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ANALYSIS OF THE ADOPTION OF FARM YARD MANURE AMONG SMALL-SCALE FARMERS IN DELTA STATE, NIGERIA

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ABSTRACT
Based on the concept of technology adoption, a logit model was used to analyze the determinant of farm yard manure (FYM) adoption decision by small scale farmers in Delta State, Nigeria. One hundred and twenty seven extension contact farmers were randomly selected and studied with the use of structured questionnaire/interview schedule. The logit model was used to analyze the primary data collected. The results of the study revealed that, the small-scale farmers' decision to adopt farm yard manure were significantly determined by: farming experience (X_1)(0.225), high cost of chemical fertilizer (X_2)(0.3264), level of Educational attainment (X_3)(0.225), expected yield from FYM (X_4)(0.200), farm size (X_5)(0.1498) and frequency of extension contact (X_6)(1.556). It was therefore recommended among other that extension officers should increase the frequency of their contact with farmers coupled with demonstration farms, since this will significantly influence their technology adoption decision. Also, significant variables in the FYM adoption model should form policy ingredients.

KEYWORDS Adoption decision, determinants, farmers, farm yard manure, small-scale

INTRODUCTION

Food is in short supply and production can only be increased to meet up with the teeming population through expansion of the land area or improving the yields of crops on the cultivated land area (Ugbomeh, 1991). As a result of population pressure on land, expansion is difficult. Moreover, after cropping for some years, soil infertility sets in with low crop productivity. This could be circumvented by the use of fertilizer technology to increase yield. According to Emuh and Agboola (2000), Bamire and Ola (2004), population pressure exacerbates and intensifies land degradation and this resulted in the use of different intensification technologies by farmers to improve yield.

Fertilizers are in the forms of inorganic and organic. Inorganic (chemical) fertilizer are very expensive and beyond the reach of resource-poor farmers and not readily available as at when needed by the resource-poor farmers (Emuh, 2010). Organic fertilizer such as FYM is readily available for use by the resource-poor farmers. Some literatures have focused on the responses of crops to farm yard manure (FYM) applications. One of the earliest reported increases to FYM application in sub-Saharan Africa (SSA) was by Hartley (1973) in the Northern Savannah. It was observed that application of 2t/ha FYM increased seed cotton yield by 100%, equivalent to fertilizers applied at the rate of 60kg N/ha and 20kg P/ha.

The small-scale farmers, as posited by Akinsorotan (2002), face several constraints in the use of fertilizers. The constraints include, among others, escalated price of fertilizers, unavailability or late arrival of fertilizers, insufficient quantities of fertilizers, no soil testing and fertilizer recommendation or lack of information on correct use, lack of incentives and low benefit–cost ratio (Igbokwe, 1982; International Fertilizer Development Centre, 1995; Williams,1986; Adeniyan and Ojeniyi, 2005; Emuh, 2010). High costs of fertilizers have been shown to drastically reduce its use in developing countries (Misra, 1974). Therefore, agricultural extension agencies advised farmers to use organic manure as alternatives, since many studies (Adeoye, 1995; Serna and Pomares, 1991; Kato *et al*., 1997) have shown that organic agriculture is an economically viable alternative.

Organic manure impact positively on soil and eventually crops. Farm yard manure (FYM), is the best of all the organic manure as it contain all the nutrients, has lasting effect on the soil, improves soil structure thus aeration and moisture retention capacities, and is reasonably cheap to obtain from farms. Adepetu (1977), Nnaji *et al.,* (2004) posited that organic manure improves soil productivity through two ways: through nutrients applied as well as method of supply. According to Agboola (1988), Bamire and Ola (2004), Egbuchua (2007), apart from its role as a storehouse of plant nutrients, organic manure is a major contributor to the cation exchange capacity and a buffering agent against unstable pH fluctuations. The soil capacity to store and release nutrients is also improved by farmyard manure application. Rapid deterioration of soil physical properties has been shown to accompany organic matter decline in Nigerian soils. Blake (1994) reported that as a result of continuous cultivation at Iwo, in South Western Nigeria, there was a considerable reduction in soil aggregation, aggregate stability, porosity, hydraulic conductivity and increased bulk density. According to

Serna and Pomares (1991), Ano and Agwu (2005), poultry manure samples gave higher mineralization rate than other types of manure tested. This implies that, poultry manure is better than manure from other animal sources. This supports Agromisa (1999) that opined that chick manure is of high quality. John *et al.* (2004), Nnaji *et al*. (2005), Dauda *et al.* (2008), reported that poultry manure contains essential elements which maintains optimum soil condition and also conserves soil properties. Similarly, Ano and Agwu (2005) reported that animal manure reduced acidity and increased exchangeable Mg and Ca. Maskina and Randhawa (1988) stated that organic manure and levels of zinc significantly increased the dry-matter yield of shoots (114%) and also raised the iron and manganese content in plants. Similarly, John *et al.* (2004), Dauda *et al.* (2008), reported that poultry manure promoted root development and vegetative growth while Emuh (2010) reported that poultry manure significantly increased plant growth parameters and yield of tomato crop.

The transfer of material technology to farmers for adoption has been described as simple and straight forward, unlike the transfer of knowledge-based technology (Swanson, 1996). Farm yard manure (FYM), is one of such technology. Adoption of technologies is the best course of action available (Rogers 1995). According to Van den Ban and Hawkins (1996), technology or innovation is an idea, object or method which is regarded as new by an individual, but which may not always be the result of recent research.

Decisions on chemical fertilizer and organic manure technology use are made in a cascading fashion using relative comparism of singular alternatives rather than intrinsic assessment (Schoemaker 1992). Farmer (decision maker) are the experts on how they arrive at technology adoption decision they make. Hence, it is crucial to elicit from the decision-makers, their critical decision factors, be it social, economical or environmental factors. Understanding farmers' decision determinants is a key to bridging the gap between researchers and farmers. Hence using a reductionist logic based on binary opposition (e.g. decision to use FYM versus decision not to use FYM) a researcher could determine the factors that could influence farmers' choice between technology options.

Adoption of an innovation is the decision of an individual or group to use or apply an innovation. Farmers are said to go through a logical, problem-solving process known as adoption process when considering any technology or innovation. A farmer decision about whether or not to adopt a recommended agricultural practice is recognized to occur over a period of time in stages rather than instantaneous (Mgbada 1999; Adekoya and Tologbonse 2005). Ofuoku *et al.* (2005) and Ofuoku *et al.* (2008) reported that farmer decision to adopt innovation are determined by extension contact, level of formal education, age, farm size and farm income. The broad objective of this study was to identify and analyze the factors that influence farmers' decision to adopt FYM technology in Delta State. While the technology gain on manure use has been immense, what is lacking is the need to develop an adoption decision model, which can be translated into a useable form for farmers and extension workers. This will ultimately bring about a positive change in the way farmers use the resources (Farm yard manure) available to them.

The specific objectives were to: identify and analyze the demographic characteristics of small-scale farmers in the study area.

(i) find out how farm yard manure technology adoption has affected agricultural productivity of small-scale farmers in the study area.

(ii) identify the variables that determine farmers' decision to adopt farm yard manure technology in the study area.

RESEARCH METHODOLOGY

Description of study area, sampling technique and data collection

Delta State is one of the thirty six states, and is located in the Niger-Delta region of the Federal Republic of Nigeria. Delta State was chosen for the study due to its potential for profitable crop production and majority of the farmers are small-holders that cultivate about 0.5 to 2.5 hectares. The crops grown include: root and tuber crops (cassava, cocoyam and yam), cereals (maize and rice), tree crops (oil palm, coaca and rubber) and a variety of vegetables. The major agricultural problems of small-holder farmers in the area include: high cost of labour, small farm size, soil fertility, low farm returns, continuous cropping, displacement through crude oil contamination of soil, seasonal bush burning and high cost of purchased farm inputs (Achoja 2001). Simple random sampling technique using the lottery method (Ladele 2004) was adopted to select 19 Local Government Areas (LGAs) in Delta State. The list of the Local Government Areas was obtained from the Directorate of Local Government and Chieftaincy Affairs. Ten (10) villages in each of the selected Local Government Areas were randomly selected. From each of the ten (10) selected villages, thirteen (13) contact farmers were selected from the list of extension contact farmer of the Delta State Agricultural Development Programme (ADP). Hence a sample size of 130 farmers was used for the study. Structured and pre-tested questionnaire was used to collect information from the respondents. Out of the 130 copies of questionnaires administered, 127 copies were duly filled and returned, hence 127 samples size was used for the purpose of the analysis.

Model Specification and Estimation

Applications of qualitative choice models in explaining different socio-economic phenomena are not new. Qualitative choice models are important in analysing relationship involving a discrete variable. In such relationships, the probability of an event occurring is a function of a set of non-stochastic explanatory variables and a vector of unknown parameters. The simplest of the qualitative response models (the linear probability model (LPM)), is a mean to the ordinary least which bounds probability values (0, 1) are the probit and logit models. Applications of the probit model include, Rahn and Huffman (1984) and Nagatu and Parikh (1999). The logit has also been extensively applied mainly to technology adoption decision. An example of such study is one by Batz *et al*. (1999).

The farm technology adoption variables were previously studied, some of which were found to be relevant to the present study, are: level of extension activities (Malla 1983), farm size (Malla 1983: Belbase 1992), credit (Shakaya and Flinn 1985), Education (Rahn and Guffman 1984), age (Hoover and Witala 1991), society membership (Saije and Ganapin 1991) and market access (Lapar and Pandey 1991).

A form of the logit model adopted in the study is (Pindyck and Rubinfield, 1981). $P^i = C/ (1 + e^{-z}{}_j)$

Where P^i is the probability that a farmer i (i = 1, 2.....n) will be chosen to adopt farm yard manure or not, given the information embodied by index Z_j and C is a constant.

Index Z_j though unobserved was investigated as being predicted by the following relationship:

$$Z_j = B_0 + B_1X_1 + B_2X_2 ....B_k + X_k$$

Where X_1..........X_k are the factors influencing the farmers decision to adopt farm yard manure technology or not. Constant "C" was assumed to be unity without loss of generality and the form in which the logit model was empirically estimated as:

$$Ln(P_j / (1- P_j) = B_0 + B_1X_1 + B_2X_2 ....B_k + X_k$$

Variable Z_j is the choice index, on which to classify farmers in farm yard manure technology adopters and non-farm yard manure technology adopters in Delta State of Nigeria. The descriptions of symbols of exploratory variables in the model in relation to FYM adoption technology are shown in Table 1.

TABLE 1. Description of symbols of exploratory variables in the model

Variables	Description	Measurement
X_1	Farming experience	Cumulative years
X_2	High cost of chemical fertilizer	1 if yes; 0 otherwise
X_3	Level of Education attainment	Cumulative years
X_4	Estimated yield from FYM adoption	Kilograms
X_5	Farm size	Hectares
X_6	Frequency of contact with extension Agents	Number

(**Source**: 2008 Empirical Data) .

*Though in a similar study, Bamire and Ola (2004) used the probit regression technique, it was not comprehensive at its best. For instance, they did not capture farmers' contact with extension agents in their equation. For this reason, we have decided to use the logit model due to its simplicity in use, interpretation and comprehension.

RESULTS AND DISCUSSION

The results of the demographic characteristics of the farmers are shown in Table 2. and effects of adopting farm yard manure on the yield of crops and their incomes are indicated in Table 3.

Age

The information on the socio-graphic characteristics of the farmer as shown in (table- 2) revealed that majority of the farmers (63%) were aged between 30 - 40 years. This could be regarded as middle age. Those of the age range 20 – 29 years constituted 11%, while 25.5% formed those of the age range 50 – 59 years. This result showed that farming was mainly carried out by people of the age range of 30 – 49 years in the study area.

Gender

Majority of the farmers (89.8%) were males, while only 10.2% were females. Although the result showed that small-scale arming was mostly carried out by the males, it did not mean that females were not highly involved in farming in the study area. Females in Delta State were usually involved as helpers and suppliers of labour in planting, weeding, harvesting, processing and marketing operations.

Level of Education

Only 28.0% of the respondents did not have any form of education. Most of them (72.0%) had one form of education or the other. This literacy level among the farmers enhanced their awareness about Farm yard manure. This claim is supported by Madukwe (1995), they stated that educational level of farmers was one of the isolated variables related to the adoption of improved farm practice. Similarly, Ayanwale and Bamice (1996) reported that, literacy level had a positive relationship with the decision to use poultry manure.

Marital Status

Majority (78.0%) of the respondents were married. While 9.4% were single and they were most likely to represent the young farmers. Wives are still predominately used for 'light' farm operations.

Farm Size

The data showed that 12.0% had a total farm size of less than one hectare, while 8.0% had greater than 10 hectares of farm, 31.0% had seven (7) and ten (10) hectares. The data indicated that quite a sizable proportion (39.0%) were not small-scale farmers. The reason is that, they had farm size greater than 6 hectares which were not considered as small-scale (Federal Office of Statistics, 1999). In a similar study, Adepetu (1997) reported that, farm size had a relationship decision to adopt manure.

TABLE 2. Demographic characteristics of farmers in Delta State

Variable Categories	Frequency	Percentages (%)
Age (years) 20 – 30	15	11.80
30 – 39	39	30.70
40 – 49	4	32.30
50 – 59	26	20.50
Above 59	6	4.70
Total	127	100.00
Gender:		
Male	114	89.80
Female	13	10.20
Total	127	100.00
Level of Education:		
No of formal Education	35	28.00
Adult Education	19	15.00
Primary Education	32	25.00
Senior School Education	36	28.00
Tertiary Education	5	4.00
Total	127	100.00
Marital Status:		
Married	100	78.80
Single	12	9.40
Separated/Divorced	15	11.80
Total	127	100.00
Farm size: (Ha)		
<1	15	12.00
1 – 6	62	49.00
7 – 10	40	31.00
> 10	10	8.00
Total	127	100.00

TABLE 3. Estimated increases in the yields of crops of Adopting farmers in the three years 2006 – 2008 (N= 60 – Number of adopting farmers) as indicated by the adopting farmers

Crops	2006 Yield (kg)	2007 Yield (kg)	2008 Yield (kg)
Cassava	343,600	344,209	344,407
Yam	21,600	21,672	21,751
Maize	59,100	59,725	11,087
Pepper	3,250	3,278	3,288
Tomatoes	225	228	248
Okra	2,625	2,631	2,639
Melon	2,800	2,826	2,835

Estimated total income from crops for the three (3) 2005 – 2008 for the 60 Adopters (as indicated by the adopting farmers)

	Income ₦:K	Income ₦:K	Income ₦:K
Cassava	237,812.50	241,278.60	244,909.98
Yam	148,475.00	150,439.00	152,318.00
Maize	5,592.50	5,992.25	6,111.75
Pepper	15,750.00	15,970.00	16,212.00
Tomatoes	1,050.00	1,060.00	1,084.00
Okra	12,350.00	12,474.00	12,635.00
Melon	19,100.00	19,375.00	19,544.00
Total Income	440,130.00	446,601.85	452,877.73
Average Income	7,335.50	7,443.36	7,547.96

₦ = Naira K = Kobo $ = N150.00

Table3 indicates significant increases in the yields of crops and incomes that accrue from the sales of the produce of such crops. This is enough to encourage the farmers to adopt Farm yard manure. This invariably translates into increase in the standard of living of the farmers.

Determinants of farmer decision adopt farm yard manure technology

The maximum likelihood estimates of the model investigated are shown in Table 4. The model F- test was generally significant at 5% alpha level.

TABLE 4. Maximum likelihood estimates of the logit model

Variables	Coefficient
Farming Experience (X_1)	0.0369 (0.0211)
High cost of chemical fertilizers (X_2)	0.3264 (0.0211)*
Level of Education attainment (X_3)	0.0225 (0.0725)*
Estimated yield from FYM Adoption (X_4)	0.200 (0.0690)**
Farm size (X_5)	0.1496 (0.082)**
Frequency of extension contact (X_6)	1.556 (0.757)**

* = Significant at 1%

**= Significant at 5%

Note: The figures in parenthesis under the coefficient are the corresponding standard Error

The parameters estimates for the model were eventuated at the 1%, 5% and 10% level of significance. All the six independent variables included in the model were found to be statistically significant, but at varying significance levels. The significant variables include: Farming experience (X_1), high cost of chemical fertilizer (X_2), level of educational attainment (X_3), estimated yield from farm yard manure (X_4), Farm size (X_5) and frequency of contact with extension agents (X_6). The signs of all the significant parameter estimates entered the model with *apriori* expectations. At this point the statistical significance of the individual explanatory variables in the model are discussed as follows:

Farming Experience (X_1)

This variable entered the mode is in agreement with the *apriori* expected positive sign. The results of this study showed that the farmers' decision to adopt Farm yard manure was sensitive to the length of farming experience of the farmer. This result implies that a long experienced farmer is more likely to have realized the importance of Farm yard manure in crop production. This is in agreement with Mgbada's (1999) findings on adoption of innovation.

The Cost of Inorganic (Chemical) Fertilizer (X_2)

The variable entered for in the model with the *apriori* expected positive sign. The variable turned to be a significant determinant of Farm yard manure adoption decision in the study area. The positive sign associated with the variable in the model, implies that a high cost of inorganic (chemical) fertilizer will lead to an increase in the demand for farm yard manure. This could perhaps be due to the fact that farm yard manure is a close substitute for chemical fertilizer in crop production. Hence any time chemical fertilizer is not economically accessible by small-scale farmer, due to their small income, they will rather choose to adopt farm yard manure. This is in line with Ofuoku *et al.* (2005), who reported that adoption of novel ideas were influenced by farmers' income.

Level of Educational Attainment (X_3)

The coefficient of level of Education attainment entered the model with a positive sign. This implies that the level of education of a farmer can significantly influence his/her decision to adopt Farm yard manure in crop production. This is owing to the fact that an educated farmer would have known the advantages of Farm yard manure application and would want to enjoy them. This result is in agreement with the earlier findings of Madukwe (1995), Ochi and Malumfashi (2005), Ofuoku *et al.* (2008), when he stated that educational level of farmers is one of the isolated variables related to the adoption of improved farm practices.

Estimated Yield from Farmyard Manure (X_4)

The coefficience of estimated yield from Farm yard manure adoption (X4) is positive and congruent with a *apriori* expectation that Farm yard manure would increase their crop yield when used. This will further translate to increase income of the farmers. Hence the small-holder farmer in the study area indeed was displaying rational economic behaviour on the premise of potential economic returns in Farm yard manure technology adoption. This is also in line with adoption behaviour theory (Rogers 1995).

Farm Size (X_5)

The positive and significant relationship between farm size and farm yard manure adoption decision that was evident in the model implies that in the study area, small-scale farmers are more likely to choose farm yard manure adoption as their farm size increases. Thus farm size turned out to be a major determinant of farm yard manure adoption decision. This supports the views of Ochi and Malumfashi (2005), Ofuoku *et al*. (2008) on farm size.

Frequency of Extension Contact (X_6)

The coefficience of frequency of extension contact turned out to be in the model. This implies that Farm yard manure adoption by the small-scale farmers in the study area would depend significantly on the information they get through the extension agents and the frequency of such information on Farm yard manure technology. The findings could be due to the assumption that extension agent creates more impact on technology adoption as the frequency of contact with farmer increases. This will motivate the farmers to adopt Farm yard manure in crop production. This is in consonance with the findings of Ofuoku *et al.* (2005) in a similar study in the adoption of improved *Glycine max*.

CONCLUSION

Agriculture which has been relegated to the background would keep on playing a vital role in the economy of Delta State and small-scale farmers, who make the bulk of the farmers in the State. To increase their productivity, they have to adopt innovations which are applied in the absence or scarcity of widely used chemical fertilizer. Farm yard manures are such innovations used during the scarcity of known innovations like chemical fertilizers. As long as farmers are taught how best to apply manure like Farm yard manure, the impetus to adopt chemical fertilizer by farmers would be low. Low population pressure on land which gives credence to bush fallow and the conservative nature of the small-scale farmers also hinder the adoption of Farm yard manure. Only 47.24% of the farmers adopted Farm yard manure. The level of adoption is a bit on the low side. This agrees with the findings of Raj and Knight (1977) who reported that the extent of adoption by small-scale farmers is very low and this call for more efforts to concentrate on this category of farmers by extension agent.

The factors that influenced the decision of the farmer to adopt Farm yard manure include farming experience, high cost of inorganic (chemical) fertilizers, and level of education attainment, estimated yield from farm yard manure adoption, and frequency of extension contact and with extension agent. Finally, if more farmers adopt Farm yard manure in the present condition of scarcity of inorganic or chemical fertilizers, there will be increased yield which will accrue to the farmers and consequently the living standard of these farmers would be positively affected.

RECOMMENDATIONS

1. More efforts should be made by agricultural extension agencies to see that there should be more contacts with farmers and their families
2. Extension agents should arrange to bring farmers in contact with poultry and other livestock farmers whose farm are not known to them. This will enhance the disposal of waste for the livestock farmers.
3. Vehicles should be provided for the extension agents for easy movement to the farms and farmers families in the rural settlements.
4. Extension agents should integrate method demonstration with result demonstration, but if method demonstration is done first, it should be backed by result demonstration so that the farmer would acquire the technical "know how" and the same time, get convinced by the result of the demonstration done on any innovation.
5. Small plot adoption technology (SPAT) should be employed in the method and result demonstration. On farm trials that are farmer involved should be used.

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