Effect of Fertilizer use to the Environment and the Determinant to Choice of the Nutrient Management Planning Techniques by Farmers in South East, Nigeria

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Abstract: **Effect of fertilizer use to the environment by smallholder arable crop farmers in Southeast, Nigeria was studied. One hundred and twenty farmers were purposively selected from three out of five states in Southeast. A well structured questionnaire and oral interview were used to collect information needed for the study. The objectives of the study were addressed using percentages, multinomial Logit regression and factor analysis. The results show that most of the sampled farmers were aged, fairly educated, well experienced, large number of household size and membership of organization. The fertilizer types used by the farmers were compound fertilizer, muriate of potash, single super phosphate, urea and commercial fertilizer. The sources of fertilizer to the farmer were open market, cooperative, town union, Agricultural. Development. Program (ADP), Ministry of Agriculture and Local Government Area. Also, the effect of fertilizer application to the environment were affect water supply, kidney problem, methemoglobinemia, blister in the body, carcinogenic effect, eutrophication and global warming. The fertilizer nutrient management planning adopted to reduce the potentials of environmental risk were soil testing, fertilizer application method, proper storage and handling of fertilizer, The result of the multinomial logistic regression estimates showed that farming experience, age of the farmers, educational level, extension services and membership of organization affected the choice of adaptation practices of. fertilizer nutrient management planning in order to reduce the effects of fertilizer application to the environmental. The limiting factors to fertilizer availability in the study area were diversion of fertilizer, transportation problem, political interference, delay in procurement. There is need to enhance farmers' access to extension services, cooperative membership and credit.**

***Keyword*: Fertilizer use, Smallholder Farmers, Arable crop, Environment.**

I. INTRODUCTION

The success of Green revolution in Asia and in many countries in Africa could be partly be ascribed to use of chemical fertilizer (Food Agriculture Organization (FAO), 1998, FAO, 2004). Fertilizer" is a soluble nutrient with capacity of increasing food productions in tens of fold without serious land use intensification and not maiming the biodiversity (FAO, 2004).The essence of chemical fertilizer use by our farmers cannot be overestimated (International Fertilizer Development Center (IFDC) (1998), inorganic fertilizer has features of being highly soluble in water, the nutrient easily available to plants, high concentration and low price per unit of nutrient, ease of calculating accurate application rates and the uniformity and accuracy with which specific amounts of available nutrients can be applied (International Fertilizer Development Center(IFDC), 1996,FAO, 2004).Fertilizer, if prudently used could assist in enhancing cell activities, improves cell multiplications and enlargement and luxuriant growth of plant(Bynes, 1995). These may possibly propel in the realization of economic growth, poverty alleviation and food security attainment (Parish, 1993;, Bumb, 2005). It is based on the gains of the resource that successive Nigeria governments have encouraged farmers' access to fertilizer through promotion of a State monopoly for fertilizer import and distribution, institution of price controls and subsidies, the fertilizer retail markets, provision of credit to farmers for the purchase of fertilizer, institution of import tariffs, decentralization of procurement and distribution, and deregulation of markets (Federal Fertilizer Department (FFD), 2002; Ayoola, 2014).The aforesaid fertilizer agencies had boosted considerably the fertilizer use by farmers in the country. For instance, literatures revealed that an increase of about 34kg per hectare in 1991 to nearly 54 kg of NPK applied per hectare in 2012 (Ayoola, 2014).The exceedingly subsidized fertilizers by Federal government and the wrong perception by the farmers that the more you apply fertilizer, the higher the farm yield, have resulted in the abuse of the resource (IFDC, 1996; FDC, 2004). The misuse of fertilizer has incessantly resulted to a threat to the ecological. For instance, excess application of fertilizer especially nitrogen type to fruity vegetable according to studies (Cai, *et al*; 1998; Fertilizer Procurement and Distribution Division (FPDD),

2002; Ogunmola, 2007) could result in lower quality fruit, weak stems and fewer flowers and flourishing leaves that can be predisposed to aphids and fungus attack. Furthermore, seepage of nitrogen ingredient of fertilizer into water bodies could leave fish and other aquatic animals dead through eutrophication (Zuzu, 2002). In addition, inorganic Nitrogen fertilizers has the tendency to increase the pH of the soil, smoldering of plant and roots if over used (FPDD, 2002). Additionally, Liverpool – Taise, et al (2016) reported that ammonia released by Ammonia fertilizer is detrimental to fish. As well, in organic fertilizer poses risk stripping of soil nutrients, does not improving soil structure, decreasing the plants resistance to pests and diseases and does injury to innate microbial activity (Zhihang, 2003).In addition, nitrate - nitrogen fertilizer is capable of causing methemoglobinemia (an inability to use oxygen in infants), if the water that is polluted by this fertilizer is consumed by man (Bynres, 1990).Also, some fertilizer contain some heavy metals such as cupper(Cu), lead(Pb) and zinc (Zn) , which is capable of causing environmental pollution as result of its intrinsic features. These innate attributes include physically at low concentrations in soils, acute and chronic toxicity, has carcinogenic effect, adsorb very firmly to the soil matrix, non-biodegradable, non thermo-degradable and thus readily accumulate to toxic levels Zhihang, 2003, Freeman, 2004; Gimeno-Garcia, 2008).

Literatures showed that fertilizer nutrient management planning is crucial in reducing the risks potentials of this chemical resource to human and environment, and this may possibly be inform of soil testing, manure analysis, proper storage and handling of manure, fertilizer application methods and appropriate soil management practices (FAO,1995; Bynres, 1990,Rosen and White, 2001).Therefore, it becomes imperative to determine the rate of adoption of these plan and the choice of adoption by the farmers in order to curtail maximally the effect of fertilizer use to the environment particularly in the study area. This could be a guide to policy planners and extension planners in putting up programs intended for efficient fertilizer use without compromising to environmental sustainability

Specifically, the objectives of the study are to;

i) describe the socioeconomics characteristics of the farmers;
ii) identify the fertilizer type used and the sources by the farmers
iii) identify the effects of fertilizer use to the environment;
iv) identify the fertilizer nutrient management planning techniques adopted by the farmers
v) ascertain the choice of adopting fertilizer nutrient management planning techniques in order to reduce the risk pose to the environmental;
vi) identify the factors affecting the availability of Federal Government Subsidized Fertilizer to the farmers in the study area

II. MATERIALS AND METHODS

The study area is South-East zone of Nigeria and it lies between latitudes 5^0 91' and 7^0 75' N of equator and longitudes $6^0$85' and $8^0$46' East of the Greenwich Meridian. South East has population of 16,381,729 people (NPC, 2006), land mass of 10,952,400 hectares and comprises Abia, Anambra, Ebonyi, Enugu and Imo States. It lies within the rainforest and derived savanna regions of the country within rainfall of 2650 -3100mm, temperature between 25^0C to 42^{o}C and relative humidity of 60 – 78% . The farmers were agrarian and engage in many off- farm income activities. Multi- stage random sampling techniques was used to select one hundred and twenty farmers arable for detailed study. A structured questionnaire and oral interview were used to collect information on primary data in respect to the objectives of the work The objectives i , ii and iii were analyzed using descriptive statistics such as percentage responses and frequency distribution Table. The objectives iv and v were accessed using multinomial logit and factor analysis respectively.

Model Specification

1) Multinomial Logit Model (MNLM)

This was used to ascertain the choice of adopting fertilizer nutrient management planning techniques to reduce the environmental hazards. According to Nehemachena, *et al*, (2007) MNL model for choice of adoption practices specifies the relationship between the probability of choosing an adoption option and the set of explanatory variables. The adoption practices are (soil testing, manure analysis, proper storage and handling of fertilizer, fertilizer application methods and appropriate soil management practices). The MNL Model is stated as follows:

$$P(y=j/x= \frac{\exp(x\beta j)}{[1+\sum^{J}_{h=1} \exp.(x\beta_h), j=1,\ldots,j]} \quad (1)$$

Let x be a 1 x k vector with first element unity.

Where βj is k x1, j=1,...,j

Explicit expression of the model is ;

$$Y_i= \text{In } (P_i, P_1) = \beta_0 +\beta_1X_1 +\beta_2X_2 +\beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9+ \beta_{10}X_{10} +ei \quad (2)$$

Where;

Y_i= adoption practices (soil testing, manure analysis, proper storage and handling of manure, fertilizer application methods and appropriate soil management practices)

$X_{i,}$ where I = 1,2,….10 are explanatory variables,X_1= Gender (male =1 and 0 otherwise); X_2 = Age of the farmers (years), X_3 = Educational attainment (years); X_4 = Household size (in number); X_5= Farming experience (years); X_6 = Farm Size(Ha); X_7 = Member of farmers organization (yes=1 and 0 otherwise); X_8 = Extension contact (yes=1 and 0 otherwise); X_9 = Distance to the purchasing point (km)X_{10}= Access to credit (yes =1 and 0 otherwise

Factor analysis

Factor analysis is used when there is a logical dependence among a set of pragmatic variables while the investigator is concerned in discovery some amazing thing which make this association. It is dependent on linear connection between variables that aimed at eliminating multi-collinearity within them, therefore introduce a small set of variables that are fairly independent of one another called risk factor (Eze, 2006). For instance, it look at if a number of variables of importance Q_1Q_2……Qi are linearly correlated to a small number of overlooked factor D_1,D_2……Dk. The model can be algebraically written as:

$$DM= L_1M\ Q_1+L_2MQ_2+L_3MQ_3+\ldots+LiMQi+LnMQn+eM \quad (4)$$

Where L1k is the weight of the original variable Qi in the linear composite of the factor K, in the case of n variable in the model thus n factors. Every factor Fr example K is symbolizes by a linear composite. If DM be the linear combination of the factor K as signifies in equation I it means Σ

Hence, equation 2 above locates the factor loading or score of every set of study for the factor K by substituting of the values of Qi and i = 1, 2, 3…n in it. Where; ei in equation 1 is the part of variables Qi that cannot be given detail of by the factors (Zuzu, 2002). This model is good for this study as it form the prospect and policy for discovering set factors (risk factors) that permit alternatives of one variable to stand for many. Here the principal component is used in this type of factor analysis, as it guarantees that a set of observations of perhaps interrelated variables are changed into a set of values of linearly uncorrelated variables. Principal Component is chosen above additional techniques as it wants to exploit the sum of squared loadings of each factor take out in turn. The factor analysis more so accountable for the larger variability as shown in the data (Zhihang, 2003). The model is stated thus:

$$R1 = Z_{11}\ M_1 + Z_{12}\ M_2 + \ldots Z_1NMN \quad (5)$$

$$R2 = Z_{21}\ M_1 + Z_{22}\ M_2 + \ldots Z_2NMN \quad (6)$$

$$R3 = Z_{31}\ M_1 + Z_{32}\ M_2 + \ldots Z_3NMN \quad (7)$$

$$Rk= ak_1\ M_1 + ak_2\ X_2 + \ldots Z_kNMN \quad (8)$$

Where R_1, R_2, R_3 …….RN are factors which are linear combinations of the Ms while M_1, M_2, M_3 ……QN are the observed variables which cause variation in the output of maize. They are called the factor loading. In this study, factor loading of 0.33 was used. Therefore, variables with factor loading of less than 0.33 and variables that loaded in more than one factor were discarded.

III. RESULTS AND DISCUSSION

Table 1 revealed that 44. 6% of the sampled farmers were males, while 55.4% were females.

Table .1: Distribution of Respondents According to Socioeconomic Characteristics

Factors	Frequency (n=120)	Percentage
Gender (dummy)		
Male	53	44.2
Female	67	55.8
Marital Status		
Single	25	20.8
Married	90	75
Divorced	5	4.2
Age in Years		
20 – 29	24	20
30 – 39		37.5
40 – 49	30	25
	22	18.3
60 and Above	11	9.2
Household Size (No)		
1-5	25	20.8
6-10	39	32.5
11-15	30	25
16-20	14	11.7
Mean	6	
Years of Farming (yrs)		
1 – 5	15	12.5
6 – 10	30	25

11 – 15	40	33.4
16 – 20	25	20.8
21 and above	10	8.3
Mean	14	
Extension contact (dummy)		
Had extension contact	35	29.2
No extension contact	85	70.8
Access to Credit Use (dummy)		
Yes	80	66.7
No	40	33.3
Membership of Organization (dummy)		
Yes	60	50
No	60	50
Level of Education (yrs)		
No	40	33.3
Primary	55	45.8
Secondary	15	12.5
Tertiary	10	8.3

Source: Field Survey, 2018

This implies that the use of fertilizer to propel farm productivity has no gender bias. Ume, *et al*; (2018) reported on the importance of fertilizer in maximizing farm yield, particularly in the sub-Saharan Africa where the soils are so fragile and have lost nutrients due to agents of denudation. The Table also indicated that 79.2% of the respondents were married, while 20.8 % were single. Nehemachena, *etal;* (2004) revealed that married people may not have problems of hiring labourin fertilizer application as their household members are always available to give such support. However, the use of family labour in farming has high odd of constraining farmers' farm holding, especially was they are children and aged people (Ohaijanya, 2007). The Table further shows that most farmers (57.5%) were below 40years of age, while43.5% were above 40 years. The implication was that most sampled farmers are adaptive and innovative individuals to surmount abuse of fertilizer use to the detriment of the environment (FAO, 1995).Onyenweaku, *et al;* (2010) concurred to this assertion. They found that younger farmers tend to use more sustainable agriculture technologies characterized by modern technology. More so, 53.3% of the sampled farmers had household size of 1– 10 people, whilst 46.7% had 11 persons and above. Households with members especially where they are of labour age and available as well, could supply the much needed labour especially in peasant agriculture during peak of farming season(FAO, 2004).

Also, 37.5 % of the respondents had farming experiences less than 11 years old, whereas the greater majority (62.5%) had above 11years. Long years of farming experience endears the farmers with talents of surpassing intricacies in fertilizer management with aim of enhancing agricultural productivity without degrading the ecology(Bumb, 1991).

Furthermore, the Table revealed that only 29.2 % of the respondents had contacts with extension agents, whilst 70.8% had not. Extension helps in guiding farmers in getting the source of fertilizer at right time, and in providing research feedback on farmers' response to a particular fertilizer related technology disseminated to them(Onyenweaku, *et al*; 2010).Besides, , only 66.7% of the sampled farmers had access to credit through commercial banks, microfinance bank and other lending institutions, while 33.3% had no access. Credit as asserted by Manyong, (2001)aids farmers in early and ease of procurement of fertilizer and in purchasing of protective devices to be worn during fertilizer application in order to avoid possible acidic fertilizer attack on bare body. Studies (Eze, 2006, Ume, *et al*; 20012; Liverpool-Taise, 2016) made similar findings on importance of credit to agricultural production especially in the developing countries where the farming population is poor resourced. Moreover, 66.7 % of the farmers were members of cooperatives, as33.3% were not . Cooperatives train member farmers on soil management through among others proper fertilizer application and access by members to the farm input at right time and at subsidized rate(Parish 1993, FAO, 1998).Table 1 shows that 66.7 % of the sampled farmers had formal education, while 33.3% had no formal education. Educational status of the farmers makes he/she to be receptive to adoption of technology and as well rational decision maker especially on risky issues as relates to the environmental management and resource use (Amaji, 2007).

Table 2a shows that 93.3 % of the sampled farmers used compound fertilizer which could be in form of NPK 15,15,15;20,1010; 25,10,10 and 27, 13, 13; as soil amendments in their farms.

Table 2a; Fertilizer use types in the study area

Variable	Frequency	Percentage
Compound Fertilizer	112	93.3
Muriate fertilizer	76	63.3
Single super phosphate	56	46.7
Urea	94	78.3
Commercial fertilizer	68	56.7

*Multiple Responses.

Source, Field Survey, 2018

Compound fertilizer could be complete(Contains Nitrogen, Phosphorus and Potassium.(NPK) and balanced fertilizers (contain equal nutrient amounts, such as a 10-10-10) form, of which the nitrogen component is responsible for vegetative growth and greenness of the plant, the potassium helps plant in building up and storing of food reserve and phosphorus could assist plant in root growth and development (Rosen and White, 2001, Freeman, *et al*; 2003)**.** In addition, 63.3% of the

respondents used muriate of potash in their farms. Muriate of potash could be in form of potassium; chloride, nitrate and sulfate, and can be easily applied since it is not hygroscopic in nature. This fertilizer type could slightly increase soil pH on application and important in enhancing fruit and vegetable yields (McGuiness, 2003).Also, superphosphate is among other forms of phosphorus fertilizer used by 46.7% of the respondents. This fertilizer type does not affect the pH of the soil on application (Parish, 2003).Additionally, 78.3% of the respondents applied urea in their farms. Urea fertilizer has intrinsic quality of providing nitrogen at the lowest cost, has NPK ratio of 46-0-0, easy to store and does not cause risk of fire out break when stored over long time, may be mixed with other fertilizers or may be applied alone, hygroscopic in nature and highly soluble in water (Gimeno-Garcia, 2008). As well, 53.65% of the sampled farmers used commercial fertilizer in their farms. Commercial fertilizer comprises of Nitrogen-Phosphorus-Potassium (NPK) with micronutrients such as copper, boron, magnesium and ion for high crop yield (Rosen and White, 2001).

Table 2b shows that 90% of the sampled farmers had access to fertilizer through Agricultural Development Program (ADP).

Table 2b Sources of Fertilizer to the Farmer

Variable	Frequency	Percentage
Open market	100	83.3
Cooperative	84	70
Town union	68	56.7
Agric. Develop. Program (ADP)	109	90
Ministry of Agric.	96	80
Churches	48	40
Local Government	86	71.7

.*Multiple Source,

Field Survey, 2018.

ADP is the extension arm of Ministry of Agriculture through which among others help in ensuring farmers' access to fertilizer especially that subsidized by government(Ume, *et al*.; 2016)Also, 83.3% of the respondents procured fertilizer for their farm use through the open market. Here the cost of fertilizer as asserted by Ayo (2002) is determined by the forces of demand and supply as the price of the resource is not subsidized by the government in recent time. Furthermore, cooperative has been means of farmers, especially member farmers of having access to fertilizer at government price as reported by 70% of the total respondents

Additionally, 80% of the respondents procured fertilizer for their farm use through the State Ministry of Agriculture at subsidized government price. The problems of delays in fertilizer procurement and high cost of transportation to rural areas as most government fertilizer depots are located in urban areas are very disincentive to the farmers, resulting in less patronage by the farmers(Eze, 2006). Moreso, Local Government has been avenue of fertilizer distribution at government prices as opined by 77.1%of the respondents. Local government fertilizer distribution has been smeared by politics leading to genuine farmers not having access to fertilizer in preference to some privileged individuals who hijack the resource and sell them at black market(Ume, *et al*.; 2016). Moreover, town unions were used to distribute fertilizer to the farmers as government believe that farmers can easily have access to fertilizer through the channel, as posited by 56.7% of the sampled farmers.

Table 3 shows that 72.5 % of the respondents reported that the algal bloom formed as result of fertilizer use causes discolouring as well odourto the water bodies, hence the water unfit for man use(Bynres, 1990).

Table 3 Effect of Fertilizer use to the Environment

Variable	Frequency	Percentage
Affect water supply	102	85
Methemoglobinemia	65	54.2
Blister in the body	109	90.8
Kidney	76	63.4
carcinogenic effect	63	52.5
Eutrophication	87	72.5
Global warming	80	66.7
Affect natural vegetation	24	20
Acidic water	68	56.7
Biodiversity	67	55.8
Lower agricultural productivity	108	90

Source, Field Survey, 2018

Furthermore 90.8% of the respondents complained about blister in the body. This problem is more pounced when bare hand is used in applying acidic fertilizers. Still, 63.4% of the respondents reported problem of kidney disease. Nitrate fertilizer according to Zlzhu, (2002) is capable of causing kidney disease to man. Likewise, 55.8% of the sampled farmers reported that fertilizer abuse could result in less biodiversity of the environment. Cai, *et al;* (1998) and Zhihang, (2003) revealed that abuse of nitrate fertilizers application will oppose risk to ground water through heavy precipitation and leaching, leading to less biodiversity of the environment.

Additionally, 72.5% of the sampled farmers reported eutrophication leading to death of the aquatic animal. Also, certain algae type is capable of causing water bodies to have smelling feature and this could affect the taste of aquatic animals find there(Kryzanowsski and Penny, 200).In addition, fertilizer misuse could result in global warming as reported by 66.7% of the respondents. Fertilizer like urea is capable of releasing ammonia, a greenhouse gas that often linked in combination with other gases in causing global warming through depleting the ozone layer. This results in increasing the temperature of the earth through the releasing of heat from the depleted ozone layer (Rosen and White, 2001). Also, 54.2% of the respondents reported about methemoglobinemia

disease as result of fertilizer abuse. Literatures show that nitrate levels in drinking water above drinking water standards of 10 mg/l nitrate-nitrogen could likely predispose infants under 6 months of ageto methemoglobinemia disease(blue baby syndrome)if the water is taken by them(Kryzanowsski and Penny, 2004).As well nitratelevels of 20-40 mg/l, could causerisk to domestic animals(Freeman, *et al*; 2003).

As well, excess fertilizer use could result in acid rain as reported by 56.7% of the total respondents. This is possible through the release of certain form of nitrogen gas (McGuiness, 2003)Besides, 20% of the sampled farmers reported that fertilizer use could affect natural vegetation. This is possible through killing of fauna and flora as reported by (Bynres, 1990). As well, 90% of the sampled farmers reported that excessive use of fertilizer could result in low agricultural productivity. The over utilization of fertilizer could result in land degradation, soil acidification and formation of acid sulfate soil, thus making the soil infertile, leading to reduction in crop productivity (Kryzanowsski and Penny, 2004; Amaji, 2009).

Table 3 indicated that 28.5% of the respondents did soil testing as fertilizer nutrient management planning.

Table 4 Fertilizer nutrient management planning to reduce to curtail environmental hazard

Variable	Frequency	Percentage
Soil testing,	34	28.4
Fertilizer analysis,	45	37.5
proper storage and handling of fertilizer	64	53.4
Fertilizer application methods	66	55
soil management practices	36	30

Source; Field Survey; 2018

Soils testing should be done in order to determine the actual crop-soil fertilizer requirements, improve crop growth and yield, evaluate crop quality, minimize disease and evaluating soil for reclamation, fertilizer/ manure, application or for other needed purposes or modification (IFDC, 1995).The rate of application is such that fertilizer application should not exceed the economically optimal rate(EOR),of which according Bumb, (2005),EOR is the rate expected to maximize net returns to fertilizer use per hectare. Mc Guinness,(2003) reported that It is only when a good soil test is done, that right nutrients at the right rates, times and placements to ensure nutrient use efficiency, environmental sustainability and high crop productivity could be enhanced. .However, among peasant farmers in most developing countries, this exercise is sparsely done due to poverty and ignorance and in effect, farmers use 'guise work' in fertilizer application in their farms (FAO, 2004).

Also, 55% of the sampled farmers engaged in adequate fertilizer application method in order to abate probable environmental degradation; The fertilizer application method depends on crop type, soil type, availability of labour, climatic factors, fertilizer type(liquid or granular type) and among others. Fertilizer could be applied through broadcasting, side band placement, ring method (Greene, 2002) Furthermore, proper storage and handling of fertilizer tends to facilitate in protecting the environs from pollution by chemical fertilizer as reported by 53.4% of the sampled farmers., inadequate storage and handling of fertilizer poses the risk of nitrate - Nitrogen outflow from the fertilizer seeping into the ground water, resulting in pollution of drinking water. Additionally, 30% of the respondents carried out soil management to preserve the environs. Soil management helps to curtail maximally surface runoff and lessen soil erosion in order to guide against contaminating drinking water and in preserving soil productivity(Liverpool-Taise, *et al;* 2016).

Table 5 shows the multinomial logistic model result showing the factors affecting the choice of adoption practices by fertilizer farmers in the study area.

Table 5: Result of Multinomial Logistics Regression Estimates.

Variable	Soil testing,	Fertilizer analysis,	storage and handling	Fertilizer application methods	soil management practices	No Adaptation
Gender(Dummy)	1.2177079(0.005)	5.1445062(0.03)	2.0067178(0.65)	0.9007098(0.096)	2.345077(0.08)	1.23421602(0.0560)
Age (Years)	-0.270350(-0.312)	-1.470300[0.64)	5.072355(1.25)*	-4.908355[-0.25]	4.084325(-1.62)*	3.5432908(1.04)*
Education ((yrs)	3.150200 (4.86)***	5.540359(3.09)***	2.410222(4.00)***	7.151892(5.02***	0.131248(6.06)***	
Hhld size(No)	0.369062(0.129)	4.0977099(0.007)	0.1447055(0.04)	3.3377022(0.07)	0.4977008(0.25)	
Experience (yrs)	0.567978(2.25)**	0.3279300(0.05)	3.139935 (2.89)**	1.007826 (2.00)**	0.297936 (0.13)	
Organisation(Dmmy)	0.1600963(2.12)**	3.2347062 (2.09)**	1.3777001(1.08)*	0.9819086(2.01)**	4.0677980(1.08)*	
Credit (Naira)	0.2777033(0.084)	1.0076062(0.40)	0.3577009(0.10)	1.8677076(0.097)	2.4257062 (0.41)	
Extn.Service(Dummy)	3.3677011(0.09)	6.20900629(5.09)***	7.1600431(1.90)*	0.3468432(3.05)***	0.1677990 (0.90)	

Log likelihood – 45.466789; Pseudo R2 = 0.4678; LR chi2(60) = 76.84
Base outcome = Proper storage and handling
***, ** and* shows significant at 1%, 5% and 10% levels of probability respectively.
Source; Field Survey; 2018

The Table showed that the factors influencing the choice of use of soil testing, fertilizer analysis, storage and handling, fertilizer application and soil management practices options inserted into multinomial logistic model. The likelihood ratio statistic is signified by statistics R^2 (-48.26) and was highly significant, suggesting that the model has a strong explanatory power. The coefficient of age of the household had a direct relationship with fertilizer nutrient management planning in reducing the environmental risk by farmers at 95% confidence interval. The implication is that as the farmer is advancing in age, the greater the odd of adopting proper storage and handling of fertilizer and proper soil management. The positive correlation between age and adoption of technology may perhaps be as result of long years of farming experience in which the farmer may have acquired through experimentations and long periods of observations (Tittonell, 2008). Nevertheless, Amaji, (2006) found in contrary the above relation. They opined that at old age the farmer has reduced manual strength to embark on use of improved fertilizer application practices for high crop production and productivity. In addition, the coefficient of the farming experience of the respondents was positively sign and had significant consequence on fertilizer application method, soil testing and adequate storage and handling of fertilizer in order to circumvent endangering the ecosystem. The number of years of the farmers' farming experience may possiblyaid in maximizing their efficiency in fertilizer use, thus curtailing the problem of over fertilization which might be detriment to their crops (Oluwande, 2009).This statement agreed with Ume et al; (2012), who observed that farmers with many years of farming experience has the ability to evaluate innovations and in making decisions on the technique to use bearing in mind environmental sustainability. Nevertheless, Ohaijanya, (2007) finding was not synonymous with above affirmation. They posited that experienced farmers always believe in status quo especially those generational knowledge and even when such knowledge has no "scientific wisdom" . In addition, most experienced farmers commit blunder of judging the amount of fertilizer based on their subjective experience, resulting in excessive fertilizer inputs and the unbalanced proportion of soil nutrients (Eze, 2006).

Moreso, coefficient of membership of organization was positive and had significant outcome in adopting soil testing, fertilizer analysis, storage and handling, fertilizer application and soil management practices in order to minimize environmental pollution often associated with fertilizer use abuse. Farmers' organization through its capacity building of the member farmers in form of workshops and seminars helps to educate and train members on safe method of fertilizer and the consequences of the abuse (Ayoola, 2002)As expected the coefficient of educational level of the sampled farmers correlated positively with the dependent variable at 1% risk level. This could imply that educated farmers could adopt fertilizer nutrient management planning methods such as soil testing, fertilizer analysis, storage and handling, fertilizer application and soil management practices in order to reduce the potential for environmental risk associated with misuse of fertilizer. The high educational attainment by the farmer can facilitate for ease of disseminating environmental pollution free fertilizer management by the extension agents. The finding of Greene and Ng'ong'ola, (1993) concurred with above affirmation. They posited that education enhances farmers' prudency in resource use precisely fertilizer use management in order to preserve the environment., Furthermore, educated farmers knowing the consequences of fertilizer abuse, will be more enthusiasm in using fertilizer and pesticides rationally (Freeman, *et al*; 2003). Besides, the coefficient of extension services had direct relation with the dependent variable at 95% confidence level. This could signify that farmers who had extension services could adopt technologies such as fertilizer storage and handling, fertilizer application and soil management practices as means of minimizing the dismal effect of fertilizer abuse to the environs such as methemoglobinemia in infants and eutrophication in aquatic life. Extension services as posited by Bum, (2002) and Onyenweaku, *et al*; (2010)is the major medium in most sub Saharan Africa through which farmers could have access to improved technologies that are environmental friendly as well capable of pushing their production frontier forward.

Three factors were extracted based on the response of the respondents as shown in Table 6, Factor 1= economic/institutional factor, Factor 2 = infrastructural factor and Factor 3 = socio-financial factor (Adewanyi, 2003)

Table 6. Varimax-rotated Factors against Constraints to Availability of Federal Government Subsidized Fertilizer to the farmers.

Variables	Factor 1	Factor 2	Factor 2
Quantity of fertilizer allocated	0.357	0.462	0.158
High cost of transportation	0.210	0.317	0.209
Diversion of fertilizer(0.322)	(0.322).	0.211	0.225
delay in procurement (0.333);	0.019	0.129	0.333
Political Interference	0. 312	0.260	0.182
Poor access to credit	0.321	0.226	0.231

Source; Computed from SAS 2018.

Only variable with factor loading of 0.30 and above at 10% overlapping variance were used in identification of the factors. Ume, *et al*; (2016) finding concurred with the view that varibles with factor loading of less than 0.30, implies not serious factor and variables that loaded more than one factor were removed. The variable loadings of 0.3 and above are the important factors to be considered as serious factors militating against availability and access of farmers to Federal Government Subsidized Fertilizer. The variable that loaded more than one factor like Quantity of fertilizer allocated was discovered.In identification of the factors Ume, *et al;* (2006) opined that every factor is specified a value based on the set of uniqueness it is made of. Limitations under the economic /institutional factor include poor access to credit (0.321)and political interference(0.312). Poor access to credit has resulted

in many farmers not using this soil amendment in their production, leading to misery yield. The poor access to this resource at farm level by small holder farmers could be linked to high collateral, high interest rate as charged by lending agencies and ignorance of bank credit facilities(Ume, *et al*; 2016). In addition, studies show that politicians use this resource in settling their cohorts whom are not genuine farmers and for political campaign, hence resulting in scarcity of fertilizer at farm level(Ayoola, 2002, Onyenweaku, *et al*; 2010).

The variables that loaded under factor 2 (infrastructural factor) include; high cost of transportation (0.317) and problems of diversion of fertilizer(0.322).Transportation of fertilizer from urban areas where often government and other big time fertilizer dealers have their fertilizer warehouses or depots to farm level is very problematic. This is partly due to poor road network and in effect, most fertilizer may not be timely available to the farmers as well the resource will be very expensive compare to what is obtainable in the urban areas Ume, et al; 2012). Furthermore, problems of diversion of fertilizer may be perhaps because of diversion of fertilizer consignment of the state by some privileged and connected individuals to neighbouring state, hence leaving the farmers without little or nothing to improve their impoverished soils (Bum, 1991;Liverpool-Taise, *et al;* 2016).

The Factor 3 = socio-financial factor considered here was problem of delay in procurement (0.333); The bureaucratic processes otherwise known 'red tapeism' in decision making as regard issuance of fertilizer from government agencies in charge is very cumbersome, consequently many farmers procure the resource from the open market (Amaji, 2007).

IV. CONCLUSION AND RECOMMENDATION

In line to the results, the following conclusions were drawn. The results showed that most farmers were aged, fairly educated, well experienced, had large household size and membership of organization. In addition, the fertilizer types used by the farmers were compound fertilizer, muriate of potash, single super phosphate, urea and commercial fertilizer. Also, the sources of fertilizer to the farmer were open market, cooperative, town union, Agricultural Development. Programme (ADP), Ministry of Agriculture and Local Government Area. Moreover, the effect of fertilizer application to the environment were water supply, kidney, methemoglobinemia, blister in the body, carcinogenic effect, eutrophication and global warming. Besides, the fertilizer nutrient management planning to reduce the potential for environmental risk were soil testing, fertilizer, proper storage and handling of fertilizer, Multinomial regression result estimates for the choice of adaptation practice of fertilizer nutrient management planning to reduce the potential for environmental risk showed that the determinant factors were farming experience, extension agent, age of the farmers, educational level, extension services and membership of organization. Additionally, The limiting factors to fertilizer availability in the study area were diversion of fertilizer, transportation problem, political interference, delay in procurement and delay in procurement.

Based on the conclusion the following recommendations were deduced;

1. There is immense necessitate to fortify the existing strategies on education such as the universal basic, adult educations, awareness creation campaign and mass mobilization geared at exposing farmers on modalities of fertilizer application and handling in order to curtail maximally its effects on the environments
2. Furthermore, the need to equip farmers with information bothering on environmental sustainability and fertilizer use through well trained and motivated extension agents should be intensified by the government agencies concerned.
3. Farmers are encouraged to form or join cooperative in order to have benefits of having access to production inputs at reduced cost and through interactions among members, their production objectives could be met without affecting the ecology negatively.
4. There is need to enforce laws against diversion of fertilizer to neighbouring states and countries by both the States and Federal governments agencies concerned. This diversion problem has caused farmers in the affected areas to scout for fertilizer from black market, thus increasing their cost of production.
5. There s also the need to curtail maximally unnecessary beaurocratic processes involved in fertilizer procurement as this has caused many farmers to jettison buying from government deport to black market where the services are faster but at expense of their farm profit.
6. Farmers should be encouraged to be involved in rural credit and savings mobilization, for ease of credit availability at moderate interest rate.
7. Government agencies concerned should encourage commercial and microfinance banks to lend loans to farmers at moderate interest rate.
8. Government should make sure that the subsidized fertilizer get to the farmers at the subsidized prices

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