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DETERMINANTS OF FARMERS' PREFERENCE FOR SUSTAINABLE LAND MANAGEMENT PRACTICES FOR MAIZE AND CASSAVA PRODUCTION IN OGUN STATE, NIGERIA

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ABSTRACT

In order to ensure agricultural sustainability, as highlighted in the millennium development goals, it has become necessary to focus policies on enhancing sustainable land management, especially in vulnerable areas of sub-Saharan Africa. Hence there is the need for this study which was designed to analyze the determinants of farmers' adoption of Sustainable Land Management Practices (SLMP) in the production of maize and cassava in Ogun State. Multi-stage sampling technique was adopted in this study. The data for study was collected from 338 farmers with the use of questionnaire. Information collected covered farmers' socio-economic, institutional and farm level characteristics and specific SLMPs used. The SLMPs studied included Structural and Mechanical Erosion Control (SMEC), Agronomic Practices (AP), Cultivation Practices (CP) and Soil Management Practices (SMP). Data were analyzed using descriptive statistics and the logit model. The farmers had an average of nine years of formal education, 54% participated in Community Based Organizations (CBOs), and 91% had access to extension education, 55% had land tenancy security 81% favoured the use of AP more than other SLMPs. About 47% of the farmers cultivated undulating farmlands which were vulnerable to degradation. Farmers' level of education and their participation in CBOs positively influenced their adoption of the SLMPs. Overall results from this study show that the adoption of SLMPs can be enhanced by increasing farmers' literacy level and encouraging them to participate more in community based organizations.

Key words: Sustainable land management practices, logit model, Ogun state.

INTRODUCTION

Land is an important resource in farming. Land degradation (in the form of erosion in particular) has greatly affected commercial agriculture and the environment in Nigeria. Some communities in Nigeria have had over 10% of their land mass wasted by erosion and still stand the chance of losing more of their cultivable land in the nearest future (Titilola *et al.,* 1990: 44). Latest estimates indicate that nearly 2 billion hectare of land worldwide – an area twice the size of China – are already seriously degraded, some irreversibly (FAO, 2010). About 16%, representing over 494.2 million hectares of land is degraded in Africa (Ezeaku and Davidson, 2008: 42). The annual monetary value of lost production through

land degradation is $65 million (Ezeaku and Davidson, 2008: 42). This has called for putting in place Sustainable Land Management Practices (SLMP).

As defined by the TerrAfrica partnership (2006), SLMP is the adoption of land use systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources (FAO, 2009).

Efforts have been made to reverse the ugly trend of land degradation. However, most public intervention on soil conservation and land management practices in developing countries especially Nigeria have performed below expectation (Fameso, 1992: 13). The reasons for this low performance could be traced to the nature of soil conservation technologies introduced (Anande-Kur, 1986: 18) and socioeconomic conditions of the users of the technologies among other factors. (Jansen *et al.,* 2006: 92; Bravo-Ureta, *et al.*, 2006: 267). Thus, for effective and sustainable implementation of programmes on sustainable land management practices against land degradation problem, just like any other innovation, the characteristic of the end users and their perception must be carefully evaluated and incorporated into planning framework such as highlighted in this study.

The most pressing challenge of Nigerian agriculture in the new millennium is how it can meet the food need of an ever-bourgeoning population in the fact of the myriads of social, cultural and economic problems that negates sustainable land management (Akinbile, 1997: 65; Fakoya *et al.*, 2007: 536). Projected reductions in crop yields as a result of land degradation in some Sub-Saharan African countries could be as much as 50 percent by 2020, while Crop net revenues could fall by as much as 90 percent by 2100, with small-scale farmers being the most affected (Woodfine, 2009). This will inevitably affect food security adversely. Thus, combating land degradation has become an urgent priority in global efforts to encourage commercial farming and ensure food security of millions of people.

Sequel to this, the United Nations Convention to Combat Desertification (UNCCD) came by March 2002 came up with the recommendation that the development and adoption of sustainable land management practices is one of the major solutions to combating the problem of land degradation and sustaining commercial arable farming (WMO, 2005). It is against this backdrop that this study examined the different SLMP adopted by the farmers in Ogun state, Nigeria.

The null hypothesis tested for this study is stated as follow: Socioeconomic, institutional and farm level factors do not significantly determine the choice of land management practices adopted by farmers

According to Sheng (1989: 4), common land management practices in Nigeria can be classified as follows:

1. Structural and Mechanical Erosion Control Practices (SMECP) which include contour bund, and construction of ridges across the slope.
2. Agronomic Practices (AP) which include multiple cropping, mulching, and crop rotation.
3. Soil Management Practices (SMP) which include compost and farm manure.
4. Cultivation Practices (CP) which includes minimum tillage.

RESEARCH METHODOLOGY

The study was carried out in Ogun State of Nigeria. Ogun State is located in the South-Western part of Nigeria. It is bounded in the west by the Republic of Benin, in the east by Ondo State, in the south by Lagos State and in the north by Osun and Oyo States. It lies within latitude 6^{o}N and 8^{o}N and longitude 2^{o}E and 5^{o}E. It has a land area of about 16,762 square kilometers and a population of about 3,728,098 (NPC, 2006; NBS, 2007: 5), which is approximately 2.70 percent of Nigeria's population. Farming is the major occupation of the people, particularly those living in the rural areas. The climate favours the production of arable crops such as maize, yam, cassava, rice, cocoyam and tree crops like kola nuts, cashew and oil-palm. Administratively, the state is divided into four divisions which include, Egba, Ijebu, Yewa and Remo. In all there are twenty local government areas in the state.

Primary data were collected and used for analysis in this study. The data collection employed the use of well structured questionnaire for gathering information from farmers growing cassava and maize. The multi-stage sampling method was used to select the respondents. Ten local governments were eventually used for the study. Two villages were randomly selected from each of the selected local government areas and twenty farmers sampled from each, were selected based on their cultivation of cassava and maize. Thus, a total of four hundred farmers were selected for the study.

Descriptive statistics of frequencies and percentage frequencies were used to describe the socio-economic characteristics of the respondents and the logit regression model was used to determine the factors influencing farmers' choice of SLMP. The choice of the logit model is because the dependent variable is a dummy. Where the dependent variable is a dummy, the two models often used are the logit and probit regression models. But as Amemiya (1981: 1483) has observed, the statistical similarity between logit and probit models makes the choice between them difficult. The logit model is however, computationally easier, thus, it was selected for this study. Following Gujarati (1988: 98), the model is specified as follows:

$$\text{Ln}\,(P_i/(1-P_i)) = ß_0 + ß_1X_1 + \ldots. + ß_6X_6 + e_i\,.$$

Where:

P_i = probability of farmer's adoption of various SLMP

$1-P_i$ = probability of not adopting SLMP

$ß_0$ = Intercept
$ß_i$ (1,2,3...,10) = Regression coefficients,
X_i (1,2,3...,10) = Independent variables, and
e_i = error term.
The dependent variable is the natural logarithm of the probability of a farmer adopting a SLMP divided by the probability of not adopting.
The various SLMP examined in this study are as follows:

1. Structural and Mechanical Erosion Control Practices (SMECP) which involved the use of any of contour bund and construction of ridges across the slope.
2. Agronomic Practices (AP) which involved the use of any of multiple cropping, mulching, and crop rotation.
3. Soil Management Practices (SMP) which involved the use of any of compost and farm manure.
4. Cultivation Practices (CP) which involved the use of any of minimum tillage and zero tillage.

The following variables have been hypothesized to influence the adoption either positively or negatively:

X_1 = farming experience in years;
X_2 = farmers experience cultivating current land holding in years;
X_3 = educational level (at least a secondary school education=1, otherwise=0)
X_4 = farm size, (hectares);
X_5 = Topography (flat=1, sloppy=0);
X_6 = participation in government awareness program on climate or environmental variability, land degradation/soil conservation, etc (yes=1, no= 0);
X_7 = membership of Community Based Organization i.e farmers' cooperative (yes=1, no=0);
X_8= access to extension services/education by farmer, (yes=1, no= 0);
X_9 = Frequency of extension visit
X_{10} = Quality of extension visit (good= 1, poor= 0)
The Statistical Package for Social Sciences version 17 was used to run the analysis.

RESULTS AND DISCUSSION

Socio-economic and institutional characteristics of respondents

The distribution of farmers' socio-economic and institutional characteristics is shown in Table 1 and 2. The characteristics of importance considered include years of education and experience in farming, marital status, household size, age of the respondents, household's

membership of Community-Based Organization (CBO), their collective participation in government agricultural programmes such as FADAMA and access to extension service. The most prominent CBOs are the farmers' cooperative societies.

Results in Table 1 shows that the average age across the study area was 50 years. This has implication on available farm labour, productivity and the ease with which improved agricultural practices are adopted.

The average year of education of farmers was 9 years. With this literacy level of farmers in the study area, they are expected to be able to read and communicate in English language. Farmers' educational level is expected to have significantly positive influence on their participation in development programmes and in the adoption of innovations (Fawole and Fasina, 2005: 8). However, literacy in the study area is still relatively low, with a majority of farmers having less than secondary school education.

The average household size among the farmers was 8. The household size among the farmers was on the high side judging by the state's average of approximately 6 and national average of approximately 5 (NBS, 2007: 5). Although, this may imply higher availability of family labour, large household size has been reported to be a determinant of food insecurity and poverty of households especially in Nigeria (Ajani, 2005: 91; Akinbile and Ndaghu, 2005: 101).

Farmers' year of experience in farming is expected to increase quality and quantity of output by reducing pre-harvest and post-harvest losses, increase use of conservation technologies and increase efficiency of the farmers. It is even more important among farmers with low literacy level. The result in Table 1 shows that the average years of farming experience in the study area was 24 years indicating a high potential for increased productivity among farmers, if they are adequately supported and motivated. Furthermore, the farmers reported that they have been using their current land for production, on the average, for 10 years. The more years a farmer puts to cultivating a particular parcel of land could influence the choice of and the ability to use SLMP. (Awoyinka *et al.,* 2009: 135; Traore *et al.,* 1998: 205). It also has a lot of implications on the tenure system in place in the study area.

The results in Table 1 further show that the majority of the farmers were married (94%) and are male (92%). Access to credit, in combination with other assets, is an important determinant of LMP adopted by farmers (Nkoya *et al.,* 2004). The majority (73%) of the respondents do not have access to credit facilities.

The results as presented in Table 2 show that 54% of farmers belong to one form of CBO or the other. These results are consistent with the findings of Awoyinka *et al* (2009: 135) and Jagger and Pender, (2003). They found out that participation in CBO was a constraint to adoption of SLMP among farming households.

Table 1: Socio-Economic Characteristics of Respondents

Variables	Study Area (n= 338) Freq	%
Age (mean)	50	
S.D.	10	
Min	25	
Max	80	
	9	
Years of Education(mean)		
S.D.	4	
Min	0	
Max	16	
	8	
Household Size (mean)		
S.D.	3	
Min	2	
Max	20	
Years of farming experience (mean)	24	
S.D.	12.7	
Min	2	
Max	65	
Years of farming current land(mean)	10	
S.D.	9.3	
Min	1	
Max	45	
Marital status		
Single	21	6.2
Married	317	93.8
Gender		
Male	311	92
Female	27	8
Access to credit facility		
Access	91	27
No access	24	73

Source: Field survey, 2011

Table 2: Institutional Characteristics of Farming Households

Institutional Factors	Study Area (n= 338) Freq	%
Membership of farming org		
Yes	182	54
No	156	46
Major LMP related Programme Participated in		
None	115	34
ADP initiative	117	35
FADAMA	61	18
NGO initiative	45	13
Contact with Extension Agents		
Yes	306	90.5
No	32	9.5
Number of ext. visit per month (mean ±STD)	2(±1.77)	
Quality Ranking of Extension Services		
Poor	29	8.6
Fair	43	12.7
Excellent	266	78.7

Source: Field survey, 2011

Farmers' participation in programmes which teach land management practices has an influence on eventual adoption of SLMP by farmers. Results in Table 2 reveal that farmers have a good level of participation in such programmes across the state (66% have participated).

Upon further examination of those that have participated in programmes that teach land management practices, the major types of LMP-related programme which the farmers have participated in are those initiated by the Agricultural Development Project (ADP) for which 35% of the farmers have participated.

About 91% of the farmers had access to extension service. The extension agents visited the farmers, on the average, twice a month and the quality of extension service, as reported by 79% of the farmers, was excellent.

Farm-Level Factors of the Farmers

Farm-level factors have been acknowledged to influence the use of LMP for increasing agricultural productivity among farmers in the rural area (Westra and Olson, 1997: 139; Pender and Kerr, 1998: 113). Farm-level factors of importance include land tenancy security, farm size cultivated and topography of farmland owned. The farm-level factors of farmers were analyzed in this study. The results are presented in Table 3.

Results according to Table 3 showed that 55% of the farmers had land tenancy security. Farmers' tenancy security on land owned and cultivated could determine the choice of SLMP used on the farm for increasing agricultural productivity (Gebmedhin and Swinton, 2003: 69; Wachter, 1994). Land tenancy security or insecurity has been described on the basis of type of land tenure, as presented in Table 3.

Table 3: Farm-Level factors of the farmers

Factors	**Study Area (n= 338)**	
	Freq	%
Tenancy security		
No	151	45
Yes	187	55
Source of Land Cultivated/Type of Tenure		
Inheritance	131	38.8
Lease	92	27.2
Family	45	13.3
Gift	28	8.3
Government	22	6.5
Purchase	20	5.9
Farm Size Cultivated in Hectares (mean ±STD)	3.2 (±2.36)	
Topography of Farmland		
Flat	179	53
Hilly/ Steep slopes	119	35.2
Depression Area	40	11.8

Source: Field survey, 2011

The result further shows that, cumulatively, 53percent of the farmers across the state sourced or obtained the land which they cultivated through inheritance (39%), purchase (6%), and gift (8%). These sources usually secure land tenancy. On the other hand, 47% of the farmers across the state sourced or obtained the land which they cultivated through leasehold (27%), family land (13%) and government land (7%). These are usually insecure forms of land tenancy.

The result in Table 3 indicates that average farm size cultivated by farmers in the study area was 3.2 hectare. This result showed that the level of commercialization of agricultural production is likely to be high in the study area, with farming as the major occupation for the farming folks.

The topography of the farmland may also determine the use of SLMP. The result in Table 3 shows that, although, 53percent of the farmers cultivated flat lands, 47percent of the farmers cultivated hilly (35%) and undulating (12%) lands. The existence of farmlands with the degradation and vulnerability to degradation is evident in the study area. Farmers cultivating on sloppy or undulating lands are expected to be more conscious of information on SLMP.

Specific Land Management Practices adopted by farmers.

The result according to Table 4 shows that among the Structural and Mechanical Erosion Control Practices (SMECP), construction of ridges across the slope was the most widely used by farmers in the study area for crop production activities. Forty seven percent engaged in construction of ridges across the slope, out of which 28 percent always used it. However, the use of SMECP in the study area is generally poor. This may be as a result of the associated costs, which go beyond farmers' capacity (Aromolaran, 1998: 10).

The result of the analysis of Agronomic Practices (AP) used for crop production activities revealed that the majority of the farmers (94%) engaged in multiple cropping (81% always did). This result agrees with the findings of Awoyinka *et al* (2009: 134) and Aromolaran (1998: 10).

The major Soil Management Practices (SMPs) adopted by the farmers was the application of inorganic fertilizers (89%, out of which 58% always used it). The high use of inorganic fertilizers may not be deliberately targeted at soil conservation; however, the resultant rapid growth in vegetation from fertilizer application would have conservation effect on the soil (Aromolaran, 1998: 10). Compost was not widely used by the farming households because of low availability of materials, technicality involved in the production and high cost of application due to bulkiness. The farmers that applied farmyard manure were mainly those

that combined livestock rearing with crop production (i.e mixed farming) and the majority seldom adopted the practice.

Minimum tillage was the identified Cultivation Practices (CPs) among the majority (79%) of the farmers in the study area. Although many of the farmers used minimum tillage, which has been identified as a superior CP for land management (since it involves low interruption of the soil during cultivation), a larger number of the farmers still practiced the conventional tillage system.

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Table 4: Specific Land Management Practices Adopted By Respondents

	Always practiced		Often practiced		Sometimes practiced		Not practiced	
Land management practices	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Structural and mechanical erosion control practices (SMECP)(n=338)								
Terraces	4	1.2	9	2.7	40	11.8	285	84.3
Contour bund	7	2.1	35	10.4	38	11.2	258	76.3
Construction of ridges across the slope	93	27.5	27	8	38	11.2	180	53.3
Agronomic practices (AP)(n=338)								
Multiple cropping	274	81.1	38	11.2	14	4.1	12	3.6
Mulching	128	37.9	38	11.2	63	18.6	109	32.2
Crop rotation	143	42.3	45	13.3	56	16.6	94	27.8
Cover cropping	140	41.4	49	14.5	79	23.4	70	20.7
Strip cropping	7	2.1	11		41		279	82.5
Soil management practices (SMP)(n=338)								
Compost	11	3.3	13	3.8	37	10.9	277	82
Farm/green manure	63	18.6	51	15.1	119	35.2	105	31.1
Use of fertilizer	195	57.7	69	20.4	37	10.9	37	10.9
Cultivation practices (CP)(n=338)								
Minimum tillage	167	49.4	50	14.8	51	15.1	70	20.7
Conventional tillage	118	34.9	57	16.9	49	14.5	114	33.7

Source: Computed from field survey data (2011)

Determinants of Adoption of Sustainable Land Management Practices among Farmers.

The data on the determinants of the adoption of the various Sustainable Land Management Practices (SLMPs) were analyzed, using the logit regression model. A number of variables were hypothesized to determine the farmers' decision to use a particular choice of land management practice in the study area. The use of the four categories of SLMP (Sheng, 1989) was examined. The use of a particular land management practice among farming households was hypothesized to depend on socio-economic, institutional and farm level factors (Nkoya *et al.,* 2004; Jansen *et al.,* 2006: 92).

The result of the logit model analysis is presented in Table 5. The significance of the diagnostic statistics (chi-squared and log-likelihood value) shows a good fit for the model.

The result shows that Membership of Community-Based Organization is a significant and positive ($p< 0.01$) determinant of the use of SMECP among farmers in the study area. This implies that farmers who belonged to CBOs had a higher probability of adopting SMECP. Furthermore, the result shows that farmers' participation in government agricultural programmes significantly ($p< 0.01$) and positively influenced the use of SMECP among farmers in the study area. This implies that farmers who participated in government agricultural programme were more likely to adopt the SMECP. This could be because participation in government agricultural programmes could lead to a higher level of awareness on the use of a particular SMECP. Farmers' years of education positively and significantly ($p< 0.01$) influenced the use of SMECP in the study area. Thus, the more educated a farmer was, the more likely was the decision to use SMECP to conserve soil against land degradation problem. This is expected as educational level is associated with higher understanding of the importance of SMECP for sustainable land management (Ervin and Ervin 1982: 271; Feder *et al.,* 1985: 255). Farm size cultivated and topography of farmland, as farm level factors, positively and significantly ($p< 0.05$) influenced the use of land management practices. The result agrees with earlier findings of Sheng (1984) and Awoyinka *et al* (2009: 135) that SMECP is the best practice for hilly farmlands, especially when a large hectarage is being cultivated. The result also agrees with the findings of Winters *et al* (2002) that the slope of farmland positively affects soil conservation investments.

The use of AP in the study area was influenced by membership of Community-Based Organization (CBO), years of education and farm size cultivated by respondents. Membership of community-based organization ($p< 0.01$), and years of education of the farmers ($p< 0.05$) positively influenced the use of AP in the study area, and have the same explanation as for SMECP. Farm size negatively influenced the use of AP ($p< 0.05$) in the study area, and this implies that users of AP were those with small farm sizes. This finding agrees with the result of Awoyinka *et al.,* (2009: 135), Agbamu (1995: 213) and Filson (1993: 165). The results imply that users of AP are those that belong to CBO, with many years of education and small farm size.

The use of SMP in the study area was influenced by membership of Community Based Organization, years of education, years of experience in farming, years of experience in farming, current farm holding and participation in government agricultural programmes. Membership of community-based organization, years of education of the farmers and their participation in government agricultural programme were significant variables ($p< 0.01; 0.05; 0.01$ respectively) which positively influenced the use of SMP in the study area, and have the same explanation as for SMECP. Farmers' year of experience in farming generally and their years of experience in cultivating the current farm holding also positively ($p< 0.05; 0.01$ respectively) influenced the use of SMP in the study area. This implies that the farmers who have more years of farming experience are more likely to use SMP in ameliorating soil degradation problems. This result is consistent with the findings of Awoyinka *et al* (2009: 135) but is contrast to the findings of Norris and Batie (1987), Ervin and Ervin (1982: 271) Pender and Kerr (1998: 113).

Membership of Community Based Organization ($p< 0.01$), years of education of the farmers ($p< 0.05$) and topography of farmland ($p< 0.05$) were significant variables which positively influenced the use of CP in the study area, and have the same explanation as for SMECP.

Table 5.3: Logit Model: Results of the Analysis of the Determinants of Adoption of various LMPs

Variables	SMECP	AP	SMP	CP
Constant	0.26 (1.451)	0.46 (1.407)	0.16 (1.401)	0.23 (1.402)
Farmers years of experience in farming	0.16 (0.98)	0.23 (0.63)	0.72** (2.15)	0.16 (0.10)
Farmers years of experience in farming current land holding	0.58 (0.57)	0.50 (0.42)	0.22*** (2.64)	0.684 (0.57)
Years of Education	0.14*** (2.39)	0.72** (2.62)	0.18** (2.93)	0.14** (1.98)
Farm size	0.25** (2.32)	-0.49** (2.17)	-0.011 (0.026)	0.013 (0.032)
Topography of land	0.067** (2.22)	0.28(0.35)	0.26 (0.37)	0.18** (1.99)
Participating in Government Agricultural Programme	0.748*** (2.916)	0.76 (0.21)	1.89*** (2.71)	0.97 (0.680)
Belonging to Community-Based Organisation	0.139*** (2.93)	0.53*** (2.82)	0.46*** (3.25)	0.044*** (3.12)
Access to extension education	0.734 (1.449)	0.15 (0.32)	0.94 (0.68)	0.83 (1.22)
Frequency of extension visits	0.490 (0.940)	0.89(0.22)	0.53 (0.74)	0.25 (0.77)
Quality of extension visits	0.067 (0.042)	0.49 (0.16)	0.10 (0.058)	0.040 (0.033)
Log-Likelihood	-265.48***	-216.01***	-104.57***	-393.35***
Chi-square	138.195***	98.307***	52.790***	70.333***
Pseudo R^2	0.404	0.546	0.50	0.414

Number of observation =338; Figures in parenthesis are t-ratios of the coefficients.
**** Significant at 1%; **Significant at 5%*

Source: Computed from field survey data (2011)

Based on the above results, the stated null hypothesis which says that there is no significant relationship between farmers' socio-economic, institutional and farm level factors and their adoption of SLMP, is rejected in favour of the alternative hypothesis.

CONCLUSION AND RECOMMENDATIONS

The study has shown the nexus between farmers' personal, institutional and farm-level characteristics and their choice of land management practices. The findings also confirmed the various previous research findings that established the economic and social benefits of land and

natural resource conservation. The outcomes further show possible areas of policy intervention in land management. Based on the survey results, the following recommendations have been proposed.

1. In order to achieve the social benefits of natural resource conservation, there is a need for aggressive programmes to tackle the problem of low level of education, poor participation in community organizations and government initiated soil conservation programmes.

2. Non-governmental organizations that support farmers should extend their activities to cover land management issues, and also integrate their activities in land management with those of the government.

3. Programme intervention in natural resource conservation needs to focus on detailed characterization and identification of Land Management Practices (LMPs) that are both farm-and farmer-specific. In particular, specific programmes should be designed for various land management practices that meet the peculiar needs of various categories of farmers.

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