally provided resources such as credit and training. The Federal Ministry of Women Affairs (2004) in its report to Commonwealth Plan of Action claimed that Nigerian women account for more than 60 percent of the agricultural labour force, contribute up to 80 percent of the total food production but only have access to 27 percent of the micro credit provided by Community Banks and National Poverty Eradication Programme (NAPEP). Thus, women's continued reduced access to increasingly scarce resources remains a major cause of the feminization of poverty. Women are particularly affected by the fierce competition over scarce resources, in particular land, and the means of livelihood. This has led to an increase in female-headed households struggling to survive, with very little capacity to take advantage of the new economic opportunities. From the above discussion, it is therefore necessary to address the gender dimension in development planning with a view to eradicating poverty.

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In agriculture, the analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or certain level of output at least-cost. Farrel (1957) distinguished three components of efficiency in the economic literature. They are (i) technical efficiency, (ii) allocative efficiency, and (iii) economic efficiency. This study however, focused on technical efficiency. Technical efficiency is defined as the ability to produce maximum output from a given set of inputs, given the available technology (Yao and Liu 1998). This definition indicates that differences in technical efficiency exist between farms.

Agricultural sectors in less developed countries like Nigeria are widely considered to play a vital role in the eradication of poverty. Thus, increased agricultural productivity is one of the pre-requisites of economic progress. This assertion is particularly true of Nigeria where a larger proportion of the population lives in the rural areas and depends mainly on primary production (Oladeebo and Ezekiel 2006). Higher agricultural productivity affects family incomes and nutrition, which in turn supports labour productivity resulting in better health and well-being of the people. Poor workers health may either results in the loss of working days or reduces their working capacity, leading to lower output (Croppenstedt and Muller 2000). Poverty is likely to affect the capacity of the farm households to avail themselves of better health and education facilities; to purchase inputs at the proper time; to acquire other farm assets; to adopt new technologies and resources *et cetera.* The low level of these factors in turn affects agricultural productivity adversely. From these, poverty is not only an effect but also a cause of low agricultural productivity. It is therefore highly imperative for Nigerian government to pay a serious attention to this aspect of the relationship between efficiency of agricultural production and poverty. None of the previous poverty studies in Nigeria explored the link between gender, technical efficiency of agricultural production and rural poverty. This study was therefore conducted to explore empirically the link between gender, efficiency of agricultural production and rural poverty in Nigeria as well as examining policy variables influencing technical efficiency.

II. Methodology

a) The Study Area

The study was conducted in southwestern Nigeria which is one of the six geo-political zones in Nigeria. The six states in southwestern Nigeria are: Ekiti, Lagos, Osun, Ondo, Ogun and Oyo. The summary of the six geo-political zones in Nigeria is shown below.

Table1 : Nigeria's Six Geopolitical Zones

Zone	Names of States within the Zone
South West	Ekiti, Lagos, Osun, Ondo, Ogun, Oyo
South East	Abia, Anambra, Ebonyi, Enugu, Imo
South South	Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo, Rivers
North Central	Benue, FCT, Kogi, Kwara, Nasarawa, Niger, Plateau
North East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe
North West	Kaduna, Katsina, Kano, Kebbi, Sokoto, Jigawa, Zamfara

Source: NBS, 2005

The southwestern part of Nigeria houses the Yorubas, one of the major tribes in Nigeria. Agriculture remains the primary means of livelihood for the inhabitants. Some of the states in the zone are fairly urbanized but majority of the people live in the rural areas of the zone. The provisional results of 2006 population census shows that southwestern part of Nigeria has a population of 21,581,992 people. The study area was purposely chosen because of its poor position as well as its large rural and agrarian nature in Nigeria.

b) Source of Data and Sampling Technique

The study used secondary data which were extracted from the 2004 Nigeria Living Standard Survey (NLSS) data set. The NLSS is a nationwide household survey carried out by the Nigeria National Bureau of Statistics with technical assistance from the World Bank.

Multistage random and purposive sampling procedure was adopted in obtaining data for the study. Firstly, in order to have a large number of sample for the purpose of analysis, five largely agrarian states out of the six states in southwestern Nigeria were purposely selected. Secondly, three Local Government Areas from an agricultural zone of Ekiti, Ogun, Ondo, Osun and Oyo States which are largely agrarian were selected with the use of simple random selection. Lagos state was left out because of its cosmopolitan nature and more importantly there are no respondents from the rural areas from the state in the data set.

The third stage involved simple random selection of five enumeration areas from each of the Local Government Area selected making a total of seventy five enumeration areas. The last and final stage involved purposive selection of twenty four households comprising of twelve-female headed and twelve-male headed households making a total of one thousand and eight hundred households. However, nine hundred and thirty three households were eventually used for the analysis because they contained all the necessary and important variables needed for analysis. From these, four hundred and ninety one poor households were

finally used for the analysis of which the results are presented in this paper.

The NLSS data cover items such as household composition, education, expenditure on food and non-food items, healthcare services, mortality, fertility, household income and sources, assets, agricultural outputs and inputs, credits, employment and other households' welfare parameters.

c) Data Analysis

Having initially determined the local poverty line, the study employed the use of stochastic frontier production function (SFPF) analysis to determine the effect of technical efficiency on agricultural production by gender.

d) Poverty Line

Poverty analysis in a country requires that a poverty line be defined. There is an increasing need to focus on expenditure rather than income as an indicator of poverty status in poverty studies in Nigeria. This is because it is more problematic measuring income than measuring consumption expenditure, especially in rural households whose incomes come largely from self-employment in agriculture (Aigbokhan 2000). Also the use of cash income as the sole measure of household income tends to underestimate the welfare of subsistence households. If subsistence production is positively associated with households with a large proportion of female adults, and if subsistence production is underestimated, these households may well be falsely associated with poverty. So therefore, a common solution uses total expenditure (imputing a value to the consumption of home-produced goods and services as well as those received as wages, gifts, and loans) rather than measured income as the welfare measure, since total expenditure is considered a reasonable approximation of permanent income. In addition, according to Deaton (1997), given that annual income is required for a satisfactory measure of living standards, an income-based measure requires multiple visits or the use of recall data, whereas a consumption expenditure measure can rely on expenditure over the previous weeks. Based on the foregoing, data were collected on household agricultural incomes as well as expenditures. However, in this study, per capita expenditure was used as the indicator of poverty and the unit of analysis was the household. Household was classified as poor or non-poor based on gender in relation to their level of total expenditure on food and non-food items. In doing this, two lines were set relative to the standard of living in Nigeria: (i) a moderate poverty line for those spending less than two-third of the mean per capita expenditure and; (ii) a core poverty line for those spending less than one-third of the mean per capital expenditure.

Households were then classified based on gender into one of the three groups of core (extreme) poor, moderately poor and non-poor as determined by these poverty lines.

e) Poverty lines estimate

In order to get the moderate and core poverty lines, the 2/3 and 1/3 of the mean per capita expenditure were used.

Per capita expenditure is defined as total household expenditure over number of people in the household. Now, to get the mean per capita household expenditure (MPCHEE), we have.

$$MPCHHE = \frac{Total\ \ per\ capita\ \text{exp}enditure}{Total\ number\ of\ \ households\ in\ the\ sample} \quad (1)$$

Where total per capita expenditure is the total sum that is, aggregate of all the total expenditure incurred divided by the total number of the individuals in the household.

$$\text{Therefore,} \qquad MPCHHE = ₦\frac{4201128.9}{933} = ₦4503$$

(i) For moderately poor households, $^2/_3$ of ₦4503 = ₦3002 per household per year

(ii) For core poor households $^1/_3$ of ₦4503 = N1501 per households per year.

The core poverty line is not necessary for the purpose of this study. Based on the moderate poverty line, rural households are classified poor if their consumption expenditure is less than ₦3002 relative to other households and non poor relative to other households if their consumption expenditure is higher than or equal to ₦3002. This figure is far below the national average of ₦23,733 obtained by National Bureau of Statistics for Nigeria in the year 2005. (Note that as at 2009, 1$= ₦148).

f) Stochastic Frontier Production Function

The stochastic frontier production function independently proposed by Aigner *et al* (1977) and Meeusen and Van Den Broeck (1977) assumes that maximum output may not be obtained from a given input or a set of inputs because of the inefficiency effects. It can be written as:

$$Yi = f(Xi;\beta) + \varepsilon \quad (2)$$

Where:

Yi is the quantity of agricultural output produced by the ith farming household

Xi is the vector of input quantities for ith farming household;

β is a vector of parameters to be estimated; and

εi is an error term defined as:

$$\varepsilon i = Vi - Ui, \quad i = 1,2, \ldots n \text{ farms} \quad (3)$$

Vi is a symmetric component that accounts for pure random factors on production, which are outside the farmers control such as weather, disease, topography, distribution of supplies, combined effects of unobserved inputs on production and so on and Ui is a one-sided component, which captures the effect of inefficiency and hence measures the shortfall in output Yi from its maximum value given by the stochastic frontier $f(Xi;\beta) + Vi$.

The model is expressed as:

$$Yi = \exp(Xi\beta + Vi\text{-}Ui) \quad (4)$$

The stochastic frontier production model has the advantage of allowing simultaneous estimation of individual technical efficiency of the respondent farmers as well as determinants of technical efficiency (Battese and Coelli 1995).

g) Models Specification

For the purpose of this research, production technology of the farmers was assumed to be specified by the Cobb-Douglas frontier production function proposed by Battese and Coelli (1995) and used by Yao and Liu (1998) as well as Oladeebo (2006) and this was applied in the analysis of data to capture the efficiency of rural farmers in the study area.

The model of the Cobb-Douglas frontier production function for the estimation of the technical efficiency is specified as:

$$LnYi = \beta_0 + \beta_1 lnX_1 i + \beta_2 lnX_2 i + \beta_3 lnX_3 i + \beta_4 lnX_4 i + \beta_5 lnX_5 i + \beta_6 lnX_6 i + \beta_7 lnX_7 i + Vi - Ui \quad (5)$$

Where subscript i refers to the observation on the ith farmer and,

Y is the value of output of crops (in naira),

X_1 is farm size (hectares),

X_2 is family labour used (man-hours),

X_3 is hired labour used (man-hours),

X_4 is quantity of fertilizer used (kilogram),

X_5 is quantity of crop inputs (kilogramme),

X_6 amount spent on agrochemicals (Naira),

X_7 amount spent on implements (Naira),

βi's are the parameters to be estimated,

ln's are the natural logarithms

Ln's and Ui are as previously defined

It should be noted that in this study, the fourth to seventh variables specified above were aggregated together and their monetary values were used, hence hereto referred as materials.

h) The Inefficiency Model (Policy Variables)

For the purpose of this research, it is assumed that the technical inefficiency measured by the mode of the truncated distribution (i.e. Ui) is a function of socio-economic factors (Yao and Liu 1998). Thus, the technical efficiency in equation (5) was simultaneously estimated with the determinants of technical efficiency defined by:

$$Ui = \delta_0 + \delta_1 Z_1 i + \delta_2 Z_2 i + \delta_3 Z_3 i + \delta_4 Z_4 i + \delta_5 Z_5 i \quad (6)$$

Where:

Ui is the technical inefficiency of the ith farmer,

Z_1 is the age of farmer (years),

Z_2 is years of formal education,

Z_3 is number of contacts with extension agent,

Z_4 is years of farming experience,

Z_5 is the amount of credit available to the farming household,

δ's are unknown parameters to be estimated along with the variance parameters σ^2 and γ

The parameters of the models of equations (5) and (6) were obtained by the Maximum Likelihood Estimation (MLE) method using the computer programme, FRONTIER version 4.1 (Coelli 1996). However, in the data analysis, the third variable, that is, number of contact with extension agent in equation (6) was dropped because there was no data recorded for it in the data set.

III. Results and Discussion

a) Production Frontier and Technical Efficiency Estimates among Poor Female and Male-Headed Households

The estimates of the Model 1 (OLS) and the Model 2 (Maximum Likelihood Parameter Estimates) for

poor male-headed households and poor female-headed households are presented in tables 2 and 3 respectively.

The coefficients of the variables are very important in discussing the results of data analysis. For poor male-headed households, model 2 shows that farm size had the highest coefficient of 0.6665 as shown in table 2. Table 2 shows that farm size, hired labour and expenditures on materials carried positive signs for poor male-headed households, while family labour carried negative sign. The variables with positive coefficient imply that any increase in such variables would lead to increase in farm income, while an increase in the value of the variable with negative coefficient would lead to a decrease in farm income. Also, negative coefficient on a variable might indicate an excessive utilization of such a variable. Table 2 shows that only the coefficient of expenditure on material was significant at 5 percent level of significance for poor male-headed households.

For poor female-headed households, model 2 shows that hired labour had the highest coefficient of 2.37 (Table 3). However, farm size and family labour had negative coefficients while hired labour and expenditure on materials had positive coefficients (Table 3). Table 3 further revealed that only the coefficients of hired labour was significant at 5 percent level for poor female-headed households. The estimated sigma squared for all the groups of households were large and significantly different from zero. This is an indication of a good fit of the model and the correctness of the specified distributional assumptions. The results obtained here are consistence with the findings of Seyoum *et al* (1998), Obwona (2006), Ogundele and Okoruwa (2006) and Oladeebo (2006).

b) Determinants of Inefficiency (Impact of Policy Variables on Technical Efficiency)

The estimated coefficients in the inefficiency model of model 2 are presented in tables 2and 3. It should be noted that the analysis of the inefficiency model shows that the signs and significance of the estimated coefficients in the inefficiency model had important policy implications on the technical efficiency (TE) of the farmers. Thus, a negative coefficient means increase inefficiency and a positive effect on productivity. The coefficients for age for poor male-headed households (Table 2), experience and educational level for poor female-headed households (Table 3) have the expected signs that are in line with literature. The significant coefficient for credit indicates that access to enough and timely credit is an important factor in enhancing agricultural productivity. These results are in agreement with the findings of Ajibefun and Aderinola (2004).

Table 2 : Maximum Likelihood Estimates of the Production Frontier with Inefficiency Model for Poor Male-Headed Households

Variables	Model 1 (OLS)		Model 2 (MLE)	
	Coefficient	t-ratio	Coefficient	t-ratio
Production function				
Constant (β_0)	4509.1	8.498	5342.7	1176.0**
Farm size (β_1)	0.028	0.0113	0.6665	0.290
Family Labour ((β_2)	-0.516	-0.147	-1.904	-0.717
Hired labour (β_3)	0.596	0.688	0.5124	0.644
Material (β_4)	0.774	3.604*	0.7351	4.091*
Inefficiency Model				
Constant	0	0	20.63	0.191
Experience (δ_1)	0	0	69.87	1.262
Credit (δ_2)	0	0	0.0467	0.808
Age (δ_3)	0	0	-32.25	-0.795
Education (δ_4)	0	0	59.29	1.082
Variance Parameters				
Sigma squared	0.218E+08		0.2209E+08	0.2209E+108*
Gamma	0		0.0032	0.354
Log-likelihood	-2465.0		-2464.8	

Note: * means significant at 5 percent level
** means significant at 1 percent level
Source: Data analysis

Table 3 : Maximum Likelihood Estimates of the Production Frontier with Inefficiency Model for Poor Female-Headed Households

Variables	Model (OLS)		Model 2 (MLE)	
	Coefficient	t-ratio	Coefficient	t-ratio
Production function				
Constant (β_0)	4752.9	8.883	5765.6	5547.8**
Farm Size (β_1)	-1.541	-0.592	-1.273	-0.4862
Family Labour ((β_2)	-0.844	-0.327	-0.8458	-0.3416
Hired labour (β_3)	2.164	1.673	2.370	2.149*
Material (β_4)	0.106	0.630	0.1048	0.8915
Inefficiency Model				
Constant	0	0	1.080	0.2693
Experience (δ_1)	0	0	-4.946	-0.4708
Credit (δ_2)	0	0	0.1801	3.189**
Age (δ_3)	0	0	19.46	1.70
Education (δ_4)	0	0	-4.047	-1.233
Variance Parameters				
Sigma squared	0.318E+08		0.322E+08	0.3225E+08*
Gamma	0		0.0004	0.1612
Log-likelihood	-2421.4		-2419.8	

*Note: * means significant at 5 percent level*
***means significant at 1 percent level*
Source: Data analysis

c) Technical Efficiency Analysis of Poverty Levels among Female and Male-Headed Households

The results of technical efficiency analysis of poor male-headed households and their female-headed households' counterparts are presented in tables 4 and 5. Table 4 presents the predicted technical efficiency for poor male-headed households' farm families. It is shown in table 4 that for poor male- headed households, their predicted technical efficiency indices ranges from a minimum of 58.9 percent to a maximum of 99.5 percent with a mean of 90.9 percent and a standard deviation of 8.7. Majority (66.8 percent) of the poor male-headed households had their predicted technical efficiency estimates within the decile range of equal to or greater than 90.0. From table 4, it is deduced that an average poor male-headed household farm families, in the short run, had a scope for increasing farm income by 9.1 percent by adopting the technology and techniques used by the best (most efficient) poor-male farming household.

Similarly, the results of technical efficiency analysis of poor female-headed households are presented in table 5. Table 5 shows that for poor female-headed households, their predicted technical efficiency indices ranged from a minimum of 14.2 percent to a maximum of 99.7 percent with a mean of 82.2 percent. Thus, an average poor female headed household can increase their farm income by about 18.2 percent. Thus, it is evident from tables 4 and 5 that both the poor male and female- headed households were not fully technically efficient in agricultural production, with poor male-headed households being more technically efficient than their poor female headed household counterparts. Thus, policy focus should target both male and female-headed rural poor households.

Table 4 : Decile Range of Frequency Distribution of Technical Efficiencies of Poor Male-Headed Households

Decile Range	Poor	
	Technical Efficiency	
	Frequency	%
$\geq$ 90	167	66.8
80 – 89.9	47	18.8
70 – 79.9	27	10.8
60 – 69.9	8	3.2
50 – 50.9	1	0.4

40 – 49.9	0	0.0
30 – 39.9	0	0.0
20 – 29.9	0	0.0
10 – 19.9	0	0.0
< 10	0	0.0
Total	250	100.0
Mean %	90.9	
Minimum %	58.9	
Maximum %	99.5	
Standard Deviation	8.7	

Source: Data analysis

Table 5 : Decile Range of Frequency Distribution of Technical Efficiencies of Poor Female Headed Households

Decile Range	Poor	
	Technical Efficiency	
	Frequency	%
≥ 90	40	16.6
80 – 89.9	130	53.9
70 – 79.9	51	21.2
60 – 69.9	10	4.2
50 – 50.9	6	2.5
40 – 49.9	2	0.8
30 – 39.9	1	0.4
20 – 29.9	0	0.0
10 – 19.9	1	0.4
< 10	0	0.0
Total	241	100.0
Mean %	82.2	
Minimum %	14.2	
Maximum %	99.7	
Standard Deviation	10.2	

Source: Data analysis

IV. Conclusion

This study was undertaken to investigate the effect of technical efficiency on poverty level of female and male-headed farm families in southwestern part of Nigeria. The policy variables that influenced technical efficiency across poverty levels of female and male-headed farm families in southwestern Nigeria were also determined. The results of the analysis showed that both poor male and female household heads were not fully technically efficient in the use of production resources.

In order to reduce poverty level, it is therefore suggested that agricultural production should be encouraged among the rural people by improving technologies for agricultural production with the attendant provision of institutional and timely credit for rural poor farmers. Literacy level should also be improved for easy adoption of improved technologies which may reduce poverty level. Young, educated and agile males and females should also be encouraged to go into agricultural production. This can be done by the provision of socio infrastructural facilities such as potable water, health facilities, electricity and good roads.

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Constraints to the Implementation of Climate Change Adaptation Measures by Farmers in Delta State, Nigeria

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Abstract - This study examined constraints to the implementation of climate change adaptation measures by farmers in Delta North Agricultural Zone of Delta State, Nigeria. Crop farmers in three purposively selected extension blocks served as respondents of the study. A sample of 321 respondents was used for the study. A list of farmers in contact with extension served as sampling frame. Data for the study were collected from the respondents of the study through the use of a detailed, carefully designed and validated interview schedule. Trained field assistants selected in each location in addition to the researchers collected the data for the study. Data generated by the study were analyzed using descriptive statistics. Results show that there were more male crop farmers in the area of study. Also, majority (92%) of the respondents had formal education and many years of farming experience. The study found that respondents were using some adaptation measures which include: the use of crop rotation, use of sandbags at river banks, use of bamboo stakes, planting of cover crops and the construction of drainages. Constraints to the implementation of adaptation measures that were identified by the study include: limited availability of land for farming, lack of access to weather forecast information, poor access to information sources, limited income, high cost of irrigation facilities, traditional beliefs and practices, high cost of improved and resistant varieties and government irresponsiveness to climate risk management. Recommendations of the study include first, the establishment of climate information management system that will manage issues relating to awareness creation, information on weather forecast, early warning signs and training of farmers on how to cope with climate change. Secondly, the establishment of a sustainable credit scheme which will enhance farmers' capacity to implement appropriate adaptation measures and thirdly, the creation of a separate unit by the extension service agency to handle climate change issues relating to building farmers' resilience.

I. Introduction

Climate is the average weather condition of an area over a given period of time usually 30years. There are some worries that over the years, the pattern of these weather conditions such as rainfall, temperature and others have not been stable. This instability in climate variables is what gave rise to the concept of climate change.

Climate change was defined by Miller and Edwards (2010) as change in earth's atmospheric process and other parts of the earth such as oceans. Mavi (2004) identified the basic causes of climate change to be associated with human activities such as deforestation and gas flaring related activities which result to accumulation of the greenhouse gases in the atmosphere. The European Union report on climate change (2008) showed that global warming followed the pattern predicted by earlier scholars. The report stated that the earth's temperature has undergone an annual increase of 0.6^{0c} in the past 10years as a result of the accumulation of the greenhouse gases.

Greenhouse gases are gases that cause increase in the earth's temperature by trapping heat from the sun and concentrating it on the lower vapour atmosphere. Examples of the gases are methane, nitrous oxide, ozone, carbon- dioxide, nitrous oxide, carbon monoxide, water vapour and chlorofluorocarbons. Earlier studies have shown that the accumulation of these gases in the atmosphere is a major factor causing change in the global climate and in the climate of regions around the globe (Crosson, 1997). For instance, it was reported that livestock is responsible for 18% of the world's greenhouse emission as measured in CO_2 equivalents. Livestock produces 65% of human – induced nitrous oxide, which has 296 times the global warming potential of CO_2 and 37% of human-induced methane which has 23 times the global warming potential of CO_2 (Owolabi, 2010).

According to Mckeown and Gardner (2009), greenhouse gases are generated by the following processes: a) carbon-dioxide generated by fossil fuel combustion, land clearing for agriculture, and cement production; b) methane generated by livestock production, extraction of fossil fuel, rice cultivation, landfills, and sewage; c) nitrous oxide generated by industrial process and fertilizer use and; d) the f gases made up of hydro fluorocarbons generated by: i) leakage from refrigerators, aerosols and, air conditioners; ii) aluminum production, semi-conductor industry; and iii)electrical insulation and magnesium smelting. Greenhouse gases arise from a wide range of human activities. The Intergovernmental panel on Climate Change (IPCC, 2007) gave the share of greenhouse gas emissions by sector as follows: energy supply (25%); industry (19.4%); forestry (17.4%); agriculture (13.5%) transport (13.1%); building (heating and cooling, 7.9%).

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Climate change adversely affects the socio-economic sector which includes water resources, agriculture, food security, forestry, fisheries, ecological systems, human health and settlements. The projected impact of climate change on the earth's environmental stability and hence changes in global climate would include disruption of temperature distribution, precipitation, evapo-transpiration, clouds, air-currents and consequential shifts in the vegetation belts, melting of polar ice-caps, rise in sea level that could adversely affect low-lying areas. Climate change affects crop production in many ways. For instance, uncertainty and variations in the pattern of rainfall and flood cause pest and diseases infestation in response to climate change. Irregular and unpredictable rainfall and sunshine hours affect yield of most staple crops such as maize, cassava, melon, sorghum and yam by about 2.5% per annum. Cash crops such as cocoa, cashew, orange, kola-nut, oil palm, rubber, cotton and coffee suffer severe setback under reduced photoperiods with flower and fruit abortion trends that reduce yield by 5.5metric tons per hectares. Livestock production is also affected by climate change in the following ways: Climatic stress reduces feed, water intake, grazing time and hence growth rate and productivity. High temperatures retard reproductive cycles in goats, sheep, cattle and poultry. Meat and milk outputs as well as grazing land have been reduced due to the effect of climate change Climate change also impact on forest resources through losses medicinal plants, mushrooms and bush meat.

Nigeria has been reported to likely be one of the most negatively impacted countries in the world as a result of climate change. According to DIFD (2009), Nigeria's risks are particularly high due to its low lying coastline that is highly populated with a heavy concentration of GDP generating industry and infrastructure. A DIFD preliminary Integrated Assessment Model report relating to sea level rise in Nigeria, predicted that climate change could result in a loss in GDP of between 6% and 30% by 2050 with an estimated US$ 100 to 460 billion dollars. If no adaptation is implemented by 2020, a further 2 to 11% of GDP could potentially be lost (DIFD, 2009).

The impact of climate change on the population and livelihood of Nigeria's farming communities include floods, sand deposition, mud- accumulation, salination of irrigated farmlands and ocean surges (ocean surge cause erosion of farm land and landslide of between 250 – 270m^2/ year). According to Idowu, et al. (2011), the impact of climate change on the health of farming communities in Nigeria include:

- Respiratory diseases due increase in the level of pollutants
- Malaria in more widespread levels within the population (70% annually)
- Skin ailments (45% annually)
- Heat stroke (40% annually)
- Loss of productivity (40% annually)
- Portable water shortages due to flood and/or saltwater intrusion (60% annually).

Climate change has also influenced the wind distribution patterns resulting in storm surges that usually cause losses in housing units (40% annually), loss in post-harvest sheds(30% annually), loss in poultry/piggery sheds(30% annually) and loss in farmstead stores(40% annually) Adaptation to environmental change is not new to mankind. Societies have demonstrated strong capacity for adapting to different climatic and environmental changes. According to (IPCC, 2007), examples of adaptation and coping strategies in different sectors include the following:

Human Health

- Many diseases and health problems that may be exacerbated by climate change can be effectively prevented with adequate financial and human public health resources, including training, surveillance and emergency response, and prevention and control programs.
- Urban tree planting to moderate temperature increases
- Weather advisories to alert the public about dangerous heat conditions
- Grain storage, emergency feeding stations
- Adjusting clothing and activity levels, increasing fluid intake

Coastal Areas and Sea Level Rise

- Developing county-scale maps depicting which areas will require shore protection (e.g. dikes, bulkheads, beach nourishment) and which areas will be allowed to adapt naturally
- Analyzing the environmental consequences of shore protection
- Promoting shore protection techniques that do not destroy all habitat
- Identifying land use measures to ensure that wetlands migrate as sea level rises in some areas
- Engaging state and local governments in defining responses to sea level rise
- Improving early warning systems and flood hazard mapping for storms
- Protecting water supplies from contamination by saltwater

Agriculture and Forestry

- Altering the timing of planting dates to adapt to changing growing conditions

- Altering cropping mix and forest species that are better suited to the changing climatic conditions
- Breeding new plant species and crops that are more tolerant to changed climate condition
- Promoting fire suppression practices in the event of increased fire risk due to temperature increases
- Controlling insect outbreaks

Ecosystems and Wildlife

- Protecting and enhancing migration corridors to allow species to migrate as the climate changes
- Identifying management practices that will ensure the successful attainment of conservation and management goals
- Promoting management practices that confer resilience to the ecosystem

Water Resources

- Altering infrastructure or institutional arrangements
- Changing demand or reducing risk
- Improving water use efficiency, planning for alternative water sources (such as treated wastewater or desalinated seawater), and making changes to water allocation
- Conserving soil moisture through mulching and other means
- Protecting coastal freshwater resources from saltwater intrusion

Energy

- Increasing energy efficiency to offset increases in energy consumption due to warming
- Protecting facilities against extreme weather events
- Diversifying power supply in the event of power plant failures due to excess demand created by extreme heat, or by extreme weather events

Implementation of any of these adaptation measures is limited by a myriad of constraints. Such constraints could be environmental, economic, informational, social, attitudinal and behavioural. These constraints which negatively influence farmers' adaptive capacity have not been fully understood. A proper understanding of these constraints is critical to the fight against the scourge of climate change. This study is therefore important as it aims at identifying and articulating these constraints.

II. Methodology

The study was carried out in Delta State, Nigeria. The state is located within longitude 5`$^0$ and 6.4$^0$E and 5`00 and 6.30`. Delta State is bounded Northwards by Edo State, on the east by Anambra State, on the southwest by the Bight of Benin which covers approximately 160km of the state's coastline. The state has a wide coastal belt inter – laced with rivulets and streams which form part of the Niger Delta.

The state occupies an area of 16,842km^2 and has a population of 4,098,391 persons (National Population Commission, NPC, 2006). Delta state has an annual rainfall of 266.5cm in the coastal areas and 190.5cm in the southern fringes. The temperature is high ranging between 28^{0c} and 34^{0c} with an average temperature of 30^{0c}. The Vegetation of Delta state varies between the mangrove swamps along the coast to evergreen forests and savannah in the north. The state is blessed with fertile soils and favourable climate, which makes it an important producer of food and cash crops. The state produces rubber, oil palm, yam, cassava, maize, rice, plantain and citrus amongst others for local consumption and for export. Its livestock production includes poultry, goats, pigs, sheep and cows, while it has a vast and rich fisheries resource. Delta state has 25 Local Government Areas (LGA_S) grouped into 3 Agricultural Zones as follows:

a) Delta North Agricultural Zone comprising Ika North East, Ika South, Ukwuani, Oshimili South, Oshimili North, Ndokwa East, Ndokwa West, Aniocha North and Aniocha South LGA_S.

b) Delta Central Agricultural Zone comprising Ughelli South, Ughelli North, Uvwie, Isoko South, Isoko North, Ethiope East, Ethiope West and Sapele LGA_S.

c) Delta South Agricultural Zone comprising Warri South, Warri North, Warri South East, Patani, Bomadi and Burutu LGA_S.

Delta North Agricultural Zone was purposively selected for this study because it is situated along the coastal area of the state. Three LGA_S within the zone namely, Oshimili South, Ndokwa East and Oshimili North were randomly selected for the study. From each of the selected LGA_S, one community was randomly selected for the study. Respondents were selected by use of systematic sampling. This involved selection of alternate households. This is particularly suitable in communities where exact population size is not known. A total of 321 respondents were used for the study. Their distribution is shown in Table 1.

Table 1 : Sample distribution

LGA$_S$	Communities	No. of respondents
Oshimili South	Oko-amakom	102
Ndokwa East	Abari	113
Oshimili North	Illah	106
	Total	321

Data for the study were collected through the use of structured interview schedule. Focused group discussion was conducted for community members to generate more information which helped to improve the quality of items contained in the interview schedule. Data generated by the study were analyzed using descriptive statistics such as mean scores, percentage and frequencies. For the purpose of the study, level of implementation of climate change adaptation measures was categorized into 3 as follows: a) low implementation (for adaptation measures with 0 to 39%); b) moderate implementation (for adaptation measures with 40 to 69%) and; c) high implementation (for adaptation measures with 70 to 100%). Constraint to the implementation of climate change adaptation measures was determined as follows: a) not important (for constraints with mean score of 0 to 2.9); b) important (for constraints with mean score of 3 to 3.9) and; c) very important (for constraints with mean score of 4 to 5).

III. Results and Discussion

a) Socioeconomic characteristics of respondents

Entries in Table 2 show the distribution of respondent according to their socioeconomic characteristics. Results reveal that 190 (or 59%) of the respondents were males, while 131(or 41%) are female. This indicates that more males are involved in farming than females. Information on respondents' age show that 86% of them were within the age bracket of 20 and 60 years. This suggests that most of the famers are still in their productive age and could cope adequately with the drudgery involved in farming.

Data in Table 1 further reveal that 295 (or 92%) of the respondents had one form of formal education or the other ranging from primary to tertiary education. This level of education can be a good base for understanding the issues associated with climate change and its adaptation measures. Results on responds' farming experience indicate that 247 (or 77 %) of them had farming experience ranging between 6 and 25 years. This range of experience could proved opportunity for farmers to become knowledge about climate change phenomenon

Table 2 : Distribution of respondent according to their socioeconomic characteristics

Socioeconomic characteristics	frequency	percentage
Gender		
Male	190	59
Female	131	41
Age (years)		
20 – 30	16	5
31 – 40	55	17
41 – 50	73	23
51 – 60	132	41
61 – 70	26	8
71 – 80	19	6
Educational Status		
No formal status	26	8
Primary education	87	27
Secondary education	138	43
Tertiary education	70	22

Farming experience (years)		
1 – 5	32	10
6 – 10	51	16
11 – 20	83	26
16 – 20	68	21
21 – 25	45	14
26 – 30	42	13
Marital status	253	79
Single	51	16
Divorced	16	5
Household size		
2 – 5	138	43
6 – 9	154	48
10 – 13	25	8
14 – 17	4	1
Annual income (N)		
Less than 100,000	61	19
100,000 – 199,999	54	17
200,000 – 299,999	64	20
300,000 – 399,999	87	27
400,000 – 499,999	42	13
More than 500,000	13	4

b) Implementation of climate change adequate measures by respondents

Entries in Tables 3 show the level of implementation of climate change adaption measures by respondents. Results reveal that there was a low implementation of 10 of the 18 adaptation measures investigation by the study. There was also a moderate implementations of 5 of the measures and a high implementation of only 3 measures.

Climate changes adaptation measures with low level implementation include: use of weather forecast (14%); use of resistant varieties (22%); Early planting and early harvesting of crops (26%); and sand filling for land reclamation (29%); construction of drainage systems (19%); construction of artificial lakes (28%); use of irrigation systems (38%) Use of infiltration ditches (37%); use of water harvesting (33%) and use of afforestation /tree planting (18%).

The low implementation of these adaptation measures is expected in light of the challenges faced by farmers in rural communities of Nigeria with respect if agricultural production. Farmers lack weather information which if available can be effecting used in handling some climate charge issues. Similarly, improved crop varieties that are resistant to climate change variable such as flood and high temperature regimes are expensive such that most farmers could not afford to use them since most of the farmers usually operate with low capital base and do not have access to production credit.

The above situation makes it difficult for farmers to use adaptation measures that require some financial commitment. This could be a major reason for the moderate and high implementation of the less expensive adaptation measures such as: the use of mulching and cover crops; the use of bamboo takes to divert excessive runoff water; use of crop rotation; use of sandbags by the river bank and the construction of water channels to farmland.

Table 3 : Respondent' level of implementation of climate change adaptation measures (n = 321)

	Adaptation measures	frequency	percentage	Remark
1.	Use of weather forecasting	46	14	low
2.	Use of crop rotation	282	87	High
3.	Use of resistant varieties	72	22	low
4.	Early planting and harvesting	84	26	low
5.	Sand filling and land	249	77	High
6.	Use of bamboo stakes to divert excessive runoff water	156	48	Moderate
7.	Use of sandbag by river bank	241	75	High
8.	Sand filling land reclamation	96	29	low
9.	Construction of drainage system and culvert	96	29	low
10.	Construction of water channels and farmland	174	54	Moderate
11.	Construction of artificial lakes	92	28	low
12.	Use of irrigation scheme	124	38	low
13.	Planting of cover crops	204	63	Moderate
14.	Use of mulching	146	45	Moderate
15.	Use of infiltration	121	37	low
16.	Use of water harvesting	108	33	low
17.	Use of inter cropping	168	52	Moderate
18.	Use of afforestation/ tree planting	58	18	low

- *Multiple responses recorded*

c) Constraints to the implementation of climate change adaption measures to the implementation measures

Entries in Table 4 show the mean scores of constrains to the implementations of climate change adaptation measures as perceived by respondents. Results reveal that 11 of the constraints investigated by the study were considered to be "important" only 2 constraints were identified as not important.

Among the very important constraints identified in this study are: limited available of land for farming ($\bar{X}$= 4.3); poor access to information sources ($\bar{X}$ = 4.2); non availability of credit facilities ($\bar{X}$ = 4.1); inadequate knowledge of how to cope or build resilience ($\bar{X}$= 4.4); lack of access to weather forecast information ($\bar{X}$ = 4.2); government irresponsiveness to climate risk management ($\bar{X}$ = 4.6); limited income ($\bar{X}$ = 4.3); poor agricultural extension services delivery ($\bar{X}$= 4.2); lack of capacity of extension to build resilience's of farmers on climate change ($\bar{X}$ = 4.1); poor information on early warning systems ($\bar{X}$ = 4.5) and lack of information on what to do ($\bar{X}$ = 4.4).

In the group of important constraints are: high cost of farmland ($\bar{X}$ = 3.3); inherited system of land ownership ($\bar{X}$ = 3.3); high cost of fertilizer and other inputs ($\bar{X}$ = 3.8); high cost of improved and resistant varieties ($\bar{X}$ = 3.3); non availability of storage facilities ($\bar{X}$ = 3.8); non-availability of processing facilities ($\bar{X}$ = 3.6); high cost of processing facilities ($\bar{X}$ = 3.2) traditional beliefs and practices ($\bar{X}$ = 3.5); and high cost of irrigation facilities ($\bar{X}$ = 3.5).

These constraints identified by the respondents in this obviously pose as challenges to the implementation of climate change adaptation measures. It is therefore the expectation of the researchers that urgent attention should be given to remove these constraints so that the effect climate change on agricultural production in the study area can be ameliorated.

Table 4 : Mean Scores constrains to the implementation of climate change adaptation measures

	Constraints	Mean score	Remarks
1.	limited availability of land for farming	45	low important
2.	High cost of farmland	3.7	important
3.	Inherited system of land ownership	3.3	important
4.	Communal system of land ownership	2.5	not important
5.	Poor access to information sources	4.2	very important
6.	Non-availability of credit facilities	3.5	important
7.	Non-availability of farm input	2.8	not important
8.	High cost of irrigation facilities	3.5	important
9.	High cost of fertilizer and other inputs	3.8	important
10.	Inadequate knowledge of how to cope Or build resilience	4.4	very important
11.	High cost of improved and resistant varieties	3.3	important
12.	Non-availability of farm inputs	2.7	not important
13.	Lack of access to weather forecast information	4.2	very important
14.	Government irresponsiveness to climate Risk management	4.6	very important
15.	Non-availability of storage facilities	3.5	important
16.	Limited income	4.3	very important
17.	Non- availability of processing facilities	3.6	important
18.	High cost of processing facilities	3.8	important
19.	Traditional beliefs and practices	3.5	important
20.	Poor agricultural extension service delivery	4.2	very important
21.	Lack of capacity of extension service to Build resilience of farmers	4.1	very important
22.	Poor information on early warning system	4.5	very important
23.	Lack of information on what to do	4.4	very important
24.	High cost farm labour	2.6	not important

IV. Conclusion and Recommendations

Adaption is the adjustment in natural r human systems in response to expected climate hazards or their effects. Adaptation is not new to human history as man has had to adapt to changes in climate and environment. Some adaptation measures formed to have been used y respondents in study include the use of crop rotation method, use of sandbags at river banks, the use of bamboo stakes, planting of cover crops and the construction of drainages.

Constructions to implementation of climate change adaptation measures include: limited availability of land for farming; lack of access to weather forecasting information, limited income; poor access to information sources; high cost of irrigation facilities, traditional beliefs and practices, poor information on early warning system, poor agricultural extensions service delivery, high cost of improved and resistant varieties, inadequate knowledge of how to cope or build resilience and government irresponsiveness to climate risk management.

Based on the findings of the study, the following recommendations were made: firstly the establishment of climate change information system that will manage issues relating to awareness creation, information on weather forecast, early warning signs and training of farmers on climate change coping strategies. Secondly, the establishment of a sustainable credit scheme which will empower farmers financially to be able to implement appropriate adaptation measures. Thirdly, Delta State Agricultural Development Programme (DTADP), which is the agency charged with the provision of extension services should be empowered by the government create a separate unit to handle climate change issues. Such a unit will be charged with providing relevant and up to date information to farmers on how to build resilience to confront any climate change problem.

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Attitude of Farmers Towards the Use of Animal Traction Technology in Savannah Zone of Oyo State, Nigeria

By Oladeji, J. O., Ogunleye, K. Y & Aderinto, A
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Abstract - Use of tractor in Nigeria is characterised by various short comings which ranges from untimely tractor services, unsuitable landscape for tractor use, expensive tractor spare parts and unavailability of labour which has made commercial farming difficult. An option that might help farmers overcome this problem is animal traction. This study determined the attitude of farmers towards the use of animal traction technology in savannah zone of Oyo state, one hundred and forty four (144) respondents comprising 72 contact and 72 non-contact farmers were interviewed for the study. The relationships between respondents' personal characteristics, farm characteristics and their attitudes towards the use of animal traction technology were determined using chi-square analytical tool.

Finding revealed that majority of the respondents were males and married. They were literate and had fairly large family size. They were within active age range of 21-50 years and had over 20 years farming experience. They practiced mixed cropping, exhibited a neutral attitude towards the use of animal traction technology.

Keywords : *Traction, Technology, Farmers, Contact, Farmers.*

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Abstract - Use of tractor in Nigeria is characterised by various short comings which ranges from untimely tractor services, unsuitable landscape for tractor use, expensive tractor spare parts and unavailability of labour which has made commercial farming difficult. An option that might help farmers overcome this problem is animal traction. This study determined the attitude of farmers towards the use of animal traction technology in savannah zone of Oyo state, one hundred and forty four (144) respondents comprising 72 contact and 72 non-contact farmers were interviewed for the study. The relationships between respondents' personal characteristics, farm characteristics and their attitudes towards the use of animal traction technology were determined using chi-square analytical tool.

Finding revealed that majority of the respondents were males and married. They were literate and had fairly large family size. They were within active age range of 21-50 years and had over 20 years farming experience. They practiced mixed cropping, exhibited a neutral attitude towards the use of animal traction technology. Chi-square test revealed that age, family size and farming experience of respondents were significantly related to their attitude towards the use of animal traction technology while farm size and cropping pattern were observed not to be significantly related to their attitude.

The study concludes that since respondents were neutral in their attitude towards the use of animal traction technology, a well-designed extension based animal traction programme should be put in place to arouse the interest of farmers in the technology to combat shortage of labour in the agricultural sector.

Keywords : Traction, Technology, Farmers, Contact, Farmers.

I. Introduction

Manual labour is becoming scare and increasingly expensive and the farmers are already tired of muscle power (Olomola, l998). This shows that there is shortage of hand in the agricultural sector of the economy. This is no doubt a disturbing development in the view of the fact that labour is one of the main factors of agricultural production. Shortage of labour should be of great concern to all considering the fact that Nigeria agriculture is in the hands of the peasant farmers who rely on manual labour. Agricultural practice is carried out by small holder farmers cultivating between 2-3 hectares of farm holdings using human labour and simple hand tools (Oyeniyi, 1997)

In order to avert the devastating effect of inadequate supply of labour on our agriculture, especially at the village level, looking in the ways of technologies that are capable of reducing heavy dependence on manual labour may be the right focus. This in line with Pannim and Ellis-Jonnes (1999) who stated that with the current rates of population growth, the main way to avoid food storage in African countries is to focus attention on technologies that could raise productivity of labour. This suggests that the logical answer to shortage of hands on the farm is mechanization or hand operation that could be mechanized provided it would be profitable to the farmers. The use of tractors and farm animals for examples, require a few hands.

Animal traction technology is being widely advocated in the savannah areas of Africa considering the account of realization of its benefit in several countries in Asia, Middle-East and the Mediterranean (Le Moigue, 1979). Nigeria is one of African countries with long history of animal traction. Alkali (1969) posited that the long history of animal traction dates back to1922 when the use of cattle as a source of power for agricultural production was first demonstrated with long history, it would not be out of place to think the entire savannah belt of Nigeria would have been covered. However the introduction of tractors in 1940s impeded the spread of the technology. The prevailing economic situation has made other alternative such as manual cultivation and tractorization inadvisable and unaffordable has however made the need for animal traction technology imperative.

Animal traction technology is already in use in the savannah zones of Northern Nigeria. Farmers in the areas are already taking full advantage of the technology while their counter parts in Oyo state, South-West Nigeria are yet to harness the enormous potentials of the innovation despite the suitable ecology and availability of resources for its use. It is in realization of this that the Oyo State Agricultural Development Programme introduced animal traction technology to farmers in the state. This is actually possible because Oyo state cuts across two ecological zones of savannah and rain forest.

Draft animal power is potentially an appropriate technology. It is relatively inexpensive not too

complicated and can help to increase productivity (Norman, et. al., 1981) Introducing an innovation like animal traction with great potentials is no doubt a laudable effort. However there is need to ascertain the feelings of the target beneficiaries if there will be meaningful record of its success. In the case of animal traction technology, Panin and Eills-Jones (1992) established that farmer's attitude, choices and perception could have an important bearing on the choice of power source.

It is against this background that this research tries to find out the attitude of farmers towards the use of animal traction technology in Oyo State and consequently, the following research objective were addressed by the study:

1. identify the personal characteristics of the farmers in the study area.
2. determine the influence of animal traction technology on farmers' farm size.
3. ascertain the influence of animal traction technology on farmers' cropping pattern.
4. ascertain farmers' attitude towards the use of animal traction technology.

II. Methodology

The research was carried out in the savannah area of Oyo State, South-Western Nigeria.

The state is bounded by Benin Republic in the West, in the North and East by Kwara and Osun states respectively and Ogun state in the South. Oyo state covers a land area of 27,000 sq kilometres and is made up of 33 Local Government Areas. The state is divided into four agricultural zones by ADPs namely: Ibadan/Ibarapa, Oyo and Saki zones. Based on the prevailing climatic and soil characteristic, three vegetation zones are identifiable in Oyo state. These are forest Guinea savannah, and derived savanna. The forest zone with high relative humidity favours the cultivation of tree crops such as Cocoa, Kola. Citrus, and Oil Palm as well as arable crops like Maize, Cassava, Yam and Rice. Areas within Ibadan Zone and up to Fiditi town fail within the forest zone. The derived savanna has a mixture of forest and savannah vegetation. Oyo Ogbomoso, Ilora, Fasola, Eruwa and Lagelu fall within this zone.

The savannah zone favour mainly arable crops such as Sorghum, Maize, Cowpea and Yam with some parcel of land, which supports tree crops. The wide expanse of land covered by Oyo/Ogbomoso zone in the south to Saki zone is savannah (MANR, 2001). All farmers in the savannah zone of Oyo State constitute the target population. This is due to the fact that animal traction could only take place in savannah belt therefore, Saki and Ogbomoso (ADP) zones were purposively selected for the study. There were 59 and 27 agricultural (ADP) cells in Saki and zone ten percent (10%) of cells in each of the sampled zones were randomly selected for the study i.e. 6 cell from Saki zone and 3 cells study from zone. There were 8 groups of farmers in each of the sampled cells. Each group comprises 10 contact farmers, giving a total of 480 contact farmers for Saki and 240 for zone. There were 480 and 240 non contact farmers in the sampled cells in Saki and zones respectively; this was based on 1 contact farmers to 10 non contact farmers. Ten percent (10%) of non contact farmers were randomly selected for the study resulting to 48 and 24 non contact farmers for Saki and zone respectively. A total of 144 respondents comprising 72 contacts fanners and 72 non contact farmers were used for the study. Interview schedule was used to generate information from respondents. The data was analyzed using frequency, percentage and chi-square.

III. Results and Discussions

a) Personal characteristics of respondents

Table 1 shows that majority (66.6%) of contact farmers belonged to the age range of 21- 50 years while the remaining 33.3% were above 50 years of age. However, majority (55.5%) of non contact farmers were between 21 - 50 years of age. The result generally is an indication of the fact that majority of the respondents were within the middle age group and hence expected to be very active and adventurous and desirous of innovations that are capable of improving their lives and farm work. The table further shows that majority (81.9%) of contact farmers are males and 18.1% are females. Similarly, majority of non contact farmers are males (79.2%) and 20.8% are females. The above result implies that majority of respondents are males. This could be due to the fact that women do not have access to farm land. Corroborating this, Rwelamira (1990) affirmed that the right to own land is often determined by traditional community leaders such as tribal chiefs, and land is allocated to male family members even if the household is female headed.

Furthermore, the table revealed that majority of contact farmers (87.5%) were married 6.9% were single and 5.6% were widowed. Similarly, majority (79.2%) of non contact farmers were married. Also, 15.3% were single and the remaining 5.6% were either widowed of separated and divorced. This implies that most of the respondents were settled family men and women with responsibilities and would most likely be willing to seek innovations that could increase their income earning capacity and improve their standard of living.

The table shows the ethnicity of the respondents as majority (89.6%) is predominantly Yoruba and 10.4% are non Yoruba. The table further shows that in the overall majority (61.1%) of the contact, and non contact respondents were full time farmers and

the remaining (38.9%) were civil servant and artisans. This is an indication that the respondents are likely to be serious with their farm work and be positively disposed to matters that can enhance the progress of their farm work. The result also implies that the study area is a completely rural area where basic occupation is farming. This may be due to readily available vast arable farmland. Corroborating this, Ogunbile and Olukosi (1991) asserted that the main occupation of rural people is agriculture while Olawoye (1993) affirmed that farming is a peculiar characteristic of rurality.

With regards to educational attainment of respondents, table 1 reveals that majority (55.7%) of the two categories of respondents attended formal school setting ranging from primary school to tertiary education as 30.5% attended adult literacy classes while the remaining 13.9% had no formal education. This is an indication that majority of respondents are literate and this is expected to favour innovativeness of the respondents. This is in line with Ogunfiditimi (1981) assertion that a positive and significant correlation exists between literacy level and use of recommended practice. However, this is contrary to Abubakar and Ahmad (2010), who found that farmers using animal traction in Jigawa state, Nigeria had low level of formal educational background. Majority (90.3%) of two categories of respondents had 20 years farming experience while 9.7% had between 10-20 years farming experience. The above result implies that most of the respondents are experienced famers and are therefore in good position to exhibit independent disposition towards the use of innovation that has to do with farming business.

Concerning the family size of respondents, the table reveals that majority (50.0%) of the categories of respondents had family size ranging between 6-10 members, 31.9% had 1-5 members in their household, 12.5% had over 10 members and only few did not disclose their family size. The above result implies that most of the respondents have a fairly large family size with fairly large labour force. This is expected to influence their attitude towards the use of animal traction. In many cases, households, which use drift animal power, have a larger labour force than household, which do not have (Panin,1987, Sumberg and Gilbert1992).

b) Respondents' Farm Characteristics

Table 2 reveals that overall result of 45.1% of the two categories of respondents cultivated less than 3ha of farmland, 34.0% had 3-6 ha, 15.3% cultivated between 6 -10 ha and 5.6 % had over 10 ha of land. The above result is an indication that majority of the respondents were small scale farmers. This confirms that agricultural practices in Nigeria are carried out by small holder farmer cultivating between 2 and 3 ha of farm holdings; using human labour (Oyeniyi, 1997). The small holding of respondents implies that they should be desirous of technology such as animal traction that could be applied to increased farm size thereby improving their income.

c) Score categories on attitude scale

Table 3 shows that majority (68.0%) of the categories of farmers were undecided on the use of animal traction technology while 15.3% had unfavourable attitude towards its use but few (16.7%) were favourably disposed to its use. This implies that, majority of the farmer in the area are yet to decide on the use of animal traction technology. Reason might be that they are not aware of the benefit accruable from the use of animal traction technology more so that the method has not been put into practice in the area. This is in line with the finding of Daramola, (1999) that majority of farmers in Nigeria have very little knowledge about animal traction. This might also be because majority of the farmer were small scale farmers. Table further shows that 62.5% of the two categories of respondents practices mixed cropping while few (24.3%) engaged in mixed farming and 13.2% practiced mono-cropping.

The above result agrees with the finding of Ogunkunle and Olukosi (1991) who established that mixed cropping is common practice among traditional farmers in Nigeria.

The result also brings to fore the age long practice of growing two or more crop as a form of insurance against crop failure and for maximum use of the above result the farmer may not be favourably disposed to any innovation that is not compatible with prevailing cropping pattern. Daramola (1999), in a research on potentials for animal traction in South Western Nigeria established that favourable consideration would be given to animal traction in the region as long as its adoption would not serious jeopardize farmers' subsistence nor impose additional strain on their limited resources.

d) Hypotheses testing

Table 4 shows that there is a significant relationship between contact farmer's age and attitude towards the use of animal traction technology while attitudes of non contact farmers were found to be independent of their ages. Furthermore test of relationship between respondents' farming experience and attitude showed a significant relationship towards the use of animal traction technology. Also test of relationship between family size and attitude of respondents showed that there was a significant relationship between contact farmer's family size and their attitude towards the use of animal traction technology but family size had no relationship with attitudes of non contact farmers.

Table 5 shows that test of relationship between respondents' attitudes were not influenced by their farm

size but significant relationship exist between contact farmer's cropping pattern and their attitude towards the use of animal traction technology while attitudes of non - contact farmers were found to be independent of their cropping pattern. This result corroborates the finding of Ajav (1989) that an extension programme can break the resistance to the use of animal traction.

IV. Conclusion

This study concludes that majorities of respondents were undecided on the use of animal traction technology, though they consider it to be a viable option to tractor and human labour. Therefore extension based enlightenment programme should be put in place to sensitize farmers before the actual introduction of the technology. Based on the findings of the study, farmers who are supposed to be primary beneficiaries of animal traction technology are yet to make up their mind on its use; the following recommendations were made:

- Government should design animal traction oriented programme and use the appropriate extension organ to disseminate well packaged animal traction related information to propagate the use of the technology in the zone
- Animal traction training centre should be established at suitable or strategic locations to demonstrate the use and benefits of animal to demonstrate the use and benefits in the zone.
- Government should ensure availability of draft animal at reasonable cost and encourage local fabrication of animal traction implements in the zone.

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Table 1 : Distribution of personal characteristics of respondents

Personal Characteristics	Contact farmers	Non-Contact farmers	Total
Age(Years)			
21-30	5(6.9)	0(0.0)	5(3.5)
31-40	19(26.4)	12(16.7)	31(21.5)
41-50	24(33.3)	20(27.8)	44(30.6)
51-60	16(22.2)	26(36.1)	42(29.2)
Above 60	8(11.1)	14(19.4)	22(15.3)
Sex			
Male	59(81.9)	57(79.2)	116(80.6)
Female	13(18.1)	15(20.8)	28(19.4)
Marital status			
Single	4(6.9)	11(15.3)	16(11.1)
Married	63(87.5)	57(79.5)	120(83.3)
Widowed	4(5.6)	1(1.4)	5(3.5)
Divorced	0(0.0)	2(2.8)	2(1.4)
Separated	0(0.0)	1(1.4)	1(0.7)
Ethnic Group			
Yoruba	68(94.4)	61(84.7)	129(89.2)
Edo	2(2.8)	2(2.8)	4(2.8)
Egbede	1(1.4)	2(2.8)	3(2.1)
Ghanaian	1(1.4)	1(1.4)	2(1.4)
Ibo	0(0.0)	4(5.6)	4(2.8)
Ibaru	0(0.0)	1(1.4)	1(0.7)
Hausa	0(0.0)	1(0.7)	1(0.7)
Primary Occupation			
Farming	45(62.5)	43(59.7)	88(61.1)
Civil Service	21(29.2)	24(33.3)	45(31.3)
Tractor operator	2(2.8)	1(1.4)	3(2.1)
Craftsmanship	1(1.4)	0(0.0)	1(0.7)
Business	1(1.4)	4(5.6)	5(3.5)
Security	1(1.4)	0(0.0)	1(0.7)
No response	1(1.4)	0(0.0)	1(0.7)
Educational attainment			
No formal education	12(16.7)	8(11.1)	20(13.9)
Adult literacy	11(15.3)	33(45.8)	44(30.5)
Primary education	13(18.1)	8(11.1)	21(14.6)
Secondary education	2(2.8)	5(6.9)	7(4.9)
Technical	16(22.2)	11(15.3)	27(18.8)
Tertiary education	18(25.0)	7(9.7)	25(17.4)
Farming experience			
10-20	18(11.1)	6(8.3)	14(9.7)
21-30	22(30.6)	26(36.1)	48(33.3)
31-40	21(29.2)	15(20.8)	36(25.0)
41-50	16(22.2)	19(26.4)	35(24.3)
Above 50	5(6.9)	6(8.3)	11(7.6)
Family size (Person)			
1-5	34(47.2)	12(16.7)	46(31.9)
6-10	23(31.9)	49(68.1)	72(50.0)
Above 10	7(9.7)	11(15.3)	18(12.5)
None	8(11.1)	0(0.0)	8(5.6)

Figures in parentheses are percentages

Table 2 : Distribution of respondent's farm characteristics

Farm Size (Ha)	Contact farmers	Non-Contact farmers	Total
0.1-2.99	32(44.4)	33(45.8)	65(45.1)
3.0-5.99	26(36.1)	23(31.9)	49(34.0)
6.0-9.99	10(13.9)	12(16.7)	22(15.3)
10 and above	4(5.6)	4(5.6)	8(5.6)
Total	72(100.0)	72(100.0)	
Cropping pattern			
Mono-cropping	11(15.3)	8(11.1)	19(13.2)
Mixed cropping	52(72.2)	38(52.8)	90(62.5)
Mixed farming	9(12.5)	26(36.1)	35(24.3)
Total	72(100.0)	72(100.0)	

Table 3 : Distribution of respondents according to score category on attitude towards animal traction technology.

Score category	Contact farmers	Non-Contact farmers	Total
Unfavourable	10(13.9)	12(16.7)	22(15.3)
Undecided	51(70.8)	47(65.3)	98(68.0)
Favourable	11(15.3)	13(18.1)	24(16.7)
Total	72(100.0)	72(100.0)	

Table 4 : Chi-square analysis showing relationship between selected personal characteristics and attitude of farmers towards use of animal traction technology.

Variable	Category of farmer	χ^2	df	P-value	Decision
Age	Contact	17.183		0.028	S
	Non contact	4.729	8	0.597	NS
	Both	15.817		0.045	S
Sex	Contact	1.158		0.560	NS
	Non contact	4.203	2	0.122	NS
	Both	5.122		0.077	NS
Marital status	Contact	14.072		0.090	NS
	Non contact	3.167	8	0.923	NS
	Both	11.049		0.199	NS
Primary occupation	Contact	7.603		0.815	NS
	Non contact	9.616	12	0.142	NS
	Both	9.819		0.632	NS
Educational level	Contact	8.701		0.561	NS
	Non contact	13.130	10	0.217	NS
	Both	13.632		0.190	NS
Farming experience	Contact	16.891		0.043	S
	Non contact	15.094	10	0.046	S
	Both	19.672		0.033	S
Family size	Contact	21.492		0.010	S
	Non contact	4.126	6	0.389	NS
	Both	16.688		0.010	S

Table 5 : Chi-square analysis showing relationship between respondents' farm characteristics and their attitude towards use of animal traction technology.

Variable	Category of farmer	χ^2	df	P-value	Decision
Farm size	Contact	8.758		0.188	NS
	Non contact	6.686	6	0.351	NS
	Both	8.316		0.216	NS
Cropping pattern	Contact	10.379		0.035	S
	Non contact	2.987	4	0.560	NS
	Both	8.449		0.076	NS

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Congruency of Extension Professionals' and Farmers' Perceptions of Privatization Commercialization of Agricultural Extension Services

By Ajieh, Patrick Chuks
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Abstract - This study examined the congruency between extension professionals and farmers regarding their perceptions of privatization and commercialization of agricultural extension services. The study was carried out in Delta State, Nigeria and it had a sample size of 224 respondents comprising of 134 extension professionals of the Delta State Agricultural Programme (DTADP) and 90 farmers that were randomly selected. Data for the study were collected from the respondents through the use of validated questionnaire and interview schedule. The questionnaire was used for the extension professionals, while the interview schedule was used for the farmers. Spearman's rank order correlation coefficient was used to determine the congruency in perceptions of respondents. Results of the study showed a high congruency between extension professionals' perception and their estimate of farmers' perception (rho = 0.92), while the congruency between farmers' perception and their estimate of extension professionals' perception was low (rho = 0.08). The study recommends that farmers' knowledge of issues relating to P and C should be enhanced through seminars and workshops organized by the appropriate extension agency.

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I. Introduction

Relational communication models provide a framework for identifying the relationship between individuals or groups in a communication process. The models acknowledge that communication is a delicate process evolving from the joining of two participants into a relationship that is more than the sum of its parts. They clearly illustrate the central role of message interpretation and reciprocal perceptions between parties in a communication process.

A relationship in interpersonal communication has been defined as a set of expectation which two parties have for each other's behaviour and feelings. It is the connection that exists when: a) the interactants are aware of each other and take each other into account; b) there is some exchange of influence; and c) there is some agreement about what the nature of relationship is and what the appropriate behaviours are, given the nature of the relationship (Berko, Rosenfeld and samovar,1997)

The best known example of relational communication is the coorientation model (Littlejohn, 1992). According to Gruning and Hunt (1984), the coorientation model identifies three critical relationships between participants in a communication process. These are accuracy, congruency and agreement. Figure 1 shows that accuracy relationship can be estimated between person ' A' and ' B by comparing their estimates of one another's perception with their actual perceptions, while congruency relationship can be determined by comparing each person's perception with his/her estimate of the other person's perception. Agreement relationship on the other hand, is determined by comparing the similarity in the perceptions of persons 'A' and 'B'.

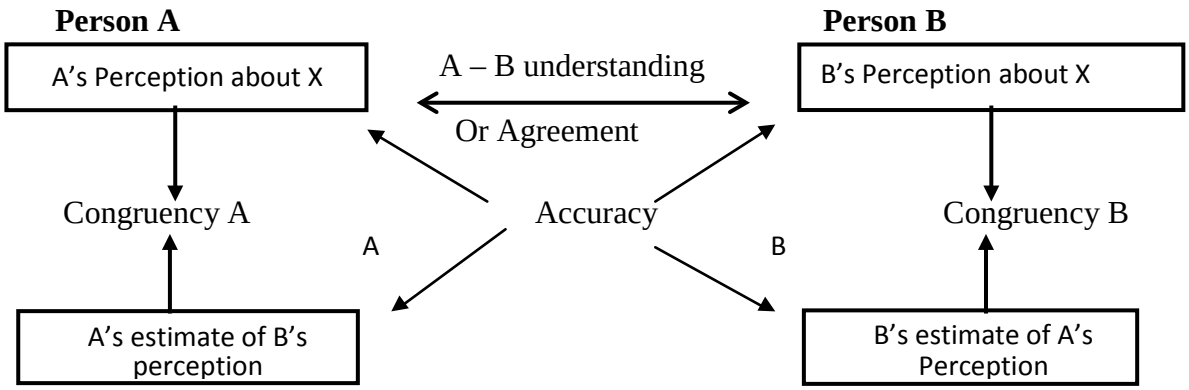

Figure 1 : Relationships in co-orientation

Source: Chaffee, S. H. and McLeod J.M. (1973) Interpersonal perception and communication. Pp 483-488

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Co-orientational studies have been reported among researchers, extension workers and farmers regarding attributes of plant cultivars (Groot, 1970; Dolly, 1997), community consensus building (Broom, 1977; Meiller, 1975), listening behaviour states (Buchili and Pearce, 1974) and shared behaviour among rational partners (Gantz, Carrico and Kroon, 1995). The co-orientation model has, also, been used to compare the views of community leaders and local residents regarding Hudson River ecosystem restoration in New York State (Connelly and Knuth, 2002).

This study examined the congruency between extension professionals and farmers regarding their perceptions of privatization and commercialization (P and C) of agricultural extension services. In applying the coorientation model, the conceptualization of the congruency relationships in the perceptions of extension professionals and farmers is shown in Figure 2.

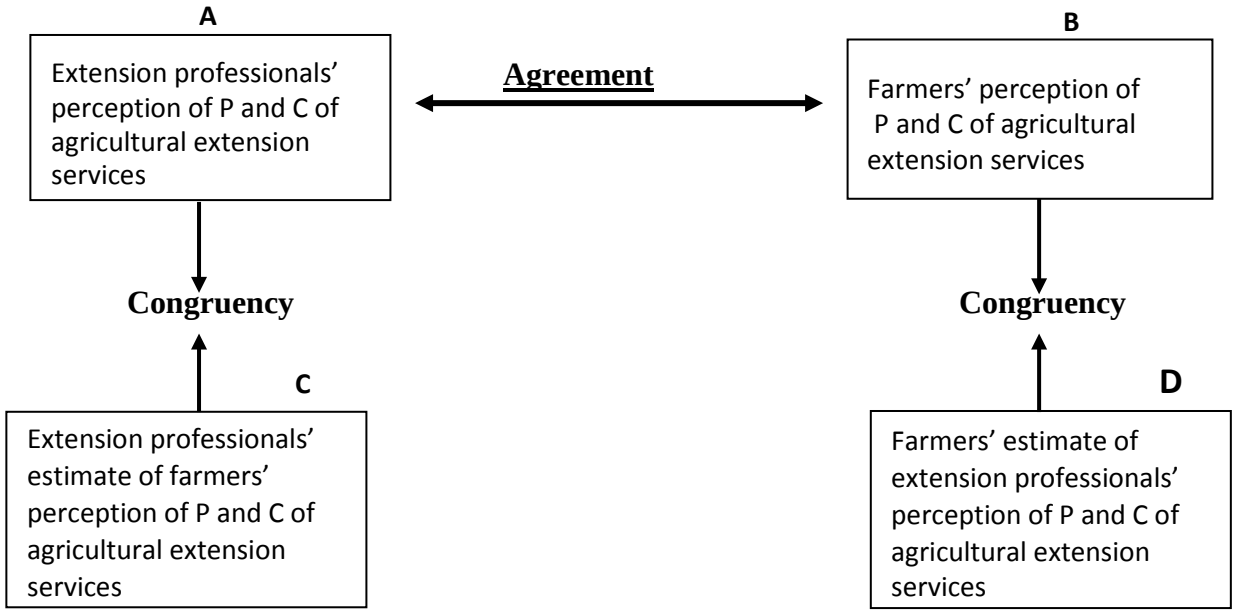

Figure 2 : Conceptual framework for analyzing the congruency relationship between extension professionals and farmers

In determining the congruency between extension professionals' perception and their estimate of farmers' perception, measures between boxes A and C were compared, while the congruency between farmers' perception and their estimate of extension professionals' perception was determined by comparing measures between boxes B and D.

II. Methodology

The study was carried out in Delta State, Nigeria. Extension professionals of the Delta State Agricultural Development Programme (DTADP) and farmers in the state formed the population from which sample was drawn. Extension professionals of the DTADP were composed of 150 extension agents (EAs); 25 block extension agents (BEAs), 25 block extension supervisors (BESs); 12 subject matter specialists (SMS) three zonal extension officers (ZEO); 3 zonal managers (ZMs); 10 directors of sub programmes; 29 heads of component programmes and one programme manager (PM). For the purpose of the study, the PM, ZEOs and ZMs were involved in the study because they were few in number. For the others, 50% proportionate random sample was drawn. This sampling procedure gave a total of 134 extension professionals involved in the study.

For the farmers, a multistage sampling technique was used in selecting respondents. In the first stage, three extension blocks were randomly selected from each of the agricultural zones in the state, giving a total of nine extension blocks. In the second stage, two extension cells were randomly selected from each of the nine extension blocks, giving a total of 18 extension cells. In the third stage, five farmers in contact with extension were randomly selected from the list provided by the extension agents in each of selected extension cells. This gave a total of 90 farmers that were sampled. In all, 224 respondents comprising of 134 extension professionals and 90 farmers were used for the study.

A set of questionnaire and structured interview schedule were used for data collection. The questionnaire was used for extension professionals, while the interview schedule was used for the farmers because of their low educational status. Content validation of the research instruments were done by a team of experts in agricultural extension system. The instruments were pilot tested before administration to

test for reliability. Trained assistants in addition to the researcher collected data for the study.

To determine congruency in perceptions of extension professionals and farmers, 17 positive and negative statements regarding the features of P and C of agricultural extension services were framed through a review of literature and interviews with experts. Extension professionals and farmers were asked to indicate their level of agreement with the statements. They were also asked to estimate one another's perception. A 4 – point Likert type scale with values of strongly agree =4; agree=3; disagree=2; and strongly disagree=1 was used to determine respondents' level of agreement to the statements. Means of their responses were then used for analysis. Spearman's rank order correlation coefficient was computed for ; (I) Congruency of extension professionals' perception and extension professionals' estimate of farmers' perception of P and C of agricultural extension services and (II) Congruency of Farmers' perception and farmers' estimate of extension professionals' perception of P and C of agricultural extension services.

III. Results and Discussion

a) Congruency of extension professionals' perception and extension professionals' estimate of farmers' perception of P and C of agricultural extension services

Data in Table 1 show the congruency of extension professionals' perception and their estimate of farmers' perception. Results of the analysis indicate a high level of congruency between extension professionals' perception and their estimate of farmers' perception. Spearman's rank correlation coefficient for the 17 statements was 0.92. Information in Table 1 further reveal that there were significant variations between extension professionals' perception and their estimate of farmers' perception in only 3 statements, while there were no significant variations in the remaining 14 statements. This shows that there was similarity between extension professionals' perception and what they think farmers' perception is.

The statements in which extension professionals' perception and their estimate of farmers' perception are similar include: P and C will make agricultural information delivery to become more effective; P and C will make it possible for more farmers to be reached, P and C will improve linkages between research and extension; P and C will break the monopoly of public extension services; P and C will make extension services to be directed at specific needs of the people; P and C will increase priority areas of extension coverage; P and C will reduce government financial burden on agriculture; P and C will create job opportunities; P and C will encourage exploitation of the farmers; P and C will promote corruption and nepotism; P and C will lead to job insecurity among public extension workers; P and C will make agricultural services unaffordable by farmers; P and C will encourage foreign domination in the provision of extension services; and P and C will lead to poor capacity building.

Table 1 : Spearman's rank correlation showing the congruency of extension professionals' perception and extension professionals' estimate of farmers' perception of P and C of agricultural extension services

SN	Statements	Extension profs' perception	Rank	Extension profs' estimate of farmers' perception	Rank
1.	Privatization and commercialization will encourage competition among extension service provider	3.50	1	3.14	4.5
2.	Privatization and commercialization will make agricultural information delivery to become more effective	3.43	2	3.15	3
3.	Privatization and commercialization will make it possible for more farmers to be reached	3.30	3	3.16	1.5
4.	Privatization and commercialization will improve linkages between research and extension	3.28	4	3.14	4.5
5.	Privatization and commercialization will provide opportunity for neglected areas of agric production to be attended to	3.25	5	3.16	1.5
6.	Privatization and commercialization will break the monopoly of public extension service	3.21	6	3.01	8

7.	Privatization and commercialization will make extension services to be directed at specific needs of the people	3.18	7	3.13	6
8.	Privatization and commercialization will increase priority areas of extension coverage	3.61	8	3.07	7
9.	Privatization and commercialization will help reduce govt. financial burden on agriculture	3.13	9	2.99	9
10.	Privatization and commercialization will create job opportunities	2.94	10	2.72	11
11.	Privatization and commercialization will lead to job insecurity among public extension workers	2.74	11	2.65	12
12.	Privatization and commercialization will make agricultural extension services unaffordable by farmers	2.58	12	2.96	10
13.	Privatization and commercialization will encourage exploitation of farmers	2.47	13	2.60	13
14.	Privatization and commercialization will lead to poor capacity building	2.31	14	2.35	16
15.	Privatization and commercialization will promote corruption and nepotism	2.10	15	2.22	17
16.	Privatization and commercialization will encourage foreign domination in the provision of extension services	2.04	16	2.46	15
17.	Privatization and commercialization will encourage income inequality	1.93	17	2.56	14

Spearman's Rank Correlation Coefficient, corrected for ties = 0.92

b) Congruency of farmers' perception and farmers' estimate of extension professionals' perception of P and C of agricultural extension services

Data in Table 2 show the congruency of farmers' perception and their estimate of extension professionals' perception. Results of the analysis indicate a low level of congruency between farmers' perception and their estimate of extension professionals' perception. Spearman's rank correlation coefficient for the 17 statements was 0.08. Information in Table 2 further show that there were no significant variations between farmers' perception and their estimate of extension professionals' perception in only 4 statements, while there were significant variations in the remaining 13 statements.

The implication of this finding is that there was no similarity between farmers' perception and their estimate of extension professionals' perception. The 4 statements in which farmers' perception and their estimate of extension professionals' perception are similar include: P and C will provide opportunity for neglected areas of agriculture to be attended to; P and C will break the monopoly of public extension service, P and C will encourage exploitation of farmers; and P and C will promote corruption and nepotism.

Table 2 : Spearman's rank correlation showing the congruency of farmers' perception and farmers' estimate of extension professionals' perception of P and C of agricultural extension services

S/N	Statements	Farmer's perception		Farmers' estimate of extension profs' perception	Rank
1.	Privatization and commercialization will encourage competition among extension service providers	3.44	1	3.43	5
2.	Privatization and commercialization will make agricultural information delivery to become more effective	3.33	2	3.36	8

3.	Privatization and commercialization will increase priority areas of extension coverage	3.28	3	3.11	11
4.	Privatization and commercialization will make extension services to be directed at specific needs of the people	3.19	4	3.10	12
5.	Privatization and commercialization will provide opportunity for neglected areas of agric production to be attended to	3.14	5.5	3.45	4
6.	Privatization and commercialization will help reduce govt. financial burden on agriculture	3.14	5.5	3.04	13.5
7.	Privatization and commercialization will break the monopoly of public extension service	3.12	7.5	3.38	7
8.	Privatization and commercialization will make agricultural extension services unaffordable by farmers	3.12	7.5	3.52	2
9.	Privatization and commercialization will make it possible for more farmers to be reached	3.04	9	3.04	13.5
10.	Privatization and commercialization will improve linkages between research and extension	3.01	10	3.62	1
11.	Privatization and commercialization will lead to job insecurity among public extension workers	2.92	11	2.77	17
12.	Privatization and commercialization will create job opportunities	2.76	12	3.32	9
13.	Privatization and commercialization will encourage exploitation of farmers	2.72	13	3.03	15
14.	Privatization and commercialization will promote corruption and nepotism	2.21	14	2.84	16
15.	Privatization and commercialization will encourage foreign domination in the provision of extension services	2.06	15	3.41	6
16.	Privatization and commercialization will encourage income inequality	1.98	16	3.22	10
17.	Privatization and commercialization will lead to poor capacity building	1.77	17	3.46	3

Spearman's Rank Correlation Coefficient, corrected for ties = 0.08

IV. Conclusion and Recommendation

The study examined the congruency in the perceptions of extension professionals and farmers regarding the P and C of agricultural extension services. Results show that there was a high congruency between extension professionals' perception and their estimate of farmers' perception (rho = 0.92), while the congruency between farmers' perception and their estimate of extension professionals' perception was low (rho = 0.22).

The low congruency between farmers' perception and their estimate of extension professionals' perception could be attributed to poor educational background of the farmers and their low knowledge of issues underlying the P and C of agricultural extension services. Recommendations of the study include that farmers should be educated through seminars and workshop organized by appropriate extension service agency to promote their understanding of issues in P and C of agricultural extension services.

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The Role of Microfinance Banks in Financing Agriculture in Yola North Local Government Area, Adamawa State, Nigeria

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Abstract - The study examined the role of microfinance banks in financing agriculture in Yola North Local Government Area of Admawa State. Primary data were collected from a total of 100 farmer selected by simple random sampling. Structured questionnaires were the instrument for data collection from the farmers. Simple descriptive statistics such as means and percentages and frequencies were used to analyze the data collected from respondents. Results reveal that, majority (67.11%) of the respondents were males, while 32.8% were females, 44.74% of the respondents were within the age limit of 31 – 40 years, 73.68% of the respondents were married, and 85.53% of the farmers had formal education. 60.53 % used the loan for the purpose for which it was collected and 55.26% repaid the loan collected from the Microfinance Bank Yola in (2010). 15.29% of the respondents identified high interest rate on loan acquired from microfinance bank as a major problem, 10.95% identified delay in loan disbursement as their major problem while only 1.18% of the respondents stated that they were not given the loan they applied for. The study recommends that loans for the farmers should be disbursed in good time; banks should reduce the interest rates on agricultural loans. Also, microfinance banks should be encouraged to act as a major lender in financing small scale farmers in the country to meet the food requirement of the teeming population.

Keywords : *Microfinance, Loan, Banks, Yola North, Adamawa State.*

GJSFR-D Classification : *FOR Code: 070106*

Strictly as per the compliance and regulations of :

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I. Introduction

The major of millennium development goals is the eradication of extreme poverty and hunger. For the goals to be achieved, sectors of the economy like the manufacturing and agricultural sectors need to be improved (FAO, 2004).

Microfinance institutions have become the main source of funding enterprises and agriculture in under-developing countries like Nigeria, Kenya, Pakistan etc. (CBN, 2004). Microfinance banks are distinguished from other financial institutions in that they offer small advanced loans and or savings, there is also the absence of asset based collateral and simplicity in their operation. Microfinance is very important in farm production and this fact cannot be overlooked in the sense that, it the bedrock upon which increased food production rests, which means adequate finance to improve on their production (Adebayo and Onu, 1999). It contributes to the farmers social welfare enhances production and sustainability of income. With capital, farmers source farm inputs with relative ease and hire labour where it exceeds the strength of the family to handle or carryout farm operations.

CBN 2006 stated that, shortage of primary production credit was one of the major causes of declining agricultural production in Nigeria. The shortage was attributed to reluctance by the commercial banks to provide credit for real sector achievement in agricultural production, urban and semi-urban based nature and mode of operation of the banks, high cost of administration of agricultural loans and inability of farmers to provide the necessary collateral (CBN, 2006). As a probable solution to the above problems and to enhance flow of financial services to Nigerian rural areas, the government has in the past initiated a series of public-finance micro/rural credit programme and policies targeted at the poor and agricultural sector. Notable among such programmes were the rural banking programmes.

Ekwueme *et al* (2007) and Ifeoma (2008) explained that, inadequate access to economic resources especially financed by the numerous sparsely located farmers across Nigeria continues to inhibit agricultural development. This calls for critical examinations and the adoption of an approach to avoid declaring farmers "an endangered species". It is important to double efforts to transform the economy and continuously explore pragmatic methodologies to address the problem of our farmers (Maurice and Tashkalma, 2000; CBN, 2005). Microfinance banks provide credit to the under banked sector of the economy and development of rural areas as well as the financial empowerment of those areas. While substantial progress has been made in this respect, there is still need for further improvement, with the expansion of the agricultural sector, the financial need of the sector is also increasing and there are significant opportunities for microfinance banks to deploy their funds in a remunerative manner (Ndanecho and Akum, 2009).

This study seeks to examine credit utilization and causes of loan default among farmers, and identify

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major problems militating against availability of credit to small scale farmers in the study area.

II. Methodology

The study was conducted in Yola North Local Government Area of Adamawa State. The study was narrowed down to Standard Microfinance Bank, Yola branch which is located in Yola metropolis. The bank was selected because it has been a major financier of agriculture in the local government area over the years. About 100 loan beneficiaries were interviewed using structured questionnaires. The data were analysed using simple descriptive statistical tools such as means, frequencies and percentages.

III. Results and Discussion

An analysis of socio-economic characteristics of the respondents is presented on table 1. The result shows that more than half (67.11%) of the respondents were males and only 32.89% were females. This implies that men engage more in agricultural activities than women in the study area. This may be attributed to the social norms and values in the area where women are restricted from going out i.e., they are usually left at home to cater for the domestic requirement of the household. The table shows that 2.63% of the respondents fell below the age of 20 years, 22.37% were between the ages of 21-30 years while 44.74% were between the age range of 31-40 years and only 7.8% were above 50 years of age. This shows that majority (67.11%) of the respondents were within the age range of 20-40 years implying that they are in their productive age and can strive more to access farm credit as well as energetic enough to carry out their farm activities.

Table 1 further shows the distribution of respondents according to marital status, the table revealed that the highest percentage of the respondent with 73.63% were married, 22.37% were single, 2.63% were widowed and only 1.32% were divorced. This implies that farmers in the study area have a lot of family responsibilities to carter for since majority of them (73.68%) are married.

The table also shows the family size of farmers and it revealed that, most (55.26%) of the respondents have family sizes of 5 – 10 people, 6.58% have family size of 11-15 people, 32.90% have less than 5 people in their households while only 5.26% have family size of 16 people and above. This implies that, majority of the (61.84%) have up to 15 people in their household and hence supply of family labour for farm production may be available. Furthermore, the table revealed that 85.53% of the respondents have formal education and 14.475% had informal education. The result indicates that majority of the respondents have attended western education. The table also revealed that majority (68.43%) had farming experience of 21 years and above and only 9.21% had farming experience of 11-15 and 16-20 years. This shows that, farmers in the study area generally have experience in farming activities. The high level of farming experience can go a long way to ease the bottlenecks (bureaucracy) in the process of loan acquisition from the bank.

a) Utilization of Agricultural Credit from Standard Microfinance Bank Limited

Table 2 reveals that majority (60.53%) of the respondents used the credit for the purpose for which it was applied. These could be the purchase of farm inputs such as agrochemicals, improved seeds etc. However 10.52% of them did not use the credit for the purpose for which it was applied for. This loan diversion may be as a result of family obligation due to large number of dependants, poverty or irresponsibility. On the other hand, 28.95% of the respondents did not get the loan they applied for; this is an indication that some respondents could not access the credit facilities available for famers by standard microfinance bank. This can be attributed to the fact that such farmers (respondents) could not satisfy the necessary condition put in place by the bank in order to acquire loan e.g. opening a savings account with the bank.

Table 3 indicates that 21.25% of the respondents used the loan they collected from the bank in that year 2010 to purchase seeds which may be improved seeds varieties, 18.75 of respondents used the credit/ loan for the purchase of agrochemicals which may include fertilizers, pesticides, herbicides etc. Also 21.25%of the respondents used the loan for other agricultural activities which includes purchase of animal feed, fattening of animals, purchase of tools for farming etc. while only 8.75% used for family obligation which is an unproductive venture, this may lead to default. However, most (30%) of the respondents did not apply for the loan. Probably the bank loan was not enough for the famers or the requirement to get the loan was so difficult for the famers. It could also be that such respondents acquire their capital from other sources such as friends, family, personal savings e.t.c.

b) Loan Default among Famers

From table 4, it can be observed that majority (55.26%) of the respondents were able to repay the loan collected from the standard microfinance bank ltd in 2010. This may implies that they used the loan for the purpose for which it was applied for or they did not encounter problems during the planting and harvest seasons e.g. natural hazards. About 14.48% 0f the respondents did not repay back the loan; this could be attributed to the loan diversion to unproductive venture like solving family problems. Other reason may include natural disaster like drought, flood, pests, etc which may result to poor yield. Some farmers believed that money from loan is part of their national cake and therefore do take repayment serious. However, 30.26% did not apply

for the loan. This could be attributed to their inability to meet the bank's requirements.

c) Problems affecting availability of credit to small scale farmers

Table 4 further revealed that greater percentage of farmers (31.76%) did not encounter any problem when seeking for loan and 20% of the respondents did not apply for the loan. However, 15.29% faced the problem of high interest rate, this may sometimes discourage farmers from seeking loan from the bank 10.59% complain of delay in disbursement of loan as a problem, while 3.53% complain of not being able to meet the banks requirement which may include making one third (1/3) deposit the amount the farmer is intending to borrow, presenting a guarantor, opening an account etc. Also 3.53% were faced with the problem of short period given by the bank for repayment of the loan they collected. This can lead to loan default among farmers especially because of the nature of agricultural production for example time lag for crop maturity and the risk associated with farming. The afore mentioned are some of the major reasons why farmers sell off their produce as soon as they harvest which gives them low value in terms of price. The practice also eventually leads to glut in the market at harvest periods. About 1.18% of the respondents face the problem of inability to read and write (illiteracy) and another 1.18% of them were faced with the problem of not given the exact amount requested. Similarly, 2.35% of the farmers faced the problem of lack of continuity by the bank in advancing credit/loan to farmers for their agricultural production.

IV. Conclusion and Recommendation

This study examined the role of microfinance banks in financing agricultural activities in Yola North LGA, Adamawa State. The results revealed that majority of the respondents (67.11%) were male and 73.68% married with about 85.53% who has formal education. The study also revealed that majority (60.53%) used the credit they obtained from the standard Microfinance Bank appropriately. Based on the findings of this study, it indicates that about 31.76% do not encounter any problem during the loan application and disbursement; however only 1.18% of the respondents did not obtain the amount they applied for, 3.53% complained of short repayment period while 10.59% complained of delay in disbursement. Based on the findings, it was recommended that loan for farmers should be disbursed on time to enable farmers use it effectively. Banks should also reduce interest on agricultural loan so as to enable farmers acquire and repay loan on time and with ease. Furthermore, financing institutions such as the microfinance banks are encouraged to lengthen the repayment period of loan so as to enable farmers to sell their produce at appropriate time to obtain value for their goods and also to reduce glut in the market during harvest periods. Such banks are also encouraged to act as a major lenders in financing small scale farmers in the area and nationwide to boost food production for the teeming population.

Table1 : Socio-Economic Characteristics of Respondents

SOCIO-ECONOMIC VARIABLE	FREQUENCY	PERCENTAGE (%)
Sex		
Male	51	67.11
Female	25	32.89
Age		
Below 20	2	2.63
20-30	17	22.37
31-40	34	44.74
41-50	17	22.37
Above 50	6	7.89
Marital status		
Married	56	73.68
Single	17	22.37
Divorcee	1	1.32
Widow/Widower	2	2.63
Family size		
Less than 5	25	32.9
5-10	42	52.26

11-15	5	6.58
16 and above	4	5.26
Educational status		
Formal education	65	85.53
Informal education	11	14.47
Farming experience (years)		
0-5	24	31.59
6-10	28	36.84
11-15	7	9.21
16-20	7	9.21
21 and above	10	13.16

Source: Field survey, 2010

Table 2 : Credit used for the appropriate purpose

Credit use for the appropriate purpose	Frequency	Percentage (%)
Yes	46	60.53
No	8	10.54
Not applied	22	28.94
Total	**76**	**100**

Source: Field survey, 2010.
No response: 24

Table 3 : Appropriate use of Farm Credit from Standard Microfinance Bank.

Activity	Frequency	Percentage (%)
Purchase of seeds	17	21.25
Purchase of agrochemicals	15	18.75
Family occupation	7	8.75
Others	17	21.25
Did not apply	24	30.00
Total	**80**	**100**

Source: Field survey, 2010.
No response: 20

Table 4 : Problems affecting availability of Credit to Small Scale Farmers.

Problems	Frequencies	Percentages (%)
High interest rates	13	15.29
Short repayment period	3	3.53
Delay in disbursement	9	10.59
Not given amount applied	1	1.18
Not able to meet requirement	3	3.53
No continuity	2	2.35
Illiteracy	1	1.18
A lot of questions during application	9	10.59
No problem encountered	27	31.76
Did not apply	17	20.00
Total	**85**	**100**

Source: Field survey, 2010.
No response: 15

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Evaluation of Engine Parts Wear Using Nano Lubrication Oil in Agricultural Tractors Nano lubrication

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Abstract - Machinery management tries to control maintenance and operation costs by reducing agricultural machinery damages as well. Today, nanotechnology has an important role in reducing engine wear costs by using nano particles in engine oils. To study the effect of nano oil on agricultural engines, performance of eight Massey Ferguson model 399, tractors manufactured in Iran were studied. Each oil sample was analyzed by atomic absorption spectrometry. In addition, Particle Quantifier (PQ), total base number (TBN), viscosity, fuel and water pollution tests were also applied. The results showed that usage of nano diamond oil additive in agricultural tractor engines would reduce wear in cylinders, gaskets, drive shafts, gears, camshaft and valve mechanisms by 68 percent. Also reduced wear was shown in piston ring, bearing, gaskets and exhaust valves by 64 percent. Furthermore, fuel consumption proved a reduction of 21 percent compared to conventional oil use.

Keywords : Fuel; Nano-diamond; Particles; Tractor engines; Condition Monitoring, Wear; Particle Quantifier.

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Evaluation of Engine Parts Wear Using Nano Lubrication Oil in Agricultural Tractors

Nano lubrication

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I. Introduction

Regarding the remarkable role of nanoparticles on oil efficiency, especially at high loads and pressure, nanotechnology would be an important technology by reducing damages served to engine and saving costs of fuel consumption. As machinery progressed, from steam engines to jet fighters, lubrication became an interdisciplinary science involves physics, chemistry, materials, fluid mechanics, and contact mechanics. In particular, one of the first proposed applications for new materials was lubrication as friction reducing nano-bearings in Microsystems (Stephen 2004). Decreasing the lubrication effects on the engine parts, would reduce engine power and increase the fuel consumption in agricultural machinery.

Condition monitoring and maintenance are two essential components of the modern industry (Thirouard et al. 1998). The purpose of condition monitoring is to detect faults occurring in machinery maintenance; on the other hand, is defined to maintain and extend, the lifetime of machinery. With regard to monitoring methods, oil analysis has been considered as an and effective approach because of its capability to reveal the wearing condition of the machinery through the analysis of oil properties and wearing particles (Yuan et al. 2002). Generally, recently replaced components will experience a period of higher wear known as running-in until reaching wearing pattern, under higher load conditions. Wearing will keep increasing, especially if the component is in contact with another part. Many factors control the quantification of these reactions, such as operating conditions (e.g., temperature and humidity distance shipping) and composition of the lubricating oil (Macia et al. 2003). The lubrication layer changes during the engine cycle from the piston ring motions, oil film evaporation and the like; therefore, it affects the piston ring lubricant condition. In fact, major portion of oil consumption arises from bore distortion and poor piston ring sealing resulting from ring and bore wear. Clearly, aluminum exhibits a transition from mild to high wear when the nominal contact stress exceeds a threshold value (Venkataraman and Sundararajan 1996). Application of newer technology and/or materials is being explored to achieve this goal. By employing nanomaterial, much of this objective could be achieved. Nanoscale materials have received much concern in recent years due to their outstanding properties compared to those of micron-size counterparts. Due to the remarkable tribological properties of nanoparticles, together with their good self-repair function against the worn surface and also their environ mental-friendly property, they have been known as excellent candidates for traditional lubricant additives, especially at severe frictional conditions, such as high temperature, high load and sliding speed (Sun-qing et al. 1999). Nano-lubrication therefore can be defined as the art and science necessary to control adhesion, friction, and wear of surfaces coming into contacts at the micro/nano-scale (Stephen 2004). A lot of research has been conducted on the tribological performance of diamond nanoparticles (He- long et al. 2007; Chou and lee 2008). For example, by adding Cu nanoparticles into oil, the average wear scar diameter of the stationary balls at room temperature, 50 ^{o}c, 80 ^{o}c, 110 ^{o}c and 140 ^{o}c was reduced by 13%, 16%, 21%, 23% and 25%, respectively. Therefore friction coefficient was reduced by 5%, 8%, 10%, 15% and 20%, respectively. Accordingly, this indicates that the higher the

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temperature, the better the tribological properties of Cu nanoparticles will be (Gubarevich et al., 2004). It was expected that nano-diamond additive could be increase the oil productivity in the engine, specially at high pressure and loads for agricultural operations. Also, this Y additive was shown to be able to reduce the wear in tractor engines. Basically, the reduction of damages by the use of nanotechnology are not only able to reduce the repair and maintenance costs, but they are also able to control the timelines costs.

II. Material and Methods

The experiments were performed at Agro-industry Amir Kabir company which is located in south of Ahwaz, Khouzestan province, Iran. The Agricultural land available in this company which was used for the purpose of this study was about 12000 hectares. In this company there were about 300 Massey Ferguson model 399 tractors being used for sugar cane transportation . Each tractor carried a file , in which all maintenance and repairing were recorded.

a) Research Methodology

Eight Massey Ferguson model 399 tractors were used for this research . These tractors were equal regarding operating conditions . The analysis of data in this study was performed by using a completely randomized block design . Each block of experiment was based on hours and years of operation and maintenance conditions. Engine model was four-stroke and also water-cooled Perkins diesel 1006. Tractors were working about six months in a year (at an average of 10 to 16 hours a day). They were being used for soil preparation and sugarcane transportation in high dust haze conditions. If tractors stopped due to a failure: repair and timeliness costs were measured. The first oil sampling after 120 hours of operation was taken from each tractor while Behran azarakhsh oil (base oil) was used in tractor engines. The samplings were performed immediately after the engine was turned off. Nano oil was used in the four engines and Behran turbo diesel oil in the other engines with equal characteristics . Samplings were taken at 65, 90, 115, 150 hours of the operation. Finally, each sample was analyzed by atomic absorption, while viscosity, pollution of water, and fuel were also measured. The spectrometric test was conducted to measure chemical elements in the particles and also to recognize amount and types of chemical compounds. Spectroscopy is a technique for detecting and quantifying the presence of elements in the oil and is based on the ASTM D -6595 standard. Spectroscopy benefits from the fact that each element has a unique atomic structure. Therefore, when no two elements have the same pattern of spectral lines , the elements can be differentiated. Indeed, the intensity of the emitted light is proportional to the quantity of the element present in the sample allowing the concentration of that element to be determined. The Particle Quantifier (PQ) is a ferrography screening tool. The PQ gives an index value that is not size dependant. This trendable value can assist in identifying large ferrous worn particles, whose size is greater than 10μm. This index helps to confirm growing normal wear, the onset of aggressive wear or the prospect of eminent catastrophic failure. Other indicators were viscosity and viscosity index (VI). The kinematic viscosity of the lubrication oil was measured at 40°C, in mm2/s and were based on the ASTM D445 standard . Analysis of oil samples were calculated and oil type effect was studied on the engine's worn parts . Also, fuel consumption was measured using the full tank method in all the experimental stages.

III. Results

The characteristics of engine wear, TBN and fuel consumption were investigated after using nano and turbo oils in Massey Ferguson model 399 tractors.

a) Iron (Fe)

Effect of oil type on Fe wear ratio was significant ($P \leq 0.05$). Results showed that the use of nano diamond in agricultural tractor engines as an oil additive reduced Iron wear. The average ratio of Fe wear ni turbo oil and nano-oil as shown in Figure 1. The effect of time on the Fe worn particles was significant≤ (0P.01) and they were increased when engine operation was longer. According to Table 1, the use of turbo oil after 150h reduced the Fe wear 1.21 ppm compared to base oil with 120 h operation while this amount was 19 ppm where nano oil was applied.

b) Chromium (Cr)

The analysis of variance showed a significant effect ($P \leq 0.05$) of oil type on Cr wear in tractor engines. According to Figure 1 the meaning of Cr wear effect in tractor engines for turbo-oil was more than that of nanooil. According to Table 1, the use of turbo oil after 150h reduced the Cr wear by 0.24 ppm in comparison with base oil after 120 h operation while this reduction was 1.12 ppm with the use of nano oil.

c) Particle Quantifier (PQ)

Inspection of the analysis of variance showed that the effects of oil type and time on PQ in tractor engines were significant ($P \leq 0.05$) and ($P \leq 0.01$), respectively. Figure 1 shows higher PQ index for turbo-oil compared to nano-oil. The use of turbo oil after 150h increased the PQ index to 0.88 ppm compared to base oil while this reduction was 17 ppm when nano oil was used (Table-1). 3

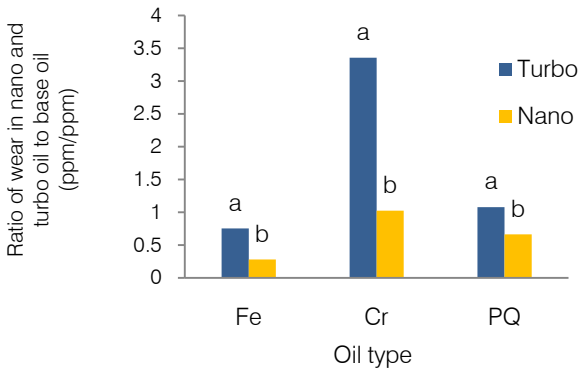

Fig.1 : Mean of different effect of oil type measuring friction on Engine parts

d) Viscosity

The effect of oil type on viscosity rate was significant ($P \leq 0.05$). Results showed that the use of nano diamond in agricultural tractor engines as an oil additive reduced the viscosity loss. Effect of time on the viscosity ratio was significant ($P \leq 0.01$). According to Table 1, the loss of Viscosity was 21.25 cSt with the use of nano oil after 150h, compared to base oil with 120h of operation also the loss increased by 13.5 cSt with the use of turbo oil in comparison with base oil.

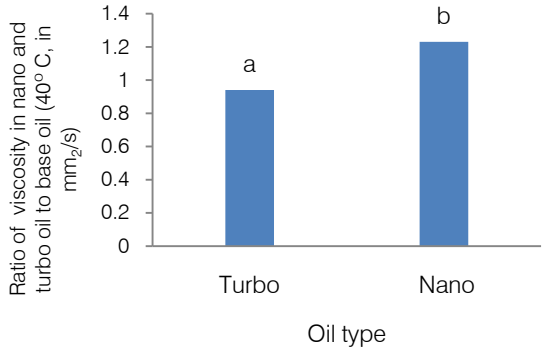

Fig. 2 : Mean of different effect of oil type measuring viscosity

Table 1 : The effect of oil type on wear and viscosity in Massey Ferguson 399 model tractors

Oil type	Base (120h)	Turbo (150h)	Base (120h)	Nano (150h)
Fe	17.5	16.29	38	19
Cr	0.68	0.44	1.75	0.63
PQ	11	11.88	27	10
Vis. @ 40 °C-cSt	164.2	150.7	157	178.3

e) Fuel Consumption

Results showed that the effect of oil type on fuel consumption was significant ($P \leq 0.05$). According toFigure 3 the reduction of fuel consumption was 1.1 litr/h were nano oil was used after 150h of noitarepo compared to base oil with 120h.

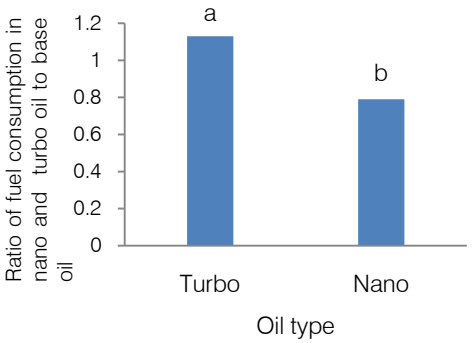

Fig. 3 : Mean of different effect of oil type on fuel consumption in Massey Ferguson 399 model tractors

IV. Discussion

Oil type affects engine components wear and fuel consumption. The nano-oils had less opportunity to contact the metal surface because of the presence of nanoparticles, whereas conventional oil is in direct contact with the metal surfaces. Lee et al. (2009) found that the friction coefficient of the nano-oil was less than that pure oil over the entire orbiting speed ranges between 300 and 3000 rpm. Consequently, reduction of the Fe particles wear had an important effect on reducing engine parts damages, for example cylinders, gaskets, drive shaft, wheel gear, the desire cam, and valve mechanism. This can therefore reduce the cost of repairing engine parts. Ginzburg et al. (2002) and Rapoport et al. (2002) reported that the fullerene particles suspended in the nano-oil had spherical structure and played a role as ball-bearings on the friction surfaces, this phenomena was identified by the lower friction coefficient of nano-oil compared to regular oil. The presence of nano-particles in oil reduced the metal-metal contact in tractor engines. Due to the applied high Cr in engine component; reduction in friction effect by nano-oil was significant. It is assumed that carbon nanoparticles were coated on the frictional surfaces so that the presence of nanoparticles between the frictional surfaces seemed to prevent metal contact. As more nanoparticles were added to the coated area, the microstructure of the coating became finer and more compact (Erb 1995). Chromium was highly used in engine components as rings, tapered roller bearings, gaskets and exhaust valves. Piston ring dynamics is very important for the lubricant characteristic of reciprocating engines which leads to the consequences of engine wear and amount of lubricating oil

consumption (Wannatong et al. 2007). As a result, the nanoparticles reduced friction in these engine parts through better lubrication. It appears less metal contacts occur with the presence of nanoparticles in the oil suspension. This is because nanoparticles, which were inserted between the friction surfaces, improved the lubrication performance by increasing viscosity and preventing contact between the metal surfaces. Effect of nano-oil in reducing PQ showed nanodiamond additive could play an important role in better lubrication and reduced damages and parts wear in tractor engines. Very high friction coefficients can occur in practical mechanical contact when there is a breakdown or absence of lubrication. It can be seen that the wear scar diameter and friction coefficient of oil containing nanoparticles are lower than those of pure oil. Hsiao et al (2009) previously reported a large reduction in the friction appeared after adding 2% or/and 3% of the nano-diamond a tnacirbuldditive to a base oil. The nano-additive reduced the risk of direct metal–metal contact hence achieving a very positive tribological role against surface adhesion, wear, and eventually global friction. In other zones of the same lubricated contact; it could be found that a nano-film did completely separate the contacting surfaces (Hsiao et al. 2009; Van Alsten and Granick 1988). This reveals that the addition of nano-diamond additive is beneficial to postpone or even avoid scuffings during the test. The viscosity of oil changes with temperature. The frictional heat raises the temperature of the interface and the oil. Frictional heat makes the temperature at contact spots to rise continuously. It appears that the temperature of oil containing nanoparticles is lower. Viscosity affects heat generation in bearings, gears, pistons, etc., due to internal fluid friction. Furthermore, formation of lubricating films, rate of oil consumption, starting of machines at various temperatures, is all affected by viscosity (Saurabh 2005). The dispersion nano-diamond particles in oil collected the oil cells with dimensions about 6 microns, increased the viscosity of the lubrication, and created a thin layer on the surface. Also better heat transfer with use of nano-diamond particles in engine oil reduced the viscosity loss, increased the stability of lubricating, and reduced the oil drip. Nano-diamond as additives in oil can effectively improve the lubricating properties of oil. The nano diamond by increasing of the lubrication and insulation improved the engine efficiency and reduced the fuel consumption in tractor engines.

V. Conclusion

In summary, nano-diamond particle resulted in an improvement of anti-scuffing performance in the engine oil. Using of nano diamond in agricultural tractor engines as an oil additive was able to reduce the wear in cylinders, gaskets, drive shaft, gears, camshaft, and valve mechanism by 68 percent . Also this additive reduced the wear in rings, the bearings, gaskets and exhaust valve by 64 percent. This could indirectly indicate that the nano-oil enhanced the characteristics of the antiwear and friction resistance on the engine parts. As a result of various tests, the nano-particles in lubrication oil improved the lubricating performance on the friction surfaces by reducing wear on metal surface. Durability of the nano-oil utilized in agricultural tractor engines was 22 percent more than turbo-oil. Also fuel consumption was reduced 21 percent compared to conventional oil.

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Studies on Distribution and Disappearance Pattern of Calcium from Calcite Powder and Its Influence on Rumen Fermentation

By B. Abegaze
Jimma University, Ethiopia

Abstract - Mineral supplements differ in their bio-availability, which must be taken into consideration, before the use of any such supplement. Two crossbred fistulated calves housed in individual pens and fed Calcium carbonate (T1) and Calcite powder (T2) were used to study the distribution and disappearance pattern of calcium and its influence on rumen fermentation. The proportion of Ca distributed in soluble, particulate and solid phase of the rumen digesta, pH of the filtrate, Ammonia-N and VFA concentration, rate of disappearance of Ca and rumen flow rate, dry matter intake and other related measurements were used as evaluation parameters. The results obtained showed that there were no significant difference ($P<0.05$) between the treatments in NH3- N concentration in the rumen liquor of the experimental animals, indicating that replacing $CaCO_3$ with calcite powder did not affect NH_3-N concentration in the rumen. There was no significant difference between different sources of Ca fed to animals in total DMI or DMI per 100 kg body weight of animals, suggesting that calcite powder had any adverse effect on the palatability of the diet. Rumen pH and concentration of NH_3-N and total VFA in the rumen liquor of animals were similar, indicating that functions of cellulolytic organisms in the rumen were not affected by feeding calcite poweder.

Keywords : Calcium carbonate, Calcite poweder, Disappearance pattern, Solubility and Rumen fermentation.

GJSFR-D Classification : FOR Code: 100303

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Keywords : Calcium carbonate, Calcite poweder, Disappearance pattern, Solubility and Rumen fermentation.

I. Introduction

Mineral supplements are nutritional devices to fortify the normal feeds and fodders in the areas to meet the mineral needs of livestock and poultry at specific levels of animal productivity. The effort to increase animal productivity manipulating by genetic potentials has further accentuated the problem of mineral nutrition and also of the mineral supplements. In case of high producing animals, there is a tremendous daily drainage of calcium (Ca) through milk and adequate mineral supplements need to be devised to replenish the daily loss, in spite of the fact that internal regulatory mechanism in animal can take care of the transient periods of enhanced needs. ISI (now BIS) has laid down the specifications of minerals supplements and the same has been reviewed a number of times (1960, 1961, 1968, 1982, 1992 and 2002). In certain countries, specific mineral supplement like high calcium, high magnesium and high phosphorus are commercially manufactured to meet the demands of specific areas in question, called region specific mineral supplements. Mineral supplements are available under various trade names in the market. The Bureau of Indian Standards (BIS) imposes compositional standards of feeds and mineral mixture for different categories of livestock and modifies the standards periodically. (12) recommended the use of bone meal, chalk powder and di-calcium phosphate as a source of Ca and P in mineral mixture. Quality specifications were also laid down (13). (14) allowed the use of calcined bone meal, in addition to steamed bone meal, chalk powder and di-calcium phosphate. In 1982, ISI recommended the use of ground limestone in the list of ingredients for use in formulation of mineral mixture. In 1992 specifications for Mg and S were laid down (4).

(5) withdrew the use of supplements of animal origin i.e. bone meal, di-calcium phosphate of animal origin, calcined bone meal, etc., and allowed the use of calcite powder in mineral mixture. Indian cattle feed industry is using calcite powder on wide scale on account of it's being easily available and cheaper source of calcium (26). (25) reported that various mineral supplements differ in their bio-availability, which must be taken into consideration, before the use of any such supplement it is necessary to comparatively scan them for availability of useful elements and also ensuring the absence of toxic levels of incriminating minerals in them. Unfortunately there is no literature on the availability/ utilization of Ca from calcite powder in livestock although; calcite has been used as a buffer in high milk producing cows (17). This being the case, the major objective of this research undertaking was to study/to determine ruminal distribution and

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disappearance of calcium from calcite powder and its influence on rumen fermentation.

II. Materials and Methods

a) Management of the Experimental animals

Two crossbred male rumen fistulated calves of 4 years of age housed in individual pens were used for this study. Based on the calcium and phosphorus content of $CaCO_3$ and calcite powder two mineral mixtures (Table 1) were prepared using Diammonium phosphate as the sole source of P.

Two concentrate mixtures were also prepared by mixing maize, barley, groundnut cake, wheat bran, mustard cake and the respective mineral mixtures shown in Table 2. The quantity of NPN supplied through DAP of mineral mixtures in concentrate mixture of group I and group II was adjusted with the addition of urea and the concentrate mixtures were made iso nitrogenous and iso caloric.

The experimental treatments differed only with respect to supplements of Ca from mineral mixture as the mineral mixtures of different treatment groups contained different sources of Ca supplements. Each animal was offered 3 kg concentrate mixture and 5 kg wheat straw/ day for study period of 21 days at the end of which the samples of rumen liquor were taken for the estimation of the parameters to be studied the animals were then switched over to the next treatment in a switch over design in which experimental pre-feeding was followed again for 21 days followed by sampling.

b) Sample Collection and Ca Determination

The rumen contents were mixed manually by inserting hand inside the rumen followed by collecting of about 500 ml of rumen digesta from each animal in stoppered measuring cylinder. The digista were filtered through four layers of cheeas cloth by pressing it hard. Finally, the proportion of Ca distributed in soluble, particulate and solid phase of the rumen digesta was determined.

III. Determination of Rumen Metabolites

The pH of the filtrate was immediately recorded with the help of ECIL digital pH meter. Ammonia-N was determined by Micro diffusion technique of (6) and calculated as Ammonia-N (mg/ 100 ml SRL) = ml of acid used x normality of acid x 14 x 100. The Total volatile fatty acids (TVFA), was estimated by the method of (2) and calculated as:

$$\text{TVFA (in meg/ 100 ml of SRL)} = \frac{\text{Vol. of NaOH used x Normality of NaOH x 100}}{2}$$

The Individual VFA fractions were partitioned and estimated with the help of Nucan gas chromatograph. A standard mixture of acetate, propionate and butyrate in the molar ratio of 60:30:10 was also run into the gas chromatograph under similar conditions, as those for the samples. Different proportions of acetate, propionate and butyrate in the samples were calculated as

Peak area = ½ height of the peak x width of the base line

a) Rumen disappearance pattern of Ca

The disappearance of Ca from the rumen was calculated based on the principles of disappearance pattern of N from rumen as described by(24) and calculated as.

Disappearance of Ca through rumen fluid = rumen fluid flow rate (1/ hr) x mean Ca concentration of rumen fluid (mg/ l ml)

The rumen fluid flow rate (1/ hr) of all the animals under different treatments was calculated by estimating first their respective rumen volumes. The concentration of Ca in the f rumen fluid was estimated after ashing known amount of aliquot.

b) Rumen fluid volume and flow rate

Rumen fluid volume was estimated with the help of polyethylene glycol (PEG, of M. W.4000) according to (11) as modified by (30). During rumen volume and flow rate determinations the feeding pattern was slightly changed. The animals were maintained in a steady state condition of rumen fermentation by offering wheat straw and water distributed at hourly intervals. About 100 ml of 25% solution of PEG was infused into the rumen just at the time of feeding of concentrate mixture as recommended by (30). Samples of the rumen liquor collected at 1, 2, 3, 4, 5, 6, 7 and 8 hrs after the infusion of PEG solution were stored in deep freezer for further analysis.Estimation of PEG concentration was done according to (30). A standard curve was drawn for different concentration of PEG against OD readings.

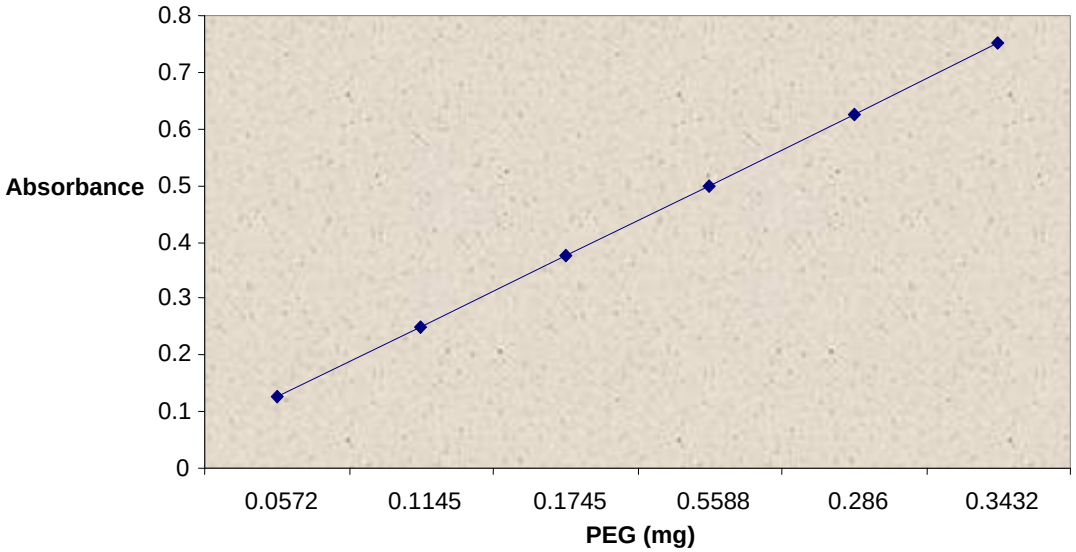

Fig 1 : Standard curve for estimation of PEG

Finally data on different parameters were subjected to t-test

IV. Results and Discussions

a) Mineral composition of experimental concentrate mixtures

The mineral composition of concentrate mixtures of treatment I (T_1) and treatment II (T_2) prepared from mineral mixtures containing $CaCO_3$ and calcite powder respectively is presented in Table 3. Although there was some variation in the chemical composition of $CaCO_3$ and calcite powder, quantities of Ca and P per 100 kg of concentrate mixture were so adjusted that the respective concentrate mixture supplied the same quantity of Ca and P. The Ca content of concentrate mixtures fed to animals in T_1 and T_2 was 1.2% whereas P content ranged from 0.64 to 0.65%. Wheat straw which was the sole source of roughage in both the treatments contained 0.22% Ca and 0.08% P. There was only little variation in Mg and other trace mineral contents in concentrate mixtures under the respective treatment groups.

b) Dry matter and Ca intake of animals

The average live weight of animals and their total dry matter intake have been presented in table 4. The mean value for DMI of animals in $CaCO_3$ and calcite powder fed treatments was 8.19±0.41 and 8.66±0.66kg per day respectively and differences were non-significant (P>0.05). Dry matter intake per 100 kg body weight of animals in respective treatment groups was 1.90 and 1.99 kg/ day, respectively. These difference were also non-significant (P>0.05). (Intake of Ca through concentrate mixture, wheat straw and total has been presented in Table 4. In the treatment groups T_1 and T_2 the total dietary Ca content ranged from 54.18 to 55.41 (g/d) indicating that about 27.00 and 35.72% of Ca in the respective concentrate was from externally added supplement. These different sources of Ca fed to animals in concentrate mixtures did not show any difference in the total DMI or DMI per 100 kg body weight of animals. The results suggested that neither the $CaCO_3$ nor the calcite powder had any adverse effect on the palatability of diet.

V. Effect of Different Sources of Casupplements on Rumen Metabolite

a) Rumen Metabolites

The average value of rumen pH, NH_3-N concentration and total and individual VFAs in SRL collected 4 hours after feeding have been presented in Table 5.

b) Rumen pH

Rumen pH in different treatment groups T_1 and T_2 were respectively 6.21 ± 0.11 and 6.99 ± 0.06 and there was no significant difference between the treatments. (7) observed that major minerals play an important role in maintaining the physico-chemical characteristics of rumen medium, the major buffering components in the rumen are Na, K, P and VFAs and any change in these components in rumen results in the change in rumen pH. In the present experiment no significant effect on rumen pH was observed as there was no difference in the supply of dietary P or Na and the supply of minerals was similar in both the groups. The results of the present study are in concurrence with the findings of (23),Who fed different sources of Ca to calves and observed that rumen pH in different treatment groups varied between 6.20 ± 0.13 to 6.56 ± 0.07 and that there was no treatment effect in the various groups.

c) Ammonia-N

NH_3-N concentration in the rumen liquor of animals in treatments T_1 and T_2 were 27.48 ± 3.23 and 25.13 ± 2.81 mg) 100 ml SRL (Table 5). These values were statistically similar, indicating that replacing $CaCO_3$ with calcite powder did not affect NH_3-N concentration in the rumen. The increased ammonia-N concentration in the rumen fluid during P deficiency has been reported *in vivo* (9) and *in vitro* (18, 19, 20, 21) as a result of reduced utilization by rumen microorganism. In the present investigation the diet was adequate in P in both the treatments and thus, there was no difference in the NH_3-N concentration among the various treatment groups.

d) Total volatile fatty acids

The level of total VFAs in respective treatment groups T_1 and T_2 were 8.02 ± 0.50 and 7.94 ± 0.21 meq/ 100 ml SRL. The ruminal TVFA showed no significant difference ($P>0.05$) indicating that functions of cellulolytic organisms in the rumen were not affected by feeding the different sources of Ca supplement in concentrate mixtures. The relative percentage of individual VFAs i.e. acetate, propionate and butyrate also showed no treatment effect (Table 5). It was evident from the data in Table 5 that the treatment did not influence the relative proportions of acetate, propionate and butyrate. Therefore, it can be concluded that different sources of Ca supplements (calcium carbonate and calcite powder) exerted no influence on energy metabolites. (23) used different sources of Ca and P such as dicalcium phosphate and chalk powder, marble powder and sodium phosphate, gypsum and sodium phosphate, rock phosphate and sodium phosphate and superphosphate and sodium phosphate and observed that neither TVFAs nor the proportion of acetate, propionate or butyrate differed in any of the treatments. (1) fed $CaCO_3$ and Ca propionate (prilled) to steers and observed that TVFA were not affected by Ca level or its source, however, the addition of Ca propionate decreased the molar percentage of acetate due to the increase in propionate being fed. In fact, the proportion of acetate was lower with supplemented Ca propionate compared with $CaCO_3$.

VI. Distribution of Calcium in Ruminal Contents

The distribution of Ca in soluble (centrifuged supernatant SRL), particulate (centrifugate mass) and solid phases (separated solid portion) of the rumen digesta collected 4 hrs after feeding, have been presented in Table 6.

The % Ca content ranged from 8.84 to 12.03 in soluble phase, 19.01 to 25.21 in particulate phase and 62.75 to 72.14 in solid phase of the rumen digesta respectively. The distribution of Ca was lowest in soluble phase of rumen content and was a little more than doubles the value of soluble phase in the particulate phase. However, Ca was mostly located in solid phase or rumen digesta in both the treatment groups. Data in Table 6 further indicates the distribution of Ca from $CaCO_3$ and calcite powder in different phases of rumen digesta did not vary significantly. It was observed earlier through; *in vitro* studies with ruminal buffer, that various Ca supplement sources did not have similar Ca solubility in the rumen. The Ca solubility was influenced by pH changes (phase-II). Such findings indicated that there may be variability of Ca distribution in soluble, particulate and solid phase in rumen liquor. The present studies suggested that Ca from different sources was soluble from 8-12%. These findings are in agreement with the findings of (22) who observed that Ca from various sources such as marble, gypsum, rock phosphate and superphosphate was soluble in the rumen fluid to the extent of 7-9%. The proportion in the solid phase was the resultant effect of its distribution in the soluble and particulate phase and was about 62-72% of total Ca present in the rumen contents which was lower than the observations of (22) who observed that the proportion of Ca from marble, gypsum, rock phosphate and superphosphate varied between 80.5 to 86.7% of total Ca present in the rumen content.

a) Calcium concentration in SRL

The calcium concentration in the ruminal fluid is influenced by the dietary levels of this element and its solubility in the rumen contents (33, 32, and 22). In the present experiment, Ca concentration in SRL samples collected at 0, 1, 2, 3, 4, 5, 6, 7, and 8 hours after feeding of concentrate mixtures prepared from $CaCO_3$ and calcite powder as a source of Ca is presented in Fig. 2.

The mean values of Ca concentration in T_1 and T_2 were 28.45 ± 1.40 and 14.88 ± 0.80 mg / 100 ml SRL (Table 7) which were statistically not similar. It was further evident that in both the treatments the maximum concentration of Ca (mg/ 100 SRL) was after 1 hour of feeding Calcium concentration in the ruminal fluid is known to be influenced by dietary level of Ca and its solubility in the rumen contents (33, 32). In the present experiment dietary intake of Ca was similar in both the treatment groups but the solubility of Ca from calcite powder was lower hence the concentration of Ca was lower in the SRL of T_2 group, indicating that the sources of Ca in the diet exerted significant effect on Ca concentration of SRL in contrast, (22) observed that there was no variation in the Ca concentration (mg/ 100 ml SRL) of calves fed similar quantity of Ca through various sources of Ca supplements i.e. marble, gypsum, rock phosphate and super phosphate, which might be due to the fact that in this studies solubility of Ca from different sources of Ca was similar supports the findings of the present study.

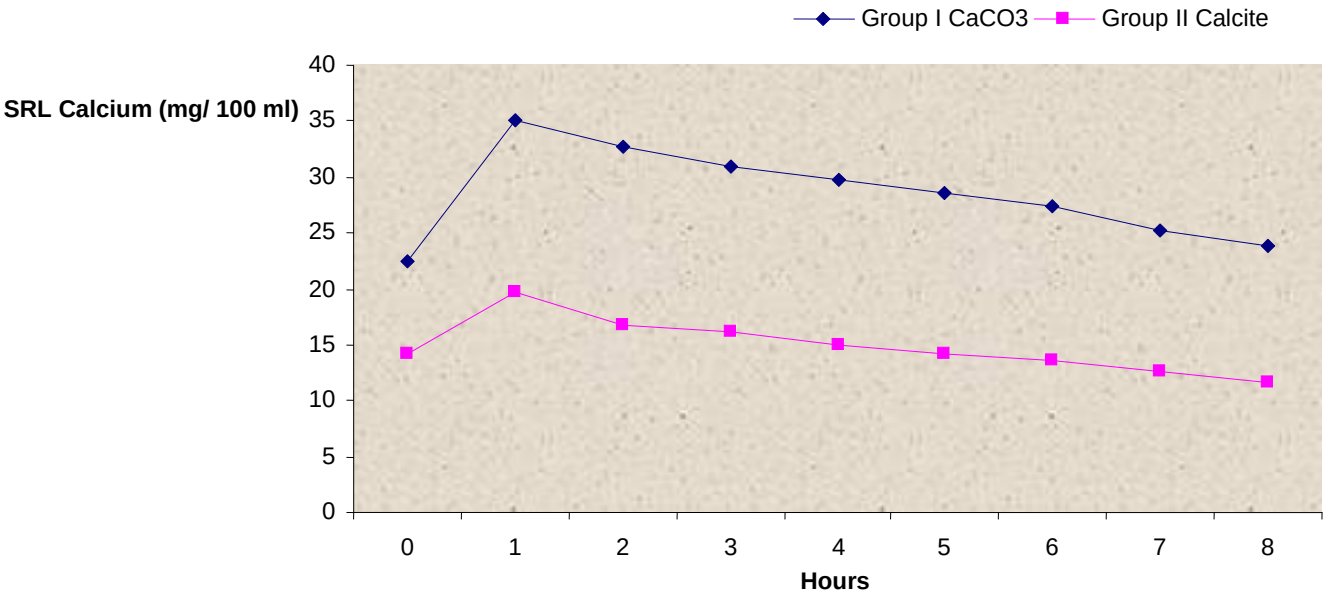

Fig. 2 : Calcium Concentration in SRL

VII. Ruminalfluid Volume and Its Flow Rate

The data on rumen fluid volume, rumen fluid flow rate and water intake of animals have been presented in Table 8.

The mean values of rumen fluid volume under various treatments (T_1 and T_2) were 56.52 ± 1 and 56.25 ± 1.26 L, respectively. Statistical analysis of the data did not reveal any significant variation in the rumen volume of calves fed diets containing $CaCO_3$ or calcite powder as source of Ca. The results revealed that rumen volume was not influenced by the source of Ca supplement used. The mean liquid outflow rate (L/h) in crossbred calves fed on diets containing $CaCO_3$ (T-1 1.67 ± 0.22) was lower than the diet containing calcite powder (T_2 – 2.04 ± 0.19) as a source of Ca. However, statistical analysis of the data revealed that $CaCo_3$ or calcite powder did not alter the liquid outflow rate in crossbred male caves. The findings of the present study are in agreement with the findings of many earlier workers (28) who reported that rumen fluid volume, that ruminal fluid out flow and ruminal fluid outflow per kg DMI were not altered significantly by the source of Ca included in the diet. (22) also demonstrated that source of Ca in the diet of crossbred calves did not influence the rumen volume and rate of passage of liquid digesta, however, he reported lower values of rumen volume and rate of passage of liquid digesta than that recorded in the present study, which could possibly be due to difference in the age of experimental animals affecting DMI and water intake.

Ingestion of certain inorganic salts like sodium chloride or sodium bicarbonate was found to increase water intake, rumen fluid volume and flow rate (8, 31) and decrease DMI and digestion of organic nutrients (28). In the present study the ingestion of sodium salt (sodium chloride) was similar in both the treatment groups which might also be reason that there was no significant variation in water intake or rumen fluid volume of both the treatment groups.

Rumen fluid volume as percent of body weight in calves fed different sources of Ca (T_1 and T_2) was 13.08±0.23 and 11.24±0.64 respectively and the variations among the treatments were not significant (Table 8). Percent volume was comparable with those reported by (27, 29, 3 and 10).

a) Rumen disappearance rate of calcium

The rumen disappearance rate of Ca through rumen fluid under various treatments has been presented in Table 8. These values were 475.12±23.54 and 303.55±6.39 mg/hr for the groups T_1 and T_2 respectively. The difference in disappearance rate of Ca through rumen fluid was statically significant, showing variability in rumen disappearance rate of Ca on using $CaCO_3$ and calcite powder as a source of Ca in the diet. This difference could be attributed to low solubility of Ca from calcite powder at rumen pH 7 (Phase-II) resulting in lower Ca concentration in soluble phase of SRL (Table 8). The availability of Ca to the animals from the lower gut may depend upon the rumen fluid concentration and the digesta flow rate, since the treatment groups in the present study indicate significant difference in the Ca concentration of SRL and ruminal disappearance rate of Ca in the availability of Ca from both the Ca supplements ($CaCO_3$ and calcite powder) to the animals *in vivo.* Thisneeds to be evaluated further.

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Table 1 : Composition of mineral mixtures used/ 100 kg of concentrate mixture*).

Treatments	Ca/ P sources used	Ca and P content		Qty. (kg/ 100 kg of conc. mixture	Total supply of Ca and P through supplement in 100 kg conc. mix.	
		Ca%	P%		Ca (g)	P (g)
Group I	Calcium carbonate	39.2	0.12	1.0113	396.73	1.21
	Diammonium phosphate		23.0	0.7000	--	161.00
	Total				396.73	162.42
Group II	Calcite powder	40.9	1.1	0.9779	399.96	10.76
	Diammonium phosphate		23.0	0.5800	--	133.4
	Total				399.96	144.16

* In addition to Ca and P sources used the following ingredients were added to the mineral mixture of group I and group II for the preparation of complete mineral mixture. sodium chloride 0.900 kg, trace mineral mixture 0.1185 kg containing magnesium carbonate 90 g, ferrous sulphate 15 g, copper sulphate 2.1 g, cobalt chloride 1.5 g, potassium iodide 0.3 g, zinc sulphate 7.5 g and manganese dioxide 2.1 g.

Table 2 : Composition of concentrate mixtures* (kg/ 100 kg).

	Group I	Group II
	Treatment-I	Treatment-II
Maize	20.0000	20.0000
Barley	20.5204	20.6486
Groundnut cake	10.0000	10.0000
Wheat bran	34.0000	34.0000
Mustard cake	12.0000	12.0000
Urea	0.7300	0.7750
Calcium carbonate	1.0113	--
Calcite powder	--	0.9770
Diamonium phosphate	0.7000	0.5800
Sodium chloride	0.9000	0.9000
Trace M. Mixture*	0.1185	0.1185

***** Contained magnesium carbonate 90 g, ferrous sulphate 15 g, copper sulphate 2.1 g, cobalt chloride 1.5 g, potassium iodide 0.3 g, zinc sulphate 7.5 g and manganese dioxide 2.1 g. Vitamin supplement, having the strength of 82,500 IU of vitamin A, 50 mg of vitamin B, 12,000 IU of vitamin D and 10 mg of vitamin K per g of spectromix powder was mixed 10 g of concentrate mixtures.

Table 3 : Mineral composition of experimental concentrate mixtures and wheat straw (%DM basis).

Parameters	Wheat Straw	Conc. Mixture I	Conc. Mixture II
Total ash	11.20	5.17	4.59
AIA	6.44	0.36	0.37
Ca%	0.22	1.20	1.20
P %	0.08	0.65	0.64
Mg%	0.13	0.45	0.39
Fe (ppm)	525.00	710.00	699.00
Cu (ppm)	18.50	22.00	27.00
Zn (ppm)	32.00	61.00	57.00
Mn (ppm)	33.00	58.00	55.00

Table 4 : Average live weight, intake of DM using different sources of Ca.

Parameter	Treatment	
	T_1 ($CaCO_3$)	T_2 (Calcite powder)
Average live weight (kg)	432±0.91	435±0.91
DM intake		
Concentrate (kg)	3.69±0.01	3.71±0.01
Wheat straw	4.50±0.17	4.95±0.13
Total DM intake (kg)	8.19±0.41	8.66±0.62
DM intake/ 100kg BW	1.90	1.99
intake of Ca (g) through		
Concentrate	44.2	44.52
Wheat straw	9.9	10.89
Total	**54.18±17.19**	**55.41±16.82**

Similarly Lall (1987) used DCP, marble powder gypsum and super phosphate in the ratio/n of calves as a source of Ca and observed that there was no adverse effect of these Ca sources on the DMI of the calves.

Table 5 : Rumen metabolites in animals under various treatments.

	T_1	T_2	t (calculated value
Rumen pH	6.21 ± 0.11	6.99 ± 0.06	0.76
NH_3 – N (mg/ 100 ml SRL)	27.48 ± 3.23	25.13 ± 2.81	0.78
Rumen VFA			
i) Total Volatile fatty acids(meq/100 ml SRL)	8.02 ± 0.50	7.94 ± 0.21	
ii) Proportion of individual VFA's (%)			
Acetate	50.93 ± 0.62	49.64 ± 0.79	1.28
Propionate	27.47 ± 0.35	27.48 ± 0.30	0.03
Butyrate	21.58 ± 0.73	22.87 ± 0.90	1.11

Table 6 : Calcium distribution (%) in ruminal contents of animals under various treatments.

	Treatment-1 ($CaCO_3$)	Treatment-II (calcite powder)
Distribution of Ca%		
In soluble phase	12.03 ± 1.24	8.84 ± 1.32
In particulate phase	25.21 ± 6.28	19.01 ± 5.78
In solid phase	62.75 ± 16.21	72.14 ± 18.18

Table 7 : Mean calcium concentration (mg/ 100 ml) in SRL of animals under various treatments function of time.

Treatment-1 ($CaCO_3$ as Ca source)	Treatment-II (calcite powder as Ca source	t (calculated values)
28.45 ± 1.40	14.88 ± 0.80	8.42**

** Significant ($P<0.01$)

Table 8 : Effect of different dietary calcium supplements on rumen fluid volume, out flow rate and disappearance pattern of Ca through rumen fluid.

Parameters	Treatment-1 ($CaCO_3$)	Treatment-II (calcite powder)	(t)calculated value
Water intake (lit/ day)	51.74 ± 3.79	47.68 ± 3.06	0.84
Rumen fluid volume	56.52 ± 1	56.25 ± 1.26	0.18
Rumen fluid flow rate (l/ h)	1.67 ± 0.22	2.04 ± 0.19	1.025
Rumen fluid volume as % of B.W.	13.08 ± 0.23	12.93 ± 0.29	0.41
Rumen fluid flow rate per kg DM (Lit/ kg DM)	5.57±0.74	6.38± 0.60	0.85
Rumen disappearance rate of Ca through rumen fluid (mg/h)	475.12±23.54	303.55±16.39	6.02*

***** Significant ($P<0.05$)

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Induced Breeding of African Catfish (Clariasgariepinus) Under Varying Brood Stock Ratios

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Abstract - A reputable fish farm in Abeokuta, Ogun State, Nigeria were used to carry out studies on the induced breeding of Clarias gariepinus under varying brood stock ratios. Six gravid females weighing 1.00 kg each and 6 reproductively matured males weighing 1.00 kg were used for the three induced breeding trials in ratios of 2:1, 1:2 and 2:3, female/male respectively. Females were injected at a dosage of 0.50 ml ovaprim/kg body weight and 0.25 ml/kg body weight for males. Hatching starts after 24 hours of incubation and lasted for 6 hours. Dissolved oxygen, pH, ammonium ion, nitrate ion levels and temperature were monitored. Mean weight of eggs produced is 285.00 g ± 65.00 with a relative percentage weight of eggs to body weight of 26 to 33%. Also, fecundity was the same in all the treatments with a value of 66,000+100 eggs. The lowest pseudo-gonadosomatic index of 41.50+6.50 was recorded in treatment 1, while the highest value of 51.00+3.00 was recorded in treatment 2. The effect of the varying brood stock (female:male) ratios in all the trials were not significantly different at ($P<0.05$) as indicated by the number of fertilized eggs, number of hatched eggs, % larval production and survival.

Keywords : *Brood stock, Clarias, fertilization, induced breeding.*

GJSFR-D Classification : *FOR Code: 070201*

Strictly as per the compliance and regulations of :

Induced Breeding of African Catfish (*Clariasgariepinus)* Under Varying Brood Stock Ratios

Dr. I. Abdulraheem [α], S. O. Otubusin [α], O.T. Agbebi [α], O. Olowofeso [σ], K. A. Adeyemi [σ], Ashley-Dejo S. S [α]

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I. Introduction

Over the past decades, aquaculture has grown in leaps and bounds in response to an increasing demand for fish as a source of protein globally (Akinrotimi *et al.*, 2007a). The single most important drawback of large-scale commercial culture of several fish species is the deficiency of quality seed of uniform size and free of diseases, parasites, and pests at the time of stocking in culture ponds (Marimuthu *et al.,* 2009). Odedeyi (2007) noted that the largest mature *C. lazera* (*gariepinus*) would usually give the best spawn weight in induced breeding, but there is no literature available as to whether the fish with the best spawn would equally give the best fry survival and best growth performance. A major pre-requisite for successful fish farming enterprise is a reliable and consistent source of fish seeds (fingerlings) of the commercially important species(Nwubaand Aguigwo, 2002). The surest and most reliable source of supply is to produce the fingerlings under a controlled system, usually in a hatchery as earlier emphasized by Ezechi and Nwuba (2007). The objective of this study was to determine the most appropriate male-female ratio of catfish (*Clariasgariepinus*) brood stock for induced breeding.

II. Materials and Methods

a) Experimental site

The hatchery facilities of a reputable private fish farm known as 'Aqua Consult Ltd' situated in Abeokuta, the Ogun State capital in Nigeria was used for the study. The hatchery has an indoor flow through system with ten holding concrete tanks (six 2 m × 6 m and four 2 m × 3 m) equipped with 101.60 mm diameter inlet and outer polyvinyl chloride (PVC) pipes. The concrete incubation tank measured (2 m × 3 m × 1 m) also with inlet and outlet PVC pipes, respectively.

b) Catfish brood stock for the trial and hormone injection

Gravid female and matured male were obtained from the brood stock pond of the farm mentioned above. A total of 6 females and 6 males were used for the three hatching trials in each tank in the ratio of female: males 2:1, 2:2 and 2:3 (weight in kg). Oxygen in each tank was maintained above 6.00 mg/l and temperature ranged from 25.70 to 27.00°C. All the fish were weighed ad starved for 24 hours before ovaprim was administered using 2.00 ml capacity syringe with $1^{1/4"}$ needle for injecting the fish. The needle was inserted 2.00 to 2.50 cm intramuscularly at an angle between anterior part of the dorsal fin towards the direction of the tail. The females were injected at a dosage of 0.50 ml/kg body weight and 0.25 ml/kg body weight for males.

For the first trial, the eggs from the two females were stripped after a latency period of 11 hours into a bowl and the total egg weight was weighed using a weighing balance. The male was sacrificed and the testes collected and pierced with a needle and the milt squeezed on the eggs contained in the bowl and thoroughly mixed dry for a minute with a plastic spoon. Clean sterilized water was added and the eggs mixed for another two minutes. The fertilized eggs contained in bowl were incubated by spreading them on submerged

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Hapa netting in a prepared incubation tank. This procedure was repeated for the second and third trials respectively.

Fecundity was estimated according to Hogendon (1977) and Haylor and Oyegunwa (1993) by the equation:

$$TotalNoofEggs = 66.60[Femalebodyweight(g)] \text{ ---------- } Eq.1$$

The pseudo-gonadosomatic index (PSI) also taken as sensitivity to ovaprim was calculated with the relation:

$$PGSI = \frac{100(Weightofeggscollectedbystripping)}{Bodyweightbeforeinjection - Weightofeggsstripped} \text{ --------- } Eq.2$$

After 24 hours of incubation, hatching started and lasted for 6.00 hours. During this time, water parameters such as, temperature, pH and dissolved oxygen concentration in the incubation tank were assessed. Percentage larval production, larval survival and mortality were calculated as follows:

$$\%Larvalproduction = \frac{100(Numberofeggs)}{Numberoffertilize\deg gs} \text{ -------- } Eq.3$$

$$\%Larvalsurvival = \frac{100(Numberofnormallarval)}{Numberofeggshatched} \text{ ------ } Eq.4$$

$$\%Mortality = \frac{100(Numberofdeformedlarvae)}{Numberofeggshatched} \text{ --------- } Eq.5$$

After the third day of hatching, the larvae have absorbed their yolk sacs and they were distributed into the prepared twelve compartments in the outdoor nursery tanks of 2.80 m × 1.70 m each and were fed with *copens* fish feed.

c) Statistical analysis

Data collected were subjected to statistical analysis using one-way analysis of variance (ANOVA) test and the differences were tested for significance ($P<0.05$) using Duncan's Multiple Range Test (Duncan, 1955).

III. Results

a) Latency period, fecundity and pseudo-gonadosomatic index

The dosages of ovaprim administered were 0.50 ml for females of 1000 g each and 0.25 ml for males weighing 1000 g each. Latency period for the females was from 11 to 11 hrs, 20 mins. (Average 11.10 h) (Table 1). Weight of eggs was highest in treatment II and lowest in treatment I with a relative percentage weight of egg to body weight of 33 and 26% respectively.

The pseudo-gonadosomatic index (PSGI) ranged from 35% to 49%. This also showed a direct relationship with mean weight of eggs of fish. Treatment II had the highest PGSI of 49% followed by treatment III (46%) while treatment I had the least PGSI of 35%.

Table 1: Latency period and pseudo-gonadosomatic index of *C. gariepinus* under varying female: male brood stock ratios

Parameter	Treatment I	Treatment II	Treatment III
Brood stock ratio (F:M)	2:1	2:2	2:3
Mean body weight (g)	1000.00	1000.00	1000.00
Mean dosage of ovaprim (ml/kg BW)	0.50	0.50	0.50

Mean latency period (h:min)	11:00±0:06	11:10±0:07	11:15±0:03
Mean weight of eggs (g)	260.00	330.00	317.00
% WE/BW	26.00	33.00	32.00
Mean PGSI (%)	41.50±6.50	51.00±3.00	46.50±3.50

b) Hatchability rate and larval survival

The milt from the male fish was milky and sticky in nature. The fertilized eggs were transparently greenish brown in colour, while the unfertilized ones were whitish in colour. Incubation was for 24 hours after which hatching started and lasted for six hours. Treatment I with ratio of female to male of 2:1 had a total fecundity of 117,882 eggs, mean fertilized eggs, 41,259±1631.50, mean hatchability, 58% and with mean percentage larval survival of 73%.

Treatment II with ratio of female to male of 2:2 had a total fecundity of 117,882 eggs; mean fertilized eggs of 45,455±1165.50 eggs; mean hatchability of 63% and mean percentage larval survival of 67% (Tables 1 and 2).

Treatment III with female: male of 2:3 had a total fecundity of 117,882 eggs, mean fertilized eggs of 46,600±0.00 mean hatchability of 56% and with percentage larval survival of 6.7% (Tables 1 and 2).

Table 2 : Mean values of percentage larval production and survival in ovaprim induced *C. gariepinus* under varying brood stock (female: male) ratios

Parameter	Treatment (female: male)		
	I (2:1)	II (2:2)	III (2:3)
No of stripped eggs	58,941±2330.99[a]	64,935±1664.99[a]	66,600±0.00[a]
No of fertilized eggs	41,259±1631.50[a]	45,455±1165.50[a]	46,600±0.00[a]
No of hatched eggs	23,964±5497.50[a]	28,734±1272.50[a]	25,931±410.00[a]
Percentage larval production	58.0±10.49[a]	63.2±1.19[a]	55.6±0.89[a]
No of deformed larvae	66,94±2730.49[a]	96,46±565.49[b]	86,91±121.49[b]
No of Normal larvae	14,270±2666.99[a]	19,088±706.99[b]	17,239±288.49[b]
Percentage larval survival	73±5.500[a]	66±0.000[a]	66±0.500[a]

abc mean values in each row having the same superscripts are not significantly different at P>0.05.

c) Physico-chemical parameters

The mean temperature recorded in the tank during the trial was 28°C. The pH value was 7.20; dissolved oxygen concentration 6.40 mg; NH_4 0.50 mg/l and 0.05 mg/l for NO_2 (Table3).

Table 3 : Mean values quality parameters monitored during the experiment

Parameter	T1 (2:1)	T2 (2:2)	T3 (2:3)
Temperature (°C)	28.00	28.00	28.00
pH value	7.20	7.20	7.20
DO_2 (mg/l)	6.40	6.40	6.40
NH_4 (mg/l)	0.50	0.50	0.50
NO_2 (mg/l)	0.05	0.05	0.05
Turbidity (NYU)	5.00	5.00	5.00
Total solids (mg/l)	257.00	257.00	260.00
Acidity (mg/l)	0.10	0.10	0.10
Total hardness (ppm)	60.00	60.00	60.00
Ca^{2+} (ppm)	42.00	43.00	50.00
Mg^{2+} (ppm)	18.00	17.00	12.00
Chloride (ppm)	33.00	33.00	33.00
Co_2 residual (ppm)	Nil	Nil	Nil
Bacterial counts/100 ml	TNC	TNC	TNC
Coliform counts (mpn)	Nil	Nil	Nil

IV. Discussion

The induction of ovulation and spawning in the African catfish *C. gariepinus* using ovaprim injection was effective on a single intramuscular injection of 0.50 ml for female brood fish 1000 g each and 0.25 ml for males weighing 1000 g each. The maximum latency period of 11 hrs, 20 mins recorded in this study could be ovaprim dosage-dependent as was observed for mammalian gonadotropin, methyltestosterone and partially purified Salmon gonadotropin in grey mullet *Mugil cephalus* (Shehadeh *et al.,* 1973) and for HCG and LH. RH-A in Mudskipper, *Boleosphthalamus pectinirostris* (Zhang *et al.,* 1989) or it could be due to the physiological make up of the fish (Haylor, 1993).

The pseudo-gonadosomatic index also used as index of sensitivity to ovaprim reached up to 49%, indicative of the fact that a high number of eggs could be collected when fish is induced with ovaprim. According to Richter *et al.* (1985), this is also an indication that ovaries of the fishes used in the experiment have reached the postvitellogenic stage. Also it has been observed that activity of dosage administered actually defined on the readiness of the females, their age, size, sensitivity amongst other factors (Woyhavorish and Horvath, 1980).

The temperature range of 25.70 to 27.00°C (mean 26.40°C) recorded throughout the experiment was higher than 22°C which Viveen *et al.* (1986) observed for *C. gariepinus* that exhibited latency period in excess of 15 hours. Zonnelveld *et al.* (1988) obtained their best results at 25°C. The pH of 7.00 to 8.00 was within normal range for culture fishes (Viveen *et al.,* 1986). Woynovorich and Horvath (1980) stated that a number of environmental factors such as temperature, pH, dissolved oxygen and calmness to play decisive role in ovulation and that temperature is of vital importance.

The incubation time of 24 hrs in the present study was higher than that recorded by Viveen *et al.* (1986) using carp pituitary suspension (CPS). Pillay (1993) reported that at 22°C hatching of fertilized eggs extends incubation time. In the present study the yolk sac was absorbed within three days as reported in Viveen *et al.* (1986) but differed from the six days reported by Pillay (1993). The temperature of the incubation tanks could be responsible for the differences. The high larval production (58%, 63.2% and 55.6%) in the three treatments out of which 73%, 66% and 66% survived respectively, indicates an overall good egg quality and effectiveness of ovaprim, including ovulation and spawning in the African catfish. There was no significant difference ($P<0.05$) among number of fertilized eggs, number of hatched eggs, % larval production and survival in all three treatments.

V. Conclusion

This study was conducted at the peak of breeding period of the species, hence the possibility of the experimental fish having attained the resting phase were able to positively respond to the single knockout dose of ovaprim administered. Ovaprim dosage varied with sex of the fish. However, the response in the male could not be ascertained because the sperm could only be collected by sacrificing the males. In the female, it was easier to follow the response to ovaprim since eggs were examined after lapse of the minimum prescribed latency period of 10 hrs. The maximum latency period of 11 hrs, 20 mins recorded in this study could be ovaprim-dosage dependent or due to the physiological make up of the fish.

From this study, it was observed that the fecundity value (66,600 eggs per unit body weight) of the female brood stocks were constant because they have the same weight. But weight of stripped eggs per female fish per treatment varied despite the same body weight.

High number of eggs could be collected when fish is induced with ovaprim, this was indicated by the 54% obtained as the pseudo-gonadosomatic index value, which was used as an index of sensitivity to ovaprim. It was an indication that the ovaries of the fishes used in the experiment had reached the postvitellogenic stage. Also, the height sensitivity was recorded in the biggest fish with the highest percentage body weight of eggs.

It was confirmed from this study that the standard ratio of 2:1 of male to female in fish breeding was not significant, hence a lower number of male brooder can be used to get the same result as this enhances the prudent use of male brood stock as indicated by treatment I (2:1) with the least number of male and highest percentage larval survival of 73%.

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Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

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6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

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10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be

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32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

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Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

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· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to

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- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

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- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

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The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

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- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

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- Explain materials individually only if the study is so complex that it saves liberty this way.
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- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
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- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

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- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

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- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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