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RESEARCH ARTICLE

FACTORS INFLUENCING ADOPTION OF GREEN MANURE FOR SUSTAINABLE SOIL FERTILITY MANAGEMENT IN OYO STATE

***Adeola, R. G.**

Department of Agricultural Extension and Rural Development, Ladoke Akintola University of Technology, P M B 4000, Ogbomoso Oyo state, Nigeria

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ABSTRACT

Soil fertility decline is a major constraint to increased agricultural productivity. However, the majority of the smallholders could not afford the cost of applying inorganic fertilizers to mitigate a soil fertility decline at recommended rates due to high costs. Hence, the need to supplement inorganic fertilizers with other sources of plant nutrients that is sustainable and environmentally friendly. Three hundred and fifty-six respondents (356) were sampled in Oyo state for the study. A systematic random sampling technique was used in selecting the respondents. Data were obtained with the use of structured interview schedule and analysed using both descriptive statistics and Tobit regression. Results showed that factors such as age ($P < 0.01$), cropping pattern ($P < 0.05$), educational level ($P < 0.01$), availability of legume seeds ($P < 0.01$), farm size ($P < 0.05$), farming experience ($P < 0.05$) significantly influenced the adoption of green manure for soil fertility management. Stakeholders should reach out to the farmers in order to sensitize them on the potentials of green manure technology. Researchers should look into the possibility of making seeds available for the interested farmers to ensure the sustainability of using green manure for soil fertility management.

INTRODUCTION

Low soil fertility has been among the factors limiting smallholder arable crop production in Nigeria. The use of inorganic fertilizers to mitigate a soil fertility decline is limited by high costs (Christopher and O'raye (2006). Some of the farmers that use inorganic fertilizers still cannot afford recommended rates. Integration of green manure legumes into the farming systems could also serve as a cheaper alternative to alleviate the problems of soil fertility (Kanyanjua, *et al.*, 2000). Growing green manure crops will provide multiple benefits of protecting soil from erosion; improve soil structure, chemistry and biological health (Traynor *et al*., 2010). According to Sullivan (2003) green manuring is the incorporation of any field or forage crops at the greenish stage or soon after flowering for the purpose of soil improvement. Green manures can be applied directly by leaving it on the soil as mulch or composted before application. It can also be used as animal feed with resulting animal manure used as organic fertilizer (FAO, 2011). From the foregoing, the integration of green manure crops in the farming system therefore becomes an important factor in the management and preservation of soil fertility and productivity. However, adoption and production of green manure crops for soil fertility management is yet low among smallholder farmers. There is also a dearth of literature on the specific factors that influence the adoption of green manure crops, especially among small scale farmers in Oyo state. Specifically the study was designed to:

- Identify the existing green manure crops in use by farmers in the study area
- Examine the level of awareness of the farmers concerning the soil fertility potential of green manure crops and
- Examine factors that determine the extent of adoption of green manure crops by farmers.

MATERIALS AND METHODS

The study was conducted in Oyo state southwest, Nigeria. The state is located between latitudes $7^0 3'$ and $9^0 12'$ north of the equator and longitudes $2^0 47'$ and $4^0 23'$ east of the Meridian, with a land mass area of about 27, 249 square kilometers. It is bounded in the south by Ogun State, in the north by Kwara State, in the west it is partly bounded by Ogun State and partly by the Republic of Benin, while in the East by Osun State Oyo State has an equatorial climate with bimodal rainfall and relatively high humidity. The dry season lasts from November to March while the wet season starts from April and ends in October.

Sampling Procedure and Sample Size

Two agricultural zones in Oyo state: Ibadan/Ibarapa and Saki zones were purposively selected for the study to represent

Corresponding author: Adeola, R. G.
Department of Agricultural Extension and Rural Development, Ladoke Akintola University of Technology, P M B 4000, Ogbomoso Oyo state, Nigeria

rainforest and guinea savannah vegetation respectively. Six Local Government Areas (LGAs) that are rural based were selected from Ibadan/Ibarapa zone. The LGAs were Akinyele, Lagelu, Ona Ara, Oluyole and Ido while Saki east, Saki west, Atisbo, Orelope, Irepo and Olorunsogo were randomly selected from Saki zone. One village was randomly selected from each of the selected LGAs. Based on the number of registered farmers in each village by the Oyo State Agricultural Development Programme (OYSADEP), 356 respondents were selected proportionate to size using 5% of the registered farmers in a village. Data were obtained from the respondents through the use of structured interview schedule.

Analytical Method

This study employed a Tobit model for this analysis because it can measure the probability and intensity of adoption (Tobin, 1958 McDonald and Moffit, 1980). The intensity of adoption of manure crops was defined as a proportion of total farm area planted to green manure crops PROPGMCRP. In this case the dependent variable is zero for non-adopters and varies between zero and 1 for adopters (where 1 means 100% of farm area is planted to green manure crops. The Tobit model is as follows: Le IA = intensity of adoption of green manure crops; IA* = the solution to the utility of maximization problem of intensity of adoption of green manure crops subject to a set of explanatory variables. IAo = the minimum technology adoption intensity per farmer. Here, IA = 0 proportion of total farm area planted to green manure crops measured in hectares.

Therefore IA = IA* if IA* > IAo

and IA = 0 if IA* $\leq$ IAo

To model the adoption of green manure crops (PROPGMCRP = μ_i) the following simultaneous equation was specified:-

$\mu_i = B_0 + B_1X_1 + \text{----------} B_nX_n \quad i = 1 \ldots\ldots\ldots n \ldots$

0 if $\mu^* \leq T$

$\mu_i = \mu_i^*$ if $0 < \mu^* < 1$ $(i = 1, \ldots\ldots n) \ldots$

1 if $\mu_i^* > T$

where:-

μ_i = the observed dependent variable (as explained above);
μ_i^* = the non observable latent variable representing the use of green manure crops;
T = the critical (cut off) value which translates into $\mu_i^* > T$ as a farmer adopts, and $\mu_i^* < T$ as a farmer rejects the green manure crops and
n = the number of observations i.e. 356

The appropriateness of the model lies in the fact that: (i) it explains the relationships involving a continuous dependent variable and a set of independent variables (Sall and Featherstone, 2002) and (ii) allowing error terms to be truncated or censored in studying the decisions. The Tobit model also has the advantage determining the intensity of use of technology once adoption has taken place.

The following socio-economic and demographic (independent) variables were considered

AGE =Age of farmer in years

CROPPERT="1" If a green manure crop is grown in association with other crops "0" otherwise
EDUC=Number of years of formal Education of the farmers
FARMEXP=Number of years of food crop production
AVASEED=Access to seeds of green manure crops "1" if Yes and "0" otherwise
TFSIZE=Total farm size in hectares

RESULTS AND DISCUSSION

The study revealed that the majority (59%) of the farmers were within the age range of 30 – 50 years with an average of 48 years (Table 1). The implication of this finding is that most of the farmers belong to an economically active age group and their technology adoption behaviours are critical for the improvement of soil fertility using green manure crops. About 76% of the respondents were males while the remaining 23.1% of them were females (Table 1). The average farm size was 3.5 hectares with the majority (65.7%) falling within the range of 3 – 5 hectares and indication that the respondents are smallholders. The average farming experience was 25.7 years with the majority (59%) in the range of 11- 30 years of experience in farming. About 44% of the respondents had no formal education while, 56% had one form of formal education or another. On the average they had 7.5 years of formal education. This implies that the findings of this study are representative of both literate and illiterate residents of the study area. The following green manure crops: Cowpea (80%); Soya bean (67.5%); Pigeon pea (35.5%); Melon (39.2%) and Groundnut (35%) were identified with the farmers' cropping systems in the study area (Table 2). However, some of the farmers were not aware of the potentials of these green manure crops to improve soil fertility.

Farmers adduced certain reasons in deciding whether to adopt green manure crops (Table 3). Seed availability (65%); ability of the legume to intercrop with other crops (63.3%), multiple uses (15%), marketing of surplus manure crops (12.5%) and poor soils (35%) were reasons given by the farmers for using green manure crops in the study area. Results of Tobit regression model (Table 4) indicated that age, education, cropping pattern, farm size, seed availability and farming experience significantly influenced the intensity with which the green manure crops were used for soil fertility management. It is interesting to observe that age has a positive significance ($p \leq 0.01$) influence on the intensity of adoption (Etoundi and Dia, 2008). At younger ages, farmers may not be able to afford adequate resources needed for the adoption of technology. A positive significant ($p \leq 0.01$) sign was observed between education and the intensity of adoption. This implies that highly educated farmers are expected to be more efficient to understand and obtain new technologies in a shorter period of time than uneducated people (Paudel and Matsuoka, 2008; Kudi *et al.,* 2011). The cropping pattern had a negative sign which significantly ($p \leq 0.05$) influenced the adoption of green manure crops. This means that farmers with less number of crops in the cropping systems (mixed) tend to adopt green

Table 1. Socio-economic Characteristics of Respondents n = 356

Characteristics	Frequency	Percentage
Age in years		
≤ 30	56	15.7
30 – 40	104	29.2
41- 50	106	29.8
Above 50	90	25.3
Mean = 48		
Total	356	100.0
Sex		
Male	271	76.1
Female	85	23.9
Total	356	100.0
Farm size (Ha.)		
1 – 2	79	22.2
3 – 4	142	39.9
4 – 5	92	25.8
> 5	43	12.1
Mean = 3.5		
Total	356	100.0
Farming experience (Years)		
≤ 10	45	12.6
11 -20	112	31.5
21 – 30	98	27.5
< 30	101	28.4
Mean = 25.7		
Total	356	100.0
Education		
No formal education	156	43.8
Primary school	128	40
Secondary school	45	12.6
Tertiary	27	7.6
Total	356	100.0

Field survey, 2011

Table 2. Distribution of Respondents by Green Manure Crops Used in the Study Area n = 356

Green manure crops	*Frequency	Percentage
Cowpea	285	80.0
Soya bean	239	67.5
Pigeon pea	126	35.5
Melon	140	39.2
Groundnut	125	35.0

Field survey, 2011
***Multiple Responses**

Table 3. Distribution of Respondents by reasons for using Green manure crops n = 356

Reasons	*Frequency	Percentage
Seeds availability	231	65.0
Ability of the legume to intercrop with other crops	225	63.3
Multiple uses	53	15.0
Marketing of surplus manure crops	4	12.5
Poor soils	125	35.0

Field survey, 2011
***Multiple Responses**

Table 4. Tobit estimates of factors that influence the use of green manure crops for soil fertility management n =356

Variable	Coefficient	Std. Error	t-ratio	Prob
Constant	0.5894	0.1064	5.540	0.0000
AGE	0.8070**	0.2286	3.530	0.0004
EDUC	0.5071**	0.1791	2.831	0.0046
CROPPER	-0.6037*	0.1941	-3.111	0.0229
TFSIZE	0.5071*	0.1817	2.791	0.0353
AVASEED	0.8244**	0.2324	3.548	0.0004
FARMEXP	-0.6037**	0.1969	-3.067	0.0022

**= significant at P< 0.01, *= significant at P< 0.05; Sigma = 0.260; Significant at p ≤ 0.01

manure crops for soil fertility management. Farm size was found to have a positive and significant ($p \leq 0.05$) relationship with the intensity of adoption of green manure crops. This finding is consistent with the assertion that large scale is more inclined to adopting new technologies than small scale farmers (Kasenge, 1998; Mamudu *et al*., 2012). Availability of seeds was also found to positively relate to the intensity of adoption at 0.01 levels of significance. This means that seed is an important factor of green manure technology adoption. Farming experience was negatively related to the intensity of adoption at 0.01 levels of significance. This implies that more experienced farmers are not likely to take risks of leaving their own ways of doing things and adopt new technology. The sigma (ó) value of 0.260 with a't' value of 26.683 significant at $p \leq 0.01$ depicts the fitness of the model.

Conclusion

The empirical results revealed that six factors influenced both adoption of green manure crops and intensity of adoption. The factors included age, education, cropping pattern, farm size, seed availability and farming experience. The study suggests that stakeholders should intensify efforts at sensitizing farmers on the potentials of green manure technology. The identified factors should be considered when designing a sustainable programme that will encourage the use of green manure crops for soil fertility management.

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