FACTORS INFLUENCING THE UTILIZATION OF ORGANIC AND INORGANIC FERTILIZER IN SMALL SCALE WATERLEAF PRODUCTION IN EKET AGRICULTURAL ZONE OF AKWA IBOM STATE, NIGERIA.

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ABSTRACT
The study specifically estimated soil enhancing material utilization model for waterleaf farmers in Eket agricultural zone of Akwa Ibom State, Nigeria. Two hundred and sixty (260) waterleaf farmers were randomly selected for the study. Structured questionnaire was used to collect data and multiple linear regression model based on Ordinary Least Squares estimation technique was specified and estimated. The explanatory variables used were derived from the literature following in-depth reviewed of related literature and observed characteristics of the respondents. Comprehensive descriptive summary of all variables used in the analysis was presented in tabular form. Empirical results revealed that; household size, distance to fertilizer sale point and price of fertilizer were negative determinants of soil enhancing technology utilization in waterleaf production in the study area. On the contrary, education, farm size, farm income, number of poultry birds owned, farming experience, being a member of a social group and quantity of waterleaf produced were identified as positive determinants ofsoil enhancing technology utilization among waterleaf farmers in the zone.In order to promote the use of soil enhancing technology among small scale farmers in the zone, it is recommended that farmers should form social groups or corporative organizations in order to strengthen social capital formation among them. Also, policies that promote adult education and family planning are strongly advocated. Government of Akwa Ibom State should promote land reclamation and input subsidies for farmers in the State.

Key words: Waterleaf, farmers, soil enhancing materials, Eket, Akwa Ibom State

Introduction

Water leaf (*Talinumtriangulare*)is among the most consumable, cultivable and profitable vegetables in the southern region of Nigeria. It is popularly called mmongmmongikong in Ibibio/Efiktribe and is cultivated in both rural and urban areas. The crop is alight green succulent plant which is well adapted in the south - south region of Nigeria and is a major component of foods highly cherished in Akwa Ibom and Cross River State (Eyo*et al.,* 2001). Currently, waterleaf is an important component of urban farmsand its production has becomes one of the most highly preferred livelihood activities among unemployed women in the peri-urban, urban and rural areas of the south –south region of Nigeria (Akpan, *et al.* 2014). Nutritionally, waterleaf is rich in water, calorie, ash, protein, fats, carbohydrate, crude fibre, calcium, phosphorus, iron, thiamine, riboflavin, niacin and ascorbic acid(Tindall, 1983,Saidu and Jideobi, 2009 and Aya*et al.*,2010). Waterleaf production has a short gestation period andis produced all year round. The leaves are often used as a "softener" for fibrous vegetables such as Afang (*Gnetumafricanum*), Atama (*Heinsiacrinata*) and fluted pumpkin *(Telferiaoccidentalis*) among others.

Following continuous croppingof waterleaf conditioned by high demand in every period of the year and excessive land fragmentation; waterleaf farmers are constantly faced with the problem of declining soil fertility. Soil infertility arising from continuouscropping without planned replenishment of depleted soil nutrients has constituted a serious impediment to higher yield and productivity among waterleaf farmers in the region. However, adding nutrients to the soil is crucial in sustainable agriculture; as this would compensate for depletion of nutrients through harvested crops.For resource poor farmhouseholds, the use of inorganic fertilizer and organic manure are seen as one important way to potentially improve the productivity and increase agricultural output, and therefore bring substantial improvements to their incomes, lives, and well-being (Feder*et al.* 1985 and Akpan and Aya, 2009).

Evidence provided by the Akwa Ibom State Ministry of Agriculture (2010) has shown that most vegetable farmers in the State are not adequately compensating for soil nutrients loss caused by intensive cultivation practices. Hence, declining soil fertility has been highlighted as one of the major reasons for slow growth rate in food production in the State and Nigeria at large (Akpan*et al.,* 2014,Omotayo and Chukwuka, 2009). In spite of the increase public sensitization and mounting advocacy on the benefits of using soil enhancing materials to improve soil fertility, many farmers in the State, areeither not using sufficient soil enhancing materials, or are not using soil enhancing materials at all while some are still having mixed feeling concerning its usage. This is evidence from the continuous low tonnage of some food outputs such as vegetables and tree crops in the State. Since resource poor small farmers are part of the economic system, many factors have been linked to these diverse capacities in small scale farmers to utilized soil enhancing materials in a sustainable manner. Such factors range from cultural and psychological issues to social and economic issues as well as the environmental and technological linked factors.

Premised on the aforementioned category of determinants of utilization of soil enhancing materials by small scale farmers; many authors have dogged deep into discoveries specific factors affecting farmers in relation to soil enhancing technology usage. For instance, Akpan and Aya (2009) modeled and estimated the fertilizer demand function for wetland farmers in Cross River State. The results revealed that household size, household consumption expenditure, number of poultry birds kept by farmers, number of goats owned and perceived price of fertilizer had negative effect on fertilizer demand. Education of the farmer, farm size, extension agent contact, farm income, ability to predict rainfall, presence of modern communication facilities, output of maize and mixed cropping in combination with maize exhibited positive influence on fertilizer demand. Also, Olwande*et al.*, (2009) examined determinants of fertilizer adoption and use intensity in Kenya. Results showed that age, education, credit, presence of cash crop, distance to fertilizer market and agro ecological potentials are statistically significant factors influencing the probability of adopting fertilizer technology among farmers in the region. The report further showed that, the strongest determinants of fertilizer use intensity were; gender, dependency ratio, credit, presence of cash crop, distance to extension service and agro ecological potential. In western Nigeria, Obisesan*et al.*, (2013) examined fertilizer use and its determinants among smallholder farmers in OndoState. The result revealed that, years of education, distant to the nearest fertilizer market, membership of registered farmers' group, farm size and access to credit facilities as well as fertilizer price were significant factors influencing fertilizer use among farmers. The findings showed that all significant variables except distance to the nearest market and price of fertilizer influenced fertilizer use positively. In a similar Venn, Akpan*et al.*, (2013)estimated poultry litter equation among *Telfairiaoccidentalis* farmers in Ikot Ekpene area of Akwa Ibom State. The result of the empirical estimation revealed that farmer's age, education, farm size, previous year's harvest, farming practice adopted, farming experience, soil management practice, farm income, off-farm income and household expenditure were important determinants of *Telfairia*farmers' decision to use poultry litter in the study area. In western region of Nigeria, Sekumade (2017) analyzed the economic effect of organic and inorganic fertilizers on yield of maize in Oyo State, Nigeria. Results showed that determinants of choice for organic fertilizers were educational level, access to loan, access to extension contact, primary occupation and farm size while the determinants of choice for inorganic fertilizers were found to be educational level, primary occupation, farming experience, membership of cooperative and farm size of farmers.

From the literature reviewed, not much research works have been conducted in Akwa Ibom State on issues related to organic and inorganic fertilizer demand by farmers. Eket agricultural zone in Akwa Ibom State is peculiar, because most of its terrains are wetland and the area is constantly exposed to soil degradation through oil exploration and exploitation activities. The need to complement natural ability to replenish the soil fertility amidst increasing effective demandfor arable crops like 'waterleaf' becomes obvious due to increase population caused by the industrial activities of the multinational companies in the area. In an attempt to design a sustainable path of development for small scale farmers in the zone, the study specifically aimed at modeling the determinants of organic and inorganic fertilizers utilization among small scale waterleaf farmers in the study area.

RESEARCH METHODOLOGY

Study Area

The study was carried out in Eket agricultural zone in Akwa Ibom State, Nigeria. The zone consists of seven local government areas namely;Eket, EsitEket, Onna, Ikot Abasi, MkpatEnin, Ibeno and Eastern Obolo. Eketis the headquarters of the zone and is located in latitude $4^0$39`N and longitude $7^0$56`E with a population of over 200,000 people (National Population Commission, (NPC), 2006). The zone is in the rain forest belt and is prone to oil spillage, acid rain and increasing ocean encroachment. Some of the common food crops grown in the area are; cassava, plantain, waterleaf, fluted pumpkin, white yam, cocoyam, maize and banana.

Source of Data and Instrument for Data Collection

Primary data were used in the analyses and these included socio-economic and production data among others. Questionnaire was adequately structured to suit the intended objectives and was administered to the intended respondents and complemented by personal interviews to ensure consistency and accuracy of data collected. Respondents were waterleaf farmers that used organic or inorganic fertilizers either as single or in combination.

Sample Size Selection

From Cochran (1963), a representative sample size from a large population of waterleaf farmers in the study area was obtained using the equation (1) specified as thus:

$$S_n = \frac{z^2\rho(1-\rho)}{D^2} \ldots\ldots\ldots\ldots (1)$$

Where S_n is the required sample size from a large population; "Z" is the standard normal variate (at 95% confidence interval, type 1 error; 1.96). "P" is the expected proportion of waterleaf farmers in farming population of Eket agricultural zone (From available records in the State about 78% of farmers in the zone cultivate waterleaf either in their major farm and or at home). "D" is the absolute error or precision at 5% type 1 error. The sample size is derived as shown in equation (2).

$$S_n = \frac{(1.96)^2 0.78(1-0.78)}{(0.05)^2} = 264 \ldots\ldots (2)$$

In order to obtain a proportional sampling among selected villages, the sample size was scale down to 260 respondents.

Sampling Procedure and Sample Size

According to available records from individual researchers, State Ministry of Agriculture and Food Sufficiency as well as Akwa Ibom Agricultural Development Programme (AKADEP) among other agencies, there are approximately 5,000 waterleaf farmers in the zone. Out of this sample frame, only 5.2% representing 260 waterleaf farmers were chosen for the study. The respondents were sprayed across the selected local government area in the zone.

Multi-stagesampling technique was adopted in selecting respondents for the study. Three out of seven LGAs (Local Government Areas) in the zone were randomly selected. The second stageinvolved selection of 3 clans from each LGA, making a total of 9 clans from the chosen three LGAs. The third stage involved a random selection of at least 30 respondents from each clan, making a total of ninety (90) respondents for each LGA and a grand total of two hundred and seventy (270) respondents for the study. Out of the total sample size selected, proportionally and based on the number of valid questionnaires; 260 respondents were actually used for the analysis and it distribution is shown in Table 1.

Table1: Distribution of respondents in the selected LGAs in Eket agricultural zone

LGA	Frequency	Proportion (%)
Mkpat-Enin	86	33.08
Eket	88	33.84
Onna	86	33.08
Total	**260**	**100.00**

Source: Computed by author, 2019.

Analytical Techniques

To identify determinants ofutilization of soil enhancing materials by waterleaf farmers in Eket agricultural zone, a multiple regression analysis based on ordinary least squares estimation method was specified as thus:

$$\boldsymbol{SEM} = \delta_0 + \delta_1 GEN + \delta_2 AGE + \delta_3 EDU + \delta_4 HHS + + \delta_5 FAS + \delta_6 EXT + \delta_7 FAI + \delta_8 OUT + \delta_9 POU + \delta_{10} DIS + \delta_{11} EXP + \delta_{12} SOC + V\text{i} \ldots\ldots (3)$$

Where

SEM = Soil enhancing materials measured in Kg (i.e. either single or combination of organic and inorganic soil enhancing materials)

GEN= Gender of farmer (1 for male and 0 for female farmer)

AGE = Age of farmer (years)

EDU = Educational level of farmer (years)

HHS= Household size (number)

FAS = Farm size (in hectares)

EXT = Extension contact (number of times per farming season)

FAI= Farm income (naira)

OUT = Output of waterleaf measured in Kg

POU = Poultry owned (dummy, 1 for Yes and 0 for No)

DIS = Distance to sale point of soil enhancing material (kilometers)

EXP = Farming experience (years)

SOC = Membership in social organization (years)

RESULT AND DISCUSSION

The descriptive Statistics of Variables used in the analysis

The descriptive statistics of variables derived from waterleaf farmersare presented in Table 2. The result revealed an average age of about 42.94 years with coefficient of variability of 24% and age population that is positively skewed by 11.0%. This means that, most waterleaf farmers in the area are fast ageing. This implies that in the next 10 years, waterleaf production will be jeopardized due to aged farming population in the region. An average period of formal education of 10.25 yearsis negatively skewed (-0.99) with about 41% coefficient of variability. This connotes that, most waterleaf farmers in the region do not have sufficient years of formal education and this is a serious threat to technology adoption. The finding calls for rapid development of adult education programme to focus mainly on farming population in the region.The statistics also revealed that about 16.0% of the respondents were male farmers.This means that, waterleaf production is dominated by the women population (84.0%) in the region.

Social capital formation among waterleaf farmers isrelatively low (3.93 years) in the study area though positively skewed but with high coefficient of variability (119.0%). This poses a serious threat to information sharing and technology adoption among farm households in the region. The mean farm size is 0.04ha and maximum size of 0.36ha but with a long right tailed distribution. This implies that, sizable number of water leaf farmers in the region operates on farm lands that are greater than the mean size. The mean farm income obtained was N65, 872 per complete cycle of production, while the maximum stood at N332, 000. The coefficient of variability of 79.0% was obtained for income distribution. Farm income distribution oriented to the right tail with a value of 1.62 implying that sizable proportion of farmers generates income above the mean income. Only 13.0% of the farmers owned poultry business that generates poultry litter/organic manure. The coefficient of variability for poultry ownership was 258.0% with a long right tailed distribution value of 2.19. The mean farming experience of 11.77 years was found, and the maximum year of engagement in waterleaf production was 40 years. This shows that, waterleaf production in the study area is a sustainable agro enterprise. However, the coefficient of variability in farming experience was only 61% implying that new entrants were few. Nonetheless, the distribution of farm experience was right tailed (1.02) showing minimal movement to the right of the mean value.

Table 2: Summary Statisticsof Variables used in the analysis

Variable	**Mean**	**Min.**	**Max.**	**Std. D**	**C.V.**	**Skewness**
Gender	0.16	0.00	1.00	0.37	2.28	1.84
Age	42.94	22.00	66.00	10.21	0.24	0.11
Education	10.25	0.00	18.00	4.21	0.41	-0.99
Household size	4.00	1.00	9.00	1.58	0.36	0.48
Farm size	0.04	0.004	0.36	0.05	1.11	3.15
Extension contact	0.52	0.00	4.00	0.83	1.59	1.46
Farm income	65872	3000	3.32e+05	51797	0.79	1.62
Quantity of output	4652	7.00	23125	3747.4	0.806	1.49
Quantity of soil enhancing materials	505.25	1.00	3750	422.22	0.84	2.56
Owned poultry	0.13	0.00	1.00	0.34	2.58	2.19
Distance to sale point (Km)	1.10	0.00	6.00	1.04	0.94	1.96
Farming experience	11.77	2.00	40.00	7.18	0.61	1.02
Social group	3.93	0.00	25.00	4.67	1.19	1.37
Marital status	0.69	0.00	1.00	0.46	0.66	-0.85
Land ownership	0.63	0.00	1.00	0.49	0.78	-0.44
Sources of credit	3.43	1.00	7.00	1.22	0.36	-0.25
Price of SEM/kg	27.42	4.00	600.00	60.05	2.190	5.95

Source:computed by authors, 2019. Total number of respondents is 260.

The finding revealed the mean of 4652kg and the maximum of 23125kg for the quantity of waterleaf produced by farmers in the region. The quantity produced showed high degree of volatility with coefficient of variability exceeding one hundred percent. However, the distribution of outputs across respondent skewed to the right. Also, the mean quantity of soil enhancing materials (organic and inorganic materials) used by farmers was 505kg and the maximum quantity of 3750kg. About 84% of variability in quantity of soil enhancing materials was recorded while the distribution shows progressive increase in utilization. The average household size among respondents is found to be 4 members and a maximum of 9 members. The house hold distribution was almost normally distributed denoted by low coefficient of variability of 36.0% and a limited skew index of 0.48 units. This implies that, most waterleaf farmers' household size is around the mean value of 4 members. The number of times farmers have contact with extension agents in the region was really limited. An average contact time of 0.52 times and a maximum of 4 times per complete cycle of production were recorded among the respondents. Though the variability index was high (1.59), the distribution of contact with extension agents was positively skewed. The result implies that, the delivery of agricultural extension services in the region is bad and need total overhauling. Furthermore, the mean distance to point of sale of soil enhancing materials was found to be 1.10km and maximum distance of 6.0km, coefficient of variability of 94.0% and skewed value of 1.96 units. About 69.0% and 63.0% of farmers were married and owned land used for the production of waterleaf respectively.

Factors influencing the Utilization of Soil Enhancing Materials among Waterleaf Farmers

One of the major problems of the cross sectional data analysis is the issue of multicollinearity. To test for the existence of this econometric problem, the variance inflating factor (VIF) was employed. Estimates of VIF are presented in Table 3 together with the tolerance ratio. The result revealed that there is no serious or significant collinearity among explanatory variables specified. The estimated VIF with respect to each explanatory variable was greater than unity, but less than the threshold value of 10. The tolerance factor was also less than unity, validating the VIF result. The result implies that, the explanatory variables specified do not cluster together or exhibited multicollinearity tendencies. This implies that the estimates of multi-regression model based on the Ordinary Least Squares method of estimation are consistent, best and unbiased. This means that the estimates of the OLS model are stable over time.

Table 3: Estimates of Variance Inflating Factor for multicollinearity test

Variable	Variance Inflation Factors	Tolerance ratio
Gender	1.252	0.7987
Age	2.203	0.4539
Education	1.648	0.6068
Household size	1.458	0.6859
Farm size	1.816	0.5507
Extension contact	1.195	0.8370
Farm income	4.171	0.2397
Quantity of output	3.132	0.3193
Owned poultry	1.216	0.8224
Distance to sale point	1.142	0.8757
Farming experience	2.558	0.3909
Social group	1.437	0.6959
Price of SEM	1.254	0.7975

Source: computed by authors, 2019.

Following the satisfied condition of the multicollinearity property of the explanatory variables, the linear multiple-regressionmodel specified in equation 3 was estimated and is presented in Table 4. The R-squaredvalue of 0. 702 units imply that about 70.2% of variability in quantity of soil enhancing materials used is connected to the specified explanatory variables.This means that important variables that influenced the utilization of soil enhancing materials among waterleaf farmers were included in the specified model. The F-calculated ratio of 44.52issignificant at 1% probability level. This indicates that, the estimated R-squared is significant implying that, the model has a strong explanatory power, hence goodness of fit.

The diagnostic tests further revealed the RESET test ratio of 10.36that is significant at 1% probability level, and implying that there is structural rigidity in the estimated model. The normality test revealed a value of 44.54 which is significant at 1% probability level. This means that the distribution of the estimated error terms assumed a normal curve distribution. In other words, the error terms are normally distributed. The result justifies the used of the ordinary least squares estimation method. The null hypothesis of no heteroscadasticity in the estimated model was upholds. The White test ratio of 170.93 was significant at 1% probability level and thus reveals that, the variance of the error term was constant across the specified variables.

Table 4: Determinants of Utilization of Soil Enhancing Materials among Waterleaf Farmers, in Akwa Ibom State

Variable	Coefficient	Standard error	t- value	Probability
Constant	280.481	116.022	2.417**	0.0164
Gender	21.354	44.621	0.479	0.6327
Age	−1.890	2.137	−0.885	0.3772
Education	8.839	4.484	1.971**	0.0498
Household size	−19.591	11.241	−1.743*	0.0826
Farm size	5404.57	414.492	13.04***	<0.0001
Extension contact	−7.226	19.443	−0.372	0.7105
Farm income	0.0009	0.0002	4.500***	0.0004
Owned poultry	69.184	31.997	2.162**	0.1507
Distance to sale point	−31.721	15.112	−2.099**	0.0368
Farming experience	6.166	3.269	1.886*	0.0605
Social group	10.954	3.772	2.904***	0.0040
Price of SEM	−0.845	0.274	−3.082***	0.0023
Quantity of output	0.0117	0.007	1.684*	0.0935
		Diagnostic Statistics		
R-squared	0.7017	Normality test 17.3755		44.5379***
F(13, 246)	44.5202***	White's test for heteroskedasticity		170.933***
Log-likelihood	−1782.99	RESET test F(2, 244)		10.3623***

Source:results from analysis, data from field survey 2018. Asterisks *, ** and *** represent significant levels at 10%, 5% and 1% respectively. Variables are as defined in equation 3.

The empirical result revealed that increase inyears of formal education of a waterleaf farmer will increase the use of organic and inorganic fertilizer by 8.84kg at 5% significance level. This connotes that, as the level of education of waterleaf farmer increases,the likelihood to use more units of soil enhancing materials is accelerated by8.84 units. This implies that educated farmers will more likely soughttocomplement the natural ability to replenish soil fertility with the soil enhancing technologies (organic and inorganic fertilizer) to improve soil fertility and crop productivity as well as yieldscompared to less educated ones. This could be attributed to the fact that waterleaf production has been fully commercialized and farmers are searching for ways to increase farm output and farm income as well. Also, due to continuous cropping and increasing land fragmentation, the length of fallowing has been reduced and in some location is totally absent. With this situation, educated farmers are left with no better option than to source for artificial soil enhancing materials to improve the soil fertility. This result is in line with the findings of Akpan and Aya (2009), Olwande*et al.*,(2009), Obisesan*et al.,* (2013), Akpan*et al.,* (2013) and Sekumade (2017).

Also, findings revealed that, household size of waterleaf farmers has inverse relationship with the quantity of soil enhancing materials used by them. The result showed that a unit increase in household size will reduce the quantity of soil enhancing materials used by 19.59kg at 1% probability level. This result suggeststhat larger household size will increase household expenditures, which consequently would reduce farm investment. The finding agrees with the work of Akpan and Aya, (2009).

The slope coefficient of farm size relative to the used of soil enhancing materials is 5404.57kg, implying that a unit increasein area of land cultivated will led to a corresponding increase in the use of soil enhancing materials by5404.57kg.Given the size of the estimated coefficient, it is shown that land size owned by waterleaf farmers is the most important variable influencing the use of soil enhancing materials in the study area. This suggests that, as the farm size increase, the scale of production will increase too, thus propelling farmers to purchase more of soil enhancing materials. This is in line with the findings of Akpan and Aya (2009),Obisesan*et al.*, (2013), (2010) and Akpan*et al.*,(2013)as well as Sekumade (2017).

The marginal effect of farm income relative to the utilization of soil enhancing materials showed positive correlation among waterleaf farmers in the region. That is, as farm income increases, the quantity of soil enhancing materialsused increases too. The result showed that a unit increase in farm income will increase soil enhancing materials used to 0.0009kg correspondingly. This means that as farmers' income increases, farmers tend to purchase more of soil enhancing materialsto improve their production efficiency.This is in line with the findings ofAkpan and Aya (2009) and Akpan*et al.*, (2013).

The result further revealed that farmers' ownership of poultry farms have a positive relationship with the quantity of soil enhancing materials used by waterleaf farmers in the region. It showed that a unit increase in poultry farm ownership will increase the quantity of soil enhancing material used by 69.184kg. The result suggests that, waterleaf farmers who owned poultry farms are more likely to use poultry litter from their farms. Additionally, proceeds from the sale of the poultry products could serve as additional income or could increase their farm income which will enable them to purchase other forms of soil enhancing materials for their farms. This corroborates the finding of Akpan and Aya, (2009).

The result also revealed that farming experience has a positive relationship with the quantity of soil enhancing materials usedby waterleaf farmers in the State. The result showed that a unit increase in a year of farming experience will increase the quantity of soil enhancing materials used by 6.17kg at 10% probability level. This result implies that as the years of farming experience increase, farmers in the study area tend to use more of the soil enhancing materials for waterleaf production. This result could be explained by the fact that, experienced farmers have good knowledge/information of the soil properties and its performance from the previous production seasons and will response by applying appropriate soil enhancing materials. This result is in consonance with the finding of Akpan*et al.*, (2013) and Sekumade (2017).

The marginal effect of the distance to the point of sale of soil enhancing materials is negative (−31.721) and is statistically significant at 5% probability level. This connotes that, the longer the distance between a farmer and a point of sale of soil enhancing materials, the less likely such farmer will used or applied the materials in his/her farm. This suggests that, farer distance would induce additional cost to the production process through transportation cost, tax and levies. This could reduce the profit margin of farmers; hence they will try to avoid excess expenditures such as this.In the same fate, Olwande*et al.*, (2009) and Obisesan*et al.*, (2013) have submitted similar results earlier.

Being a member of a social organization predisposes one to a wide variety of ideas, social capitals and privileged information. The above assertion was confirmed as the result showed significant positive relationship between being a member of a social organization and the quantity of soil enhancing materials used by waterleaf farmers in the study area. For instance, a year increase in social organization will result in 10.95kg increase in the used of soil enhancing materials. This finding suggests that, farmers that belong to group are more likely to adopt innovation easily probably due to evidences/testimonies on such innovation that abound among group members. The finding is supported by Obisesan*et al.*, (2013) and Sekumade (2017).

Following the postulation of the law of demand for a normal good; price and quantity demand are negatively related. This assertion was verified by the significant negative coefficient of price of the soil enhancing materials in the model. The result showed that a unit increase in price will lead to a 0.845kg reduction in the quantity of soil enhancing material used. This result corroborates with the findings of Akpan and Aya, (2009)and Obisesan*et al.*, (2013).

The result also revealed that the coefficient of the waterleaf produced (output) has a positive significant relationship with the quantity of soil enhancing materials used by waterleaf farmers in the zone.For instance, 10% increase in output will likely cause about 0.0117kg increase in the utilization of soil enhancing materials by farmers. The result satisfies the *priori* expectation as increase in output is an incentive to increase farm income and inputs. The finding corroborates the empirical finding of Akpan*et al*.,(2009).

CONCLUSION AND RECOMMENDATIONS

The timely achievement of the food self-sufficiency target of the federal government is synonymous to the development of a sustainable agricultural system that is anchored on the improvement of productivity of small scale farming system practiced extensively in the country. This implies, producing optimum or efficient foods under the existing agricultural land-use system amidst mounting population pressure, increase food demand and increasing land fragmentation. However, continuous cropping without planned replenishment would lead to rapid depletion of soil fertility. This invariably means that, farm productivity can only be increase by a planned introduction of soil enhancing technologies to augment for the natural sources currently under intense pressure. In an attempt to draw a road map for increased utilization of soil enhancing technologies among small scale farmers; the study specifically estimated determinants of organic/inorganic fertilizer usage among waterleaf farmers in the study area. From the analyses, several policy variables have been identified which if harnessed will form a reliable instrument for developing a sustainable soil enhancing policy document for the State and country at large. Categories of determinant identified include: farmers' specific factors, social, cultural and economic as well as technology related determinants.

Based on the findings of the research, the following policy directions are strongly recommended:

1. Formation of farmer social groups or corporative organizations is strongly

advocated. This will encourage social capital formation and strong believed on any adopted soil enhancing technologies by farmers in the region.

2. Policy that promotes adult education especially in the rural area would invariably enhance the use of organic and inorganic fertilizer demand.
3. Government of Akwa Ibom State should continue on the current public sensitization on family planning and sizable family campaign to reduce the household size of farming households as this will helped to reduce family expenditure and increase farm investment.
4. Input subsidies are necessary for waterleaf farmers in the region as this would help to increase farm income which has a direct relationship with the utilization of soil enhancing materials in the region.
5. Waterleaf farmers should be encouraged to owned poultry farms as a cheap source of acquiring soil enhancing materials for their farm

REFERENCES

Aja, P.M., Okaka, A, N, Ibiam,U. A., Uraku A. J., and Onu, P. N. (2010). Proximate nalysis of *Talinumtriangulare* (Water Leaf) Leaves and its Softening Principle.Pakistan Journal of Nutrition, 9: 524-526.

Akpan, S. B., Ini-mfon V. P., Samuel J. U. anddoro J. U. (2014).Choice of soil management techniques as adaptation to Climate change among fluted pumpkin farmers in Akwa Ibom State, Nigeria. African Journal of Agricultural Economics and Rural Development. Volume 2(2); 112 – 120.

Akpan, S. B., and Aya E. A., (2009).Determinants of fertilizer use among small – holder farmers in Wetland Region of Cross River State.Global Journal of Agricultural Sciences vol.8 NO.2 Pp. 195– 201.

Akpan, S. B., Ini-mfon V. P., Samuel J. U., Edem A. O., and Ubong E. E., (2013). Determinants of vegetable farmers' decision to use poultry litter in the southern region of Nigeria. Journal of Agricultural Economics and Development Vol. 2(2), pp. 077 – 083.

Akwa Ibom State ministry of agriculture reports, 2010.

Cochran, W. G. 1963. Sampling Techniques, 2nd Ed., New York: John Wiley and Sons, Inc.

Eyo, E, O., Ekpe, E. O., and Ogban, P.I. (2001). Waterleaf (Talinum triagulare- wild) production in south eastern Nigeria: existing practices and suggestions for ncreased productivity and profit. Global journal of applied sciences vol. 7, No. 3, pp. 421 – 426.

Feder, Gershon, Richard E.Just and David Zilberman(1985).“Adoption of Agricultural Innovations in Developing Countries: A Survey”, Economic Development and Cultural Change. v. 33: 255 – 298.

National population Commission (NPC), Report of National Census of 2006.

Obisesan, A, A., Akinlade, R. J. and Fajimi.F.O.(2013). Determinants of fertilizer use among smallholder food crop farmers in Ondo State, Nigeria. American Journal of Research Communication, 1(7): 254 – 260.

Olwande, John; Sikei, Geophrey; Mathenge, Mary. (2009) Agricultural Technology Adoption: A Panel Analysis of Smallholder Farmers' Fertilizer use in Kenya. CEGA Working Paper Series No.AfD- 0908.Center of Evaluation for Global Action.University of California, Berkeley.

Omotayo O. E. and Chukwuka K. S. (2009). Soil fertility restoration techniques in sub-Saharan Africa using organic resources. African Journal of Agricultural Research Vol. 4 (3), pp. 144-150.

Saidu, A.N; Jideobi, N.G. (2009) The Proximate and Elemental Analysis of some Leafy Vegetables Grown in Minna and Environs. J. Appl. Sci. Environ. Manage,Vol. 13(4); 21 - 22

Sekumade, A. B. (2017). Economic Effect of Organic and Inorganic Fertilizers on the Yield of Maize in Oyo State, Nigeria.International Journal of Agricultural Economics.Vol. 2, No.3, pp. 63– 68.

Tindall, H. D. (1983). Vegetables in the tropics. The Macmillian press Ltd. U.K. pp. 102 – 106.