COMPARATIVE ECONOMIC ANALYSIS OF ORGANIC AND INORGANIC FERTILIZER USE ON MAIZE PRODUCTION IN APA LOCAL GOVERNMENT AREA OF BENUE STATE

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ABSTRACT

The study assessed the comparative economics of organic and inorganic fertilizer use on maize production in Apa Local Government Area of Benue State. The population of this study consisted of all maize farmers in Apa Local Government Area of Benue State. Multi-stage sampling technique was used in the selection of the respondents for the study. A total of (100) respondents were selected and used for the study. The study made use of primary data only. Data for the study were analyzed using descriptive statistics such as frequency, means and percentages, while inferential statistics such as multiple regression and gross margin analysis were used. The result of the study revealed that 54% of the respondent were female while 46% were male; 92% of the respondents were married and only 8% were single; majority (53%) were aged between 41-60years with a mean age of 47years; respondents had an average farming experience of 22years; the average annual income of the respondents was N139,720; Multiple regression analysis results of the effect of organic and inorganic fertilizer on total revenue of respondents shows a coefficient of determination (R^2) of 0.353 indicating that about 35% variations in total revenue of maize farmers was explained by the explanatory variables. Inorganic fertilizer has a coefficient of 1.806 which was significant at 1% indicating that a unit increase in inorganic fertilizer application will increase the total income of respondents by 1.806. Also, organic fertilizer has a coefficient of 2.206 which was significant at 1% indicating that a unit increase in the use of organic fertilizer will increase the total income of respondents by 2.206. Gross margin analysis shows that the mean gross margin for organic fertilizer is N123,680 while inorganic fertilizer had a mean gross margin of N33,719. This implies that, maize production is more profitable using organic fertilizer than inorganic fertilizer in the study area. The study therefore recommended that agricultural extension agents should educate farmers on how to use organic and inorganic fertilizers.

Keywords: *Comparative, Maize, Fertilizer, Gross margin, Regression*

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important staple food crops in Nigeria although its yield is low. It is the third most important cereal in the world, next to rice and wheat and with highest production potential among the cereals (IITA, 2009). Maize is one of the most widely distributed crops of the world (Kimani *et al.,* 2004).

Current trend of intensive cultivation (compounding soil infertility due to faster depletion of soil nutrients), low capital base of farmers, scarcity of inorganic fertilizers, and the increasing demand for food, necessitate the identification of type and factors affecting quantity of fertilizer being used to achieve optimum yields for small scale farmers, who bear the burden of providing food for over 150 million Nigerians.

A contributing factor to insufficient food production is the low soil organic matter content, and consequently, the inherent infertility of soils in Nigeria and in sub-Saharan Africa (Shiyam & Binang, 2013). As a result, small scale farmers, who produce the bulk of food in Nigeria, have to embrace fertilizer application (organic and inorganic) in order to increase yield (FAO, 2013). Druilhe & Barreiro-Hurlé (2012) asserted that among the problems hampering arable crop yield is availability and affordability of inorganic fertilizers. They stated that organic fertilizer, unlike the inorganic options, is environmentally sustainable and able to achieve increased agricultural productivity. In this regard, integrated use of nitrogen (N) and phosphorus (P) and farm yard manure (FYM) are better than application of either nitrogen (N) and phosphorus (P) or farm yard manure (FYM) alone for maize production (Melkamu *et al.,* 2020). It is against this background that this study seeks to analyze and compare the effects of organic and inorganic usage on maize production and its effect on farmers in Apa LGA., Benue State.

IITA (2009) reported that the intensity of inorganic fertilizer use among Nigerian farmers is low and has dropped due to the prevailing level of poverty. Crop yield under an organic farming system are reported as comparable to those under an inorganic system, and greenhouse gas emissions from organic farming are 36% lower than a chemical system of crop production (Yadav *et al.,* 2013).

The agronomic effectiveness and the cost effectiveness of the use of organic fertilizers have been reported (Hassan *et al.,* 2014; Naikwade, 2014). The beneficiary impact of the use of organic fertilizers on microbial counts in soil has been shown (Chhogyel *et al.,* 2015). From the foregoing, many researchers have carried out various studies on organic and inorganic fertilizers, for examples: Melkamu *et al. (*2020), studied integrated use of organic and inorganic fertilizer for maize production; Toungos (2019) studied economic effect of organic and inorganic fertilizers on the yield of maize in Mubi-North; Adelomo (2017) effect of organic and inorganic fertilizers on the yield of maize. However, no such study in the proposed study area. Hence, the study helped to fill the gap in literature thus providing a more recent information on the subject matter.

The broad objective of this study is to assess the comparative economics of organic and inorganic fertilizer uses on maize production in Apa Local Government Area of Benue

state. The specific objectives are to: describes the socio-economic characteristics of maize famers in the study area; determine the effect of organic and inorganic fertilizer on total revenue of maize farmers; estimate the profitability of organic and inorganic fertilizer usage on maize production; and ascertain the challenges encountered with the use of organic and inorganic fertilizers in the study area.

METHODOLOGY

The study was carried out in Apa Local Government Area of Benue State. It is one of the 23 Local Government Area in Benue State. Apa Local Government was created on 23 March 1981 with Headquarters at Ugbokpo. It became defunct on 31 December 1983, and was later re-created in August, 1991 by the Federal Government of Nigeria. The Local Government is located in the north western part of Makurdi, the capital of Benue State. It is bounded to the North by Agatu Local Government, to the West by Gwer West, to the South by Otukpo and to West by Omala Local Government Area of Kogi State. Geographically, Apa Local Government Area is located on latitude 7.6296N and longitude 7.8711E North of the equator (Benue State Ministry of Land and Survey, 2010). It has population of about 100,000 people with a population density of about 200,300 persons per sq. km. The Local Government has 11 council wards namely, Ugbokpo, Edikwu I, Ikobi, Akpete/Ojantelle, Oba, Iga, Oiji, Ojope, Igoro, Edikwu II and Auke ward. It is predominantly inhabited by the Idomas.

The population of this study consist of all maize farmers in Apa Local Government Area of Benue State. Multi-stage sampling technique was used in the selection of respondents for the study. Firstly, five (5) council wards was purposefully selected from the study area based on the level of use of organic and inorganic fertilizer. Secondly, two (2) farming communities were randomly selected from each council ward and thirdly, ten (10) respondents were further selected randomly from each of the communities summing up to a total of 100 respondents. The study made use of primary data only. Data for the study were analyzed using descriptive statistics such as frequency distribution tables and percentages, while inferential statistics such as multiple regression and gross margin analysis were used.

The model specification of the study is given as:

Multiple Regression Model

$Y = \hat{a}_0 + \hat{a}_1x_1 + \hat{a}_2x_2 + \hat{a}_3x_3 + \hat{a}_4x_4 + \hat{a}_5x_5 + e$

Where:

Y= maize output (kg)

$\hat{a}_0$ = constant

$\hat{a}$ = regression coefficient

x_1 = Seed (kg)

x_2 = Quantity of Inorganic fertilizer (kg)
x_3 = Organic fertilizer (Kg)
x_4 = labour (man-day)
x_5 = herbicide (litres)
e = error term

Gross Margin Analysis for cost and Returns
GM= TR - TVC
Where,
GM is gross margin of maize (Naira/hectare)
TR is total revenue on maize (Naira/hectare)
TVC is total variable cost of maize (Naira/hectare)

RESULTS AND DISCUSSION

Socio-economic Characteristics of Maize Famers in Apa Local Government Area

The results on the socio-economic characteristics of farmers in the study area is presented in Table 1. The result on sex shows that majority (54%) of respondent were female while 46% were male. This showed that there were more female maize farmers in the study area that males. This finding contradicts Adedeji *et al*. (2017) who reported that predominantly, males are mostly involved in maize farming. This is because, maize farming involves hard and tedious labour in making ridges. But this could be true if the women in the area can pay for hired labour more than their male counterpart and another reason could be that, the women manage the farms of their husbands.

Results on age shows that majority (53%) were aged between 41-60years with a mean age of 47years. The maize farmers were young and in their productive years in farming. Whereas 28% of respondents were between 21-40years, 18% are above 61years and just 1% is between 1-20 years of age. The findings agree with Adedeji *et al*. (2017) who reported that most maize farmers are still in their youthful and productive age of less than 45years.

The result on marital status shows that majority (92%) of respondents are married and only 8% are single. This implies that most of the farmers are married and are involved in farming to earn income and provide the basic needs of their households. This is in line with FAO (2013) that most farmers are married.

Results on farming experience shows that majority (32%) had 11-20years of farming experience. 30% had 21-30years farming experience, 22% had 31years farming experience, and 16% had 1-10years of farming with a mean farming experience of 22years. This shows that the farmers in the study area are experienced in maize farming. This is in line with Shiyam and Binang (2013) who reported that most small-scale farmers have about 10years of farming experience.

The results on annual income of maize farmers in the study area shows that majority (31%)

have between ? 50,001-? 100,000 with a mean annual income of N139,720. This shows that the annual income of maize farmer is moderate since most farmers are subsistence farmers. This is in line with Simonyan and Fasina (2013). who reported in his study that small scale farmers have annual income of ? 100,000 above due to their small nature of farming.

Results on household size of farmers shows that majority (51%) of respondents have between 6-10 persons in their household, with a mean household size of 10 persons per household. This result agrees with Adelomo (2017) who reported that most farming households have between 1-10 person in their households. Furthermore, results on farm size shows that majority (39%) of respondents have farm size of between 1.6-2.0hacters with a mean of 1.6hectares per maize farmer in the study area. This shows that maize farmers in the area own small portions of land due to the land tenure system practiced in the area and this affects the larger population of small-scale farmers. This is in line with Adelomo (2017) who stated that, small scale farmers use small portions of land in farming and have between 1-3hectares for cultivation of crops.

Table 1: Socio-economic characteristics of maize farmers in Apa LGA., Benue State.

Variable	Frequency	Percentages	Mean
SEX			
Male	46	46	
Female	54	54	
AGE			
1-20	1	1	47
21-40	28	28	
41-60	53	53	
=61	18	18	
MARITAL STATUS			
Single	8	8	
Married	92	92	
Divorced	0	0	
Widow	0	0	
FARM EXPERIENCE			
1-10	16	16	
11-20	32	32	
21-30	30	30	22
=31	22	22	

ANNUAL INCOME			
=50,000	21	21	
50,001-100,000	31	31	
100,001-150,000	18	18	139,720
150,001-200,000	11	11	
200,001-250,000	6	6	
=250,001	13	13	
HOUSEHOLD SIZE			
1-5	14	14	
6-10	51	51	10
11-15	16	16	
16-20	17	17	
21-25	2	2	
FARM SIZE			
=0.5	12	12	
0.6-1.0	32	32	
1.1-1.5	4	4	1.6
1.6-2.0	39	39	
2.1-2.5	3	3	
2.6-3.0	9	9	
=3.1	1	1	
EXTENSION VISIT			
Yes	62	62	
No	38	38	

Source: Field Survey, 2019.

Effect of Organic and Inorganic Fertilizer on Total Revenue of Maize Farmers

Multiple regression analysis results on the effect of organic and inorganic fertilizer on total revenue of respondents shows a coefficient of determination (R^2) of 0.353 indicating that about 35% variations in total revenue of maize farmers is explained by the explanatory variable. Also, the result revealed F-statistics of 10.270 which is significant at 1% level indicating that jointly, inorganic and organic fertilizers have effect on the total income of the respondents. Inorganic fertilizer has a coefficient of 1.806 which is significant at 1% level of significance showing that a unit increase in inorganic fertilizer application will increase the total income of respondents by 1.806. This is in line with the a priori expectation on the use of fertilizer which means that increase use of fertilizer will increase the yield of maize in the first phase of production whereby increase inputs increases output i.e increasing returns to scale of production. Also, organic fertilizer has a coefficient of

2.206 which is significant at 1% level of significance indicating that a unit increase in the use of organic fertilizer will increase the total income of respondents by 2.206. This finding agrees with Adelomo (2017) who reported that use of organic fertilizer increase output of maize and Toungos (2019) also reported that use of inorganic fertilizer properly will boost yield ofcrops.

Table 2: Multiple regression analysis results showing the effect of organic and inorganic fertilizer on the total revenue of maize farmers

Total revenue	Coefficient	Standard error	T	Sig.
Constant	17455.330	13020.848	1.341	0.183
Seed	5.461	2.281	2.394**	0.019
Inorganic	1.806	0.817	2.209**	0.030
Organic	2.206	0.599	3.681***	0.000
Labour	0.243	0.363	0.668	0.506
Herbicide	-1.824	2.039	-0.895	0.373
R^2	0.353			
Adj. R^2	0.319			
F	10.270			

***=1% significant level, **=5% significance level
Source: Computation from Field Survey, 2019.

Profitability of Organic and Inorganic Fertilizer Usage on Maize Production

The result on profitability of organic and inorganic fertilizer usage on maize production is presented in Table 3 and 4. The result on table 3 revealed that, using organic fertilizer, maize farmers had a mean total revenue of N245,230 and N121,550 as the mean total variable cost with a mean gross margin of N123,680. The result on table 4 revealed that, using inorganic fertilizer, maize farmers had a mean total revenue of N71,225 and N37,506 as the mean total variable cost with a mean gross margin of N33,719. This implies that, maize production is more profitable using organic fertilizer than inorganic fertilizer in the study area. This is consistent with the findings of Adelomo (2017) who reported that the use of organic fertilizer is more profitable than inorganic fertilizer. This can be attributed to the unavailability of fertilizers and high cost of inorganic fertilizers which led farmers to use organic fertilizer more.

Table 5 revealed the result of the test of significance for the profitability analysis. The result revealed the F-statistics (25.145) is statistically significant (p? 0.10). thereby indicating the overall significance of the model. Also, the t-statistics (**4.665**) is statistically significant (p? 0.10) thereby indicating that the relationship between the variables is significant.

Table 3: Gross margin analysis on the profitability of maize farmers using organic fertilizer

Cost Items	Minimum	Maximum	Mean	Std Deviation
Seed	1300	31000	16287	6978.83
Organic	3000	80,000	21000	17606.81
Labour	13000	150,000	58000	51801.82
Herbicide	3000	75,000	26267	24775.32
Total Variable Cost	51000	278,000	121,550	66407.07
Total Revenue	32500	560,000	245,230	137072
Gross margin	-160,000	399,000	123,680	137196

Source: Field Survey, 2019.

Table 4: Gross margin analysis on the profitability of maize farmers using inorganic fertilizer

Cost Items	Minimum	Maximum	Mean	Std Deviation
Seed	0.00	18,000	4,937	3074.55
Inorganic	0.00	15000	79100	24.87
Labour	0.00	30,000	13,781	7952.20
Herbicide	2000	70,000	18780	17272.81
Total Variable Cost	5050	118,000	37,506	24165.79
Total Revenue	5000	380,000	71,225	60395.45
Gross margin	-69,200	367,000	33,719	53620.28

Source: Field Survey, 2019.

Table 5: Test of significance

Groups	F	Sig.	t stat	Sig.
Equal variances assumed	25.145***	0.00	-4.665***	0.00
Equal variances not assumed			-2.511	0.024

***=1% significant level, **

Source: Computation from Field Survey, 2019.

Challenges encountered with the use of organic and inorganic fertilizer by maize farmers

The results of the challenges encountered with the use of organic and inorganic fertilizer by maize farmers is presented in Table 4. The result indicated that 81.2% and 80% of organic and inorganic fertilizer users respectively indicated that pest and disease was a prominent challenge encountered by maize farmers in the study area. This is true because farmers incur cost on herbicides, insecticides, pesticides, fungicides and other agrochemicals for proper crop protection before appreciable yield will be obtained. This is in line with Abdoulaye *et al*. (2014) who stipulated that the use of agrochemical increases cost of production and reduces income of farmers. The result further shows that 75.3% and 73.3% of organic and inorganic fertilizer users and 83.5% and 66.7% the respondents indicated that poor finance and lack of access to credit facilities respectively are challenges encountered with the use of organic and inorganic fertilizers **respectively**. This implies that a farmer's choice of which fertilizer to use is largely influenced by financial ability and access to credit facilities,

Further, about 78.8% and 60% **o**f organic and inorganic fertilizer users respectively indicated that lack of extension agents was a constraint with the use of organic and inorganic fertilizers. This is true because farmers find it challenging in making decisions with which type of fertilizer to use on their maize farm. But with proper extension visits, farmers will be educated on use of organic and inorganic fertilizer based on the nature of soil in the study area.

The result further revealed that 62.4% and 73.3% of organic and inorganic fertilizer users respectively were faced with the challenge of lack of viable seeds. With viable seeds, farmers would have more interest to use fertilizers because viable seeds will produce bountiful harvest. Also, 75.3 and 73.3% of organic and inorganic fertilizer users were faced with the challenge of poor transportation. In rural area where most farmers are located, good roads networks for transportation are not available. This is consistent with Duflo et *al.* (2008) who stated that poor state of the rural area makes farming difficult since most farm resources do not reach such areas.

More so, 69.4% and 80% of organic and inorganic fertilizer users respectively indicated that Government policies was a constraint with the use of fertilizers. This may be as a result of most government policies like fertilizer subsidy not being implemented. Because of the political nature of policies, rural farmers hardly benefit from some government interventions targeted at farmers. Jamilu *et al.* (2014) reported that lack of implementations of policies does not help farmers.

Table 4: Challenges encountered with the use of organic and inorganic fertilizers by maize farmers

Challenges	Inorganic (%)	Organic (%)
Pests and diseases	81.2	80
Lack of access to credit facilities	75.3	73.3
Poor finance	83.5	66.7
Poor transportation network	75.3	73.3
Lack of extension education	78.8	60
Lack of viable seeds	62.4	73.3
Inadequate access to land	96.5	93.3
Government policies	69.4	80

*Multiple response recorded
Source: Field Survey, 2019.

CONCLUSION AND RECOMMENDATIONS

The study therefore concludes that, most of the maize farmers are females who are married, had farming experience of 22years, and annual income of ? 139,720.00. And organic and inorganic fertilizer has effect on the total income of farmers. Gross margin analysis shows that use of organic and inorganic fertilizer by maize farmers is profitable. Pests and diseases, lack of access to credit facilities and lack of extension education are the most prevalent challenges faced by maize farmers in the use of organic and inorganic fertilizer.

Based on the findings of the study, the following recommendations were made;

i. Government should ensure that inorganic fertilizer should be supplied to farmers timely so as to enhance early production of farmers.
ii. Agricultural extension agents should educate farmers on how to use organic and inorganic fertilizers.
iii. Government should develop infrastructure such as roads and transport vehicle for transportation credit facilities to farmers in interior villages.
iv. Males should be encouraged to join maize farming to aid women as this will help increase output and income of farmers.

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