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Effects of Livelihood Strategies on Adoption of Farm-specific Land Management Practices among Crop Farmers in South West, Nigeria

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Abstract: Adoption of Land Management Practices (LMP) among crop farmers in Nigeria has not been effective, due, among others, to neglect of Livelihood Strategy (LS) in LMP programme intervention. This study investigated the nexus between LS and LMP. Multistage random sampling was used to collect primary data from 400 farmers in South West Nigeria. Probit regression model was used to analyze data for 2007 production season. Farmers engaged in staple Crops/Off-farm Income (LS1=30.0%); StapleCrops/WagesandSalary (LS2=22.5%);LS1/Vegetable/Fruits/Livestock Production (LS3=27.5%); LS3/Tree Crops (LS4=20.0%). Farmers adopt multiple LMPs for crop production. Agronomic Practices (AP = 80.0%) was preferred to other LMPs including Soil Management Practices (SMP = 65.0%), Conservation Practices (CP = 60.0%), Structural and Mechanical Erosion Control Practices (SMECP = 34.0%). The effect of other LS relative to LS1 on LMP reveals that households pursuing LS3 and LS4 are more likely to use SMECP and CP. LS2 households are more likely to use AP and SMP. The probability of adoption of SMECP, AP, SMP and CP increases with farmers' membership of CBO and years of education. Topography, farm size cultivated and tenancy security increase probability of adoption of SMECP. Adopters of AP and SMP cultivate small land and had contact with extension agent. Users of CP cultivate crops on slopy farm land. Farmers in rainforest belt are more likely to adopt SMECP and CP. Reverse is the case for AP and SMP. Thus, sustainable food policy and LMP programmes requires understanding of LS of the farming households.

Key words: Livelihood Strategy, Land Management Practices and South West, Nigeria.

INTRODUCTION

The fundamental value of agriculture in the development and growth of the Nigerian economy is indicated in its contributions as source of food and raw materials for industrial purpose, processing and the linkage effect with employment, income, market opportunities for industrial output and reduction in poverty[27]. Agriculture and the food sector was the mainstay of the Nigerian economy in the 1960s and 1970s, presenting as sources of livelihood to over 70% of the population residing in the rural areas, and contributing significantly to the Nation's Gross Domestic Product. It was also a major source of foreign exchange for the country[19]. Over the years, the rate of growth in agricultural production has stagnated and failed to keep pace with the needs of a rapidly growing population, resulting in a progressive increase in import bills for food and industrial raw materials[27]. This situation has been attributed to lack of funds, unimproved varieties of crops, land tenure system, continuous dependence on rain- fed agriculture, absence of price support mechanisms, inadequate extension services, inadequate incentives framework, and land degradation among others[28]. Of importance to this study, is the problem of land degradation in agriculture. Land degradation threatens the sustainability of agricultural development, as it causes food insecurity through poor productivity of land/soil and loss of crops[36]. Agronomists, environmentalists' economists and rural sociologists around the world, not only recognize these dangers, but also have initiated efforts to develop effective solutions. These include the development of sustainable land use practices and soil management practices and structures capable of reducing different forms of land degradation[34].

Many parts of Nigeria especially hilly sides and savannah areas of south west, Nigeria have been experiencing soil erosion problems due to poor farming technologies, soil type, population growth and deforestation. The consequences of these problems are reduced yield of crops, deterioration of soil structure and low crop production efficiency[15]. Evidence has shown that average net returns forgone for Nigeria's agricultural production, varied between as little as N 10, 000 to N 120, 000 million[15]. For the whole of Nigeria, on an annual basis and without taking into account possible price effects, the net returns forgone

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for maize production due to soil erosion were found to amount to N 831.5 million. Based on a ten year time horizon and a 10% discount rate, the present value of net returns forgone for Nigeria's agricultural production, due to one year of average soil loss, would amount to about N 64, 000 million[15]. Given these problems, there is need for remedies in order to improve crop production efficiency, as well as income earning strategy of the households. One of the strategies for combating the problems as contained in NEEDS[28] and MDG[31] was to promote the adoption of environmental-friendly farming practices. Although, efforts have been made by the public institutions to promote adoption of Land Management Practices (LMP) in Nigeria, this has received little attention, because the technologies introduced were neither farm specific nor farmer specific but technology specific which alters the farmers' production system[7]. Poor adoption of these technologies was mainly due to inability of public agency to thoroughly examine socio-economic, institutional and farm factors surrounding the users of the technologies[24]. In addition, low success recorded in the implementation of soil conservation technologies was traced to the negligence of household's asset variables and Livelihood Strategy (LS) pursued by the farming households in LMP policy[22,23,32].

In the past, researches on soil conservation technologies adoption in Nigeria have been carried out [3,8,14,20,21]. These studies have established the influence of socioeconomic, institutional and farm factors on soil conservation adoption. However, the results of these studies have no bearing for programme targeting, which livelihood framework recognizes. LS variables are also important policy relevant variables in the implementation of LMP policy[22,23,32]. There are empirical researches on sustainable livelihoods and non farm income diversification[1,2,6], however, these studies have not linked LS of the rural farming households to adoption of LMP. Previous research works on determinant of land use managements and adoption of natural resource management practices have been documented[9,14,16,17,37]. These literatures however, have not linked soil conservation adoption decisions to the LS of households; thus, provide little or no policy outcome for programme intervention. While several literatures have carried out impact of LS on LMP[10, 22,23,32], no studies in Nigeria have carried out impact of LS and farm-specific LMP.

Sequel to the above exposition, the following research questions are of policy relevance in examining the nexus between LS and LMP in south west, Nigeria: How do household's assets influence LS pursued by the farming households? How do LS and household assets, institutional and parcel-level factors influence LMP in the study area? This study, therefore, investigate the link between LS to LMP for sustainable LMP policy in south west, Nigeria.

The rest of this paper is organized as follows: Section II discusses the conceptual framework, while section III reviews relevant literature. Section IV shows the methodological approach used for data collection and analysis, while Section V presents key findings. Section VI concludes the paper with policy implications of the result of analysis.

II Conceptual Framework: The framework for this study was developed from interplay of LS and LMP base on utility maximization model. Farming households are both consumers and producers of goods; technology adoption behavior can be modeled as household utility maximization rather than profit maximization. Household utility is based on family income, leisure, and price of good produced and other factors. It allows inclusion of some characteristics such as institutional, socioeconomic and farm factors. The expected utility maximization model is used based on the premise that households will choose among LMP based on the resources available, knowledge possessed and constraints that limit these activities. The household utility maximization is based on non-observable underlying utility function that ranks preferences of the household according to the chosen technology. The non- observable underlying utility is represented by:

$$U_{ijk}\ [Y_{ij}\ (S_i,\ H_i,\ F_i,\ P_i,\ N_i,\ R_i,\ I_i,\ L_i)] \qquad (1)$$

Where i, is the individual household, j is the choice of technology, while k is the technology. Plot output Y, is a function of observable household assets, S (social capital), H (human capital), F (financial capital), P (physical capital), N (natural capital), R (parcel level factors), I (institutional factor) and L (livelihood strategy variables). The utility maximization approach used here is in line with previous study[4] First, it is important to start by looking at whether the household chooses not to use a particular land management practices (LMP) that is, by looking at all LMP put together. In this case the utility ranking involves comparing U_{i1} and Uio. Therefore, the utility ranking can be estimated from the vector of observable S_i, H_i, F_i, P_i, N_i, R_i, I_i, L_i as follows:

$$Uij = \sigma_i\, f_i\ (S_i, H_i, F_i, P_i, N_i, R_i, I_i, L_i) + \phi_{ij}\ [j = 0, I=1\ldots n] \qquad (2)$$

Where; f is a cumulative distribution function for ϕ_{ij}. Assuming f is logistic leads to the familiar logit model, whereas assuming f is standard normal leads to the probit model[18]. If the expected change in utility

Y* is not observed and let us observe that the farmer has some LMP. The i^{th} household will choose not to use LMP, if $Ui_0 < U_{i1}$ or if the latent variable $y^* = U_{i1} - Ui_0 > 0$ and it will pick to use LMP $U_{i0} > U_{i1}$ or if the non-observable latent variable $Y^* = U_{i1} - U_{i1} > 0$ such that:

$$Yi = \{1 \text{ if } U_{i0} > U_{i1} \text{ and } 0 \text{ if } U_{io} < U_{i1}\} \quad (3)$$

Where one signifies LMP adoption takes place and zero signifies no adoption. The probability that a household adopts LMP is a function of the independent variables:

$$\begin{aligned} Pi &= Pr\ (Yr = 1) = Pr\ (U_{i0} > U_{i1} \\ &= Pr\ (б_{i0}\ Fi\ (.) + \phi_{i0}) > Pr\ (б_{i1}\ Fi\ (.) = \phi_{i1}) \\ &= Pr\ [(\phi_{i0} - \phi_{i1} > Fi\ (б_i - б_2] \\ &= Pr\ [(\epsilon, > Fi, (.)\beta)] \\ &= F\ (X_i,\ \beta). \end{aligned} \quad (4)$$

Where X is an n x k matrix of independent variables, and β is a k x 1 vector of coefficients to be estimated. The probability that a household adopts LMP is the probability that utility from non-adoption is less than gained from adoption. The cumulative distribution function of F for ϵ is evaluated at Xi. Let us assume that the error term is normal, it makes the estimation of the probability of a farmer adopting LMP to be analyzed by probit model. This study used probit model to examine the determinants of the use of land LMP in the study area. Four class of LMP[35] are:

Structural and Mechanical Erosion Control Practices (SMECP): terraces contour bund, construction of ridges across the slope.

Agronomic Practices (AP): multiple cropping, strip cropping, mulching, cover cropping and crop rotation. Soil Management Practices (SMP): compost and farm manure, green manure, and use of fertilizer.

Cultivation Practices (CP): minimum tillage, zero tillage, conventional tillage.

Determinants of these LMP are identified using probit regression model

III Empirical Literature: Several factors have been identified in literature as determinant of adoption of LMP. Year of formal education increases probability of technology adoption[16], and in some cases it is not an important determinant of technology adoption[11]. Older farmers are expected to be less likely to adopt conservation technologies[11]. If labour and credit markets are imperfect, then older farmers lacking the labour needed to introduce and maintain conservation technologies may be less prone to adopt them[36]. The perception of erosion as a problem has been found as a as a factor influencing conservation investments[4,30]. Studies have reported negative or non-significant effects of farm size on adoption[5,11] of LMP. Conservation decisions have been found to be influenced by crop diversification and household LS[10]. Empirical studies have shown that farmers usually allocate the bulk of production and conservation technologies to cash crops, either because the profitability is higher than for subsistence crops, or because there is credit or input provision in cash crop schemes[33]. Moreover, some crop mixes (such as a high share of perennial) or land use patterns (such as a high share of pasture and fallow) are substitutes for conservation investments[12]. Previous studies[22,23,32] have shown that LS stimulate LMP in Uganda and Honduras respectively. LS is useful to policy makers by enabling them to better target households with certain common characteristics, in this way increasing the efficiency of public investment in soil conservation technologies. In addition a clear delineation of dominant LS would help in directing technology transfer programmes towards their intended beneficiaries. Similarly, land tenure can contribute to adoption, since landowners tend to adopt more frequently than tenants, an argument that has justified numerous efforts to reduce tenure insecurity[26,38]. Study[17] has found that tenancy security influences adoption of long term soil conservation technologies; while adoption of short term soil conservation technologies is influenced by tenancy insecurity. An important effect of land tenure is to facilitate the access to institutional credit[39]. However, in several cases land tenure appears to have the opposite effect on adoption[13,25]. Among parcel level factors, slope positively influences the use of LMP[37,40]. Access to institutional credit also has positive effect on adoption of LMP[11]. Imperfection in credit and capital markets can make households with higher savings or productive assets to invest in conservation. Distortions in land markets may also lead to differential investment behavior. Thus, when market imperfections are important, the theory of investment behavior suggests inclusion of household characteristics and asset endowments in explaining adoption decisions[36].

IV Methodology:

Study Area: The study was carried out in South West, Nigeria. The choice of the study area is based on the severity of erosion, which evoked land depletion in terms of loss of soil fertility and output of crops and high rainfall erosivity in combination with intense cultivation pressure. This has negatively affected farming livelihood activities of the households[15]. South West of Nigeria falls on Latitude 6^0 to the North and Latitude 4^0 to the South. It is marked by Longitude 4 ^{0} to the West and 6^0 to the East. The zone comprises of six states (Oyo, Osun, Ondo, Ogun, Ekiti, and

Lagos). The vegetation is typically rainforest; however, climatic changes over the years have turned some parts of the rainforest to derived savannah. The geographical location of South West Nigeria covers about 114, 271 kilometer square, that is, approximately 12% of Nigeria's total land mass. The total population is 15, 456, 789 and more than 96% of the population is Yorubas[29]. The zone is bounded in the north by Kogi and Kwara States, in the East by Edo and Delta States, in the South by Atlantic Ocean, and in the West by Republic of Benin. Two main seasons – the rainy and dry seasons are common in both states. Livelihood activities in both states are agricultural activities, off-farm income activities and wages and salary earning jobs. Agriculture in the area comprises of cultivation of staple crops, fruits, vegetables and tree crops; livestock activities (backyard poultry, extensive goat and sheep production) and fish farming. Farming households mostly practiced mixed farming and mixed cropping and they use LMP (Structural and Mechanical Erosion Control Practices, Agronomic Practices, Soil Management Practices and Cultivation Practices) for increased agricultural production activities[15]. Off-farm income of the households comprises of trading, processing of agricultural produce, carpentry, bricklaying, tailoring, crafts making, driving, sawmilling, gathering, vulcanizing and mechanics. Wages and salary earning jobs include teaching, civil service works, office attendant works and informal sector employment.

Sampling Method and Data Collection: The sampling frame used for the study was collected from State Ministry of Agriculture and State Agricultural Development Project (ADP) in 2007. The data were collected with the aid of structured questionnaire between February and September 2007. Multistage sampling was used in data collection. Osun and Ekiti States were purposefully selected from the states in south west geopolitical zone because of similar ecological zones and diverse livelihood strategies. The two states were stratified into rainforest and derived savannah. This was done in order to examine variation in livelihood activities of the farming households and the use of LMP. This was followed by random selection of 6 (3 each from rainforest and derived savannah belts) Local Government Areas (LGAs). The next stage was the selection of 21 villages from LGAs, followed by the selection of 44 extension blocks and 23 extension cells from villages. The final stage of the sampling was the proportionate stratification and selection of the farming household's head from the selected cells, who are adopters and non-adopters of farm-specific LMP. Based on the population of the head of farming households' in the extension cells, a total of 400 farming household's head from both states responded to the interview. They completely filled the questionnaires and information provided was used for analysis. The data collected cover household assets and LMP used by the farming households.

Analytical Model for the Determinant of Land Management Practices (LMP): Probit regression model was used to examine the influence of household assets, parcel-level factors and institutional variable and LS on LMP used by the farming households. The use of farm-specific LMP was analyzed with probit model [24,22,23,32]. Those that indicate their preference/choice for a particular are users; and non-users otherwise. The dependent variable in the use of LMP is binary variable with a value of 1 for user of farm-specific LMP relative to non-user=0. The model is as follows:

$$Y = f(Z_{i;}\ b_i) \qquad (5)$$

Y = Probability of using a farm-specific LMP (SMECP, AP, SMP and CP) relative to non-users; and

Z_i = explanatory variables (presented in table 1).

RESULTS AND DISCUSSION

Livelihood Choices, Households Assets, Institutional and Parcel Level Factors of the Farming Households: Households in the study area engaged in farm and non-farm livelihood activities for income diversification purpose. Livelihood activities of the households' are related to their endowment of social, human, financial, physical and natural capital/asset[22, 23,32]. The result of livelihood choices of the households reveals four combinations of livelihood activities. They are staple crop and off-farm activities (LS1=30%); staple crop and wages and salary (LS2 = 22.5%); staple, fruit and vegetables crops, livestock production and off-farm income (LS3 = 27.5%); staple, fruit, vegetables and tree crops, livestock production and off-farm income (LS4 =20%). The result in table 2 shows that:

Households pursuing LS1 are those with mean age of 52 years, with an average household's size of 7 members. These households mostly received primary school education with an average of 20 years farming experience. Their membership of community-based organization and participation in government agricultural programme (land management training programme) was very low. They have access to credit, especially informal credit source, and on average, they owned 7 hectares of farmland. They mostly owned and cultivated secure land, more likely to produce crops on sloppy and have poor access to extension services.

Table 1: Explanatory Variables Used in Probit Regression Model

Variable and Measurement	Type	LMP
Social capital		Applicable
Farmer's membership of Community Based Organizations (1 for being a member, 0 otherwise)	dummy	Applicable
Farmer's participation in government programme (1 for participation, 0 otherwise)	dummy	Applicable
Natural capital		
Age (years)	continuous	Applicable
Education (years)	continuous	Applicable
Household size (number)	continuous	Applicable
Farming experience (years)	continuous	Applicable
Financial capital		Applicable
Access to credit (1, for farmers' access to credit, 0 otherwise)	dummy	Applicable
Physical capital		Applicable
Value of farm machinery in Naira	continuous	Applicable
Natural capital		
Rainfall in millimeter	continuous	Applicable
Quantity of farm land owned in hectare	continuous	Applicable
Parcel-level factors		
Proportion of Farm land cultivated (%)	continuous	Applicable
Topography (1, for sloppy, 0 otherwise)	dummy	Applicable
Tenancy security (1, for secure land, 0 otherwise)	dummy	Applicable
Institutional Factor		
Contact with extension agent (1, for access to extension agent, 0 otherwise)	dummy	Applicable
Livelihood Strategy		
LS1 (1, for farmers pursuing LS1, 0 otherwise)	dummy	Applicable
LS2 (1, for farmers pursuing LS1, 0 otherwise)	dummy	Applicable
LS3 (1, for farmers pursuing LS1, 0 otherwise)	dummy	Applicable
LS4 (1, for farmers pursuing LS1, 0 otherwise)	dummy	Applicable
Ecological variable		
Location (1, for farmers in rainforest, 0, for those in derived savannah belt) (R)	dummy	Applicable
Crop production factors		
Land cultivated for crop in hectares (X_1)	continuous	Not applicable
Family labour in man-days (X_2)	continuous	Not applicable
Cost of hired labour in Naira (X_3)	continuous	Not applicable
Quantity of planting material in Kilogramme (X_4)	continuous	Not applicable
Quantity of fertilizer in Kilogramme (X_5)	continuous	Not applicable
Index of Sustainable LMP (M)	dummy	Not applicable

LS=Livelihood Strategy; LMP=Land Management Practices

Average farm size cultivated is 3.2 hectares. Households pursuing LS2 are those with mean age of 42 years, with an average household's size of 4 members. These households mostly have secondary education with an average of 15 years farming experience. Their membership of community-based organization and participation in government agricultural programme (land management training programme) was very low. They have access to credit, especially formal credit source, and on average, they owned 4 hectares of farmland. They mostly owned and cultivated secure land, less likely to produce crops on sloppy and have poor access to extension services. Average farm size cultivated is 2.8 hectares.

Households pursuing LS3 are those with mean age of 40 years, with an average household's size of 9 members. These households mostly have primary education with an average of 16 years farming experience. They mostly belong to community-based organization, in particular cooperative society and their participation in government agricultural programme (land management training programme) was high. They have access to formal credit and on average; they owned 12 hectares of farmland. They mostly owned and cultivated secure land, less likely to produce crops on sloppy and have access to extension services. Average farm size cultivated is 4.2 hectares. Households pursuing LS4 are those with mean age of 56 years, with an average household's size of 14 members. These households mostly have primary education with an average of 23 years farming experience. Their membership of community-based organization and participation in government agricultural programme (land management training programme) was high. They have access to formal credit and on average they owned 17 hectares of farmland. They mostly owned and cultivated secure land, more likely to produce crops on sloppy and have access to extension services. Average farm size cultivated is 6.2 hectares.

Household Preference for Land Management Practices (LMP): Farmers adopt multiple LMP for crop production with Agronomic Practices (AP = 80.0%) preferred to other LMPs including Soil Management Practices (SMP = 65.0%), Conservation Practices (CP = 60.0%), Structural and Mechanical Erosion Control Practices (SMECP = 34.0%). The results further shows that majority of the households in the study area (61%) preferred Soil Management Practices (SMP) to other LMP for soil retention attributes of the LMP. On the basis of soil loss and run off prevention majority of the households (58%), preferred CP to other LMP. Based on capacity of LMP to sustain yield of crop, AP was preferred to other LMP. On account of direct and indirect cost, most households (56%) in the study area preferred CP to other LMP. Livelihood strategy-wise**,** household pursuing LS1 (60%) and LS2 (61%) preferred AP to other LMP for soil fertility retention; while those pursuing LS3 (62%) and LS4 (63%) preferred CP to other LMP for the same purpose. On account of capacity of LMP to prevent soil loss and run-off, households pursuing LS1 (58%) and LS2 (62%) preferred CP, while those pursuing LS3 (62%) and LS4 (68%) preferred SMECP to other LMP. On the basis of capacity of LMP to sustain yield of crop households pursuing LS1 (68%), LS2 (70%) LS3 (76%) and LS4 (79%) preferred AP to other LMP. Households pursuing LS1 (70%); LS2 (70%); LS3 (66%) and LS4 (76%) preferred CP to other LMP on account of direct and indirect cost.

Determinants of Land Management Practices (LMP): The summaries of factors influencing farm-specific LMP[35] are presented in table 3. The influence of livelihood strategy on LMP was examined. The significance of diagnostic statistics (chi-square and log-likelihood value) show a good fit for the model. The results of the determinants of specific LMP shows that the probability of households adopting SMECP increases with membership of CBO, years of education[16], size of farm cultivated[20,21] and topography of farmland[36]. Reduce cost of farm machinery increases the probability of the use of SMECP. Users of SMECP are common in rainforest belt[35]. Tenancy security has significant effect on the use of SMECP and hypothesis that the use of long-term soil conservation measures requires tenancy security[17] is confirmed. Households pursuing LS2 relative to LS1 are less likely to use SMECP, while those pursuing LS3 and LS4 are more likely to use SMECP (table 3). The probability of adoption of AP increases with households' membership of CBO and years of education. Users of AP cultivated small farm land for crop production[20]. Households pursuing LS2 LS3 and LS4 relative to LS1 are more likely to use AP (table 3). Households that belong to CBO, older, and educated are more likely to use SMP. Adopters of SMP cultivated small farm land for crop production; they are located in area of low rainfall distribution and are less likely to be in rainforest belt[35]. Households pursuing LS2 relative LS1 are also more likely to use SMP; while those pursuing LS3 and LS4 are less likely to use SMP (table 3). Adopters of CP are more likely to belong to CBO, educated and cultivated crop on sloppy land. These households are located in area of low rainfall distribution and less likely to be found in rainforest belt. They have fewer households member. Households pursuing LS3 and LS4 are more likely to use CP; while those pursuing LS2 are less likely to use CP (table 3).

VI Policy Implication of Findings: The findings of this study have shown that household assets influence LS of the household. While households' membership of CBO was very high, their membership of land management/users organization, where decision on sustainable LMP could be taken was very low. This has implication for programme intervention in terms of training needs and capacity building on sustainable LMP policy. Households' participation in government agricultural programmes was very low, to the extent that their participation in land management training programme was also reported low. This must have contributed to their low level of awareness on LMP. In order to achieve the social benefits of natural resource conservation policy, the need for aggressive awareness

Table 2: Descriptive Statistics Result of Households' Assets by Livelihood Strategy and Location

Characters/Variables	LS1	LS2	LS3	LS4	Study Area
Human capital					
Average Age in years	52	42	40	56	42
Education (%)					
Primary	42	4	51	41	43
Secondary	37	53	11	38	39
Tertiary	2	29	37	-	18
informal	19	14	1	21	10
Average household size	7	4	9	14	7
Average years of farming experience	20	15	16	23	13
Social Capital					
Membership of community-based organization in %	32	48	68	72	57
Participation in government agricultural programme in %	45	54	45	48	40
Physical Capital					
Average value of farm machinery in Naira	4, 188.3	4,841.6	6, 006.5	12, 342	6397
Average value of livestock in Naira	-	-	13123.2	12978.7	23103
Financial capital i.e. Access to formal credit (%)	37	20	65	72	43
Natural capital					
Average farm land owned in hectares	7	4	12	17	7.2
Institutional and parcel-level factors					
Tenancy Security (%)	67	63	72	60	68
Topography of farmland cultivated	52	42	41	59	58
Access to extension agents (%)	31	23	60	68	61
Average farm size cultivated in hectares	3.2	2.8	4.2	6.2	4
Number of observation	120	90	110	80	400

Source: Field Survey, 2007

programme to tackle the low level of awareness, poor knowledge of soil conservation and lack of technical know-how becomes pertinent. Implementation of such policy could be achieved through integrated extension services that incorporate farming activities with environmental management curriculum in the study area. This will enhance household LS, and also encourage the use sustainable LMP for crop production.

Household access to formal credit was reported very low and this may constrain diversification of livelihood choices and the use of LMP that are sustainable within the context of farm and farmers specific framework. While there has been credit policy to agricultural production and other sub-sectors, credit support to LMP is lacking. The need for linking farm subsidies and credit facilities programme for enhancement of farming LS and LMP becomes pertinent. This will, to a large extent, stimulate increased crop production activities, while controlling for land degradation problem. Food policy should, therefore, evolve credit policy to crop sub-sector, as well as credit support to LMP. This is expected to facilitate adoption of LMP for reducing land degradation menace. Farm-size cultivated by the households has implication for LS and the choice of LMP to be promoted among farming households. Farmers' preference for LMP was based on selected attributes (for instance farm size and tenancy security), and the preference favoured the use of AP over other LMP. Farm size cultivated exhibited a negative and significant effect in most cases with adoption of farm-specific practices. Programme intervention in natural resource conservation needs to focus on detailed characterization and identification of LMP that are both farm and farmer-specific. This becomes necessary because some LMP are compatible with the size of cultivated plots, topography and direct and indirect cost of LMP.

The hypothesis that LS significantly influence LMP is confirmed, although in different directions, in general, the use of AP and SMP are most common among households pursuing LS1 and LS2; while CP and SMECP are mostly practiced by LS4 farming households. Thus, the need to promote sustainable LMP that are farm and farmer-specific becomes imperative in enhancing resource use efficiency of the farming households.

Table 3: Probit Model Result for the Determinants of Land Management Practices among Farming Households in the Study Area

Variable/Land Management Practices	SMECP	AP	SMP	CP
Social Capital				
Belonging to Communi-ty-Based Organization	0.0406*** (0.0036) 0.142$^+$	0.0481** (0.0254) 0.149$^+$	0.1999*** (0.0527)0.160$^+$	0.6738*** (0.0436) 0.3569$^+$
Farmers' Participation in government programmes	0.0008 (0.0788) 0.1212$^+$	0.0505 (0.0548) 0.1539$^+$	-0.6685 (0.0528) -0.0367$^+$	-0.0016 (0.0564) -0.2400$^+$
Human Capital				
Age of Household Head	0.0098 (0.0554) 0.03$^+$	- 0.0032 (0.0023) -0.0013$^+$	0.0053** (0.0023) 0.0098$^+$	0.0005 (0.0023) 0.50$^+$
Years of Education	0.0346*** (0.0004) 0.018$^+$	0.0431*** (0.0060) 0.0746$^+$	0.0360*** (0.0060) 0.0154$^+$	0.0920*** (0.0061) 0.0269$^+$
Years of Farming Experience	-0.0001(0.061) -0.040$^+$	0.0041 (0.0042) 0.0124$^+$	- 0.0037 (0.0042) -0.0045$^+$	-0.0063 (0.0042) -0.0021$^+$
Household Size	0.0086 (0.0458) 0.522$^+$	- 0.0030 (0.0068) -0.1023$^+$	0.0001 (0.0069) 0.1369$^+$	-0.0169** (0.0072) -0.0312$^+$
Financial Capital				
Access to Credit	0.0008 (0.0546) 0.1078$^+$	- 0.0045 (0.0554) -0.1001$^+$	0.0489 (0.05490 0.1567$^+$	- 0.0193 (0.0553) -0.0889$^+$
Physical Capital				
Value of Farm Machinery	-2.6420***(0.4621) -0.06$^+$	-5.94E-07(1.22E-05) -2.3E-05$^+$	6.51E-06(1.21E-07) 0.0003$^+$	2.29E-06(1.23E-07) 2.9E-07$^+$
Natural Capital				
Quantity of Farmland Owned	- 0.0005 (0.0026 -0.007$^+$	0.0024 (0.0063) 0.012$^+$	1.15E-07 (4.19E-07) 0.0082$^+$	0.0026(0.0042) 0.0108$^+$
Rainfall Distribution	- 0.0001 (0.0046 -0.004$^+$	- 0.0006 (0.0014) -0.001$^+$	- 0.0029** (0.0013) -0.0055$^+$	- 0.0200*** (0.0013) -0.0550$^+$
Parcel Level Factors				
Farm Size Cultivated	0.3881** (0.0104) 0.4300$^+$	-0.2891*** (0.0056) -0.65$^+$	-0.1934*** (0.0155) -0.1103$^+$	- 0.0012 (0.0156) -0.0293$^+$
Topography of Farmland	0.6888***(0.222) 0.8600$^+$	0.0365 (0.0521) 0.146$^+$	0.0613 (0.0521) 0.1635$^+$	0.2668*** (0.0506) 0.0054$^+$
Tenancy Security	0.1033** (0.0503) 0.2081$^+$	- 0.147 (0.0563) -0.0966$^+$	- 0.5706 (0.5511) -0.0509$^+$	0.0678 (0.0552) 0.1759$^+$
Institutional Factor				
Contact with extension agent	0.0029 (0.0055) 0.1102$^+$	0.0369 (0.5623) 0.142$^+$	- 0.0333 (0.0554) -0.0753$^+$	- 0.0417 (0.0557) -0.0674$^+$
Livelihood Strategy (cf.LS1)				
LS 2	-0.9205*** (0.0200) -0.9009$^+$	0.0280*** (0.0.208) 0..6812$^+$	0.9141*** (0.0222) 0.8705$^+$	-0.9241*** (0.0251) -0.9341$^+$
LS 3	0.9404*** (0.0105) 0.9006$^+$	0.9438*** (0.0186) 0.1069$^+$	-0.9453*** (0.0194) -0.9022$^+$	0.9347*** (0.0155) 0.9061$^+$
LS 4	0.8002*** (0.020) 0.8455$^+$	0.8582*** (0.0246) 0.0078$^+$	-0.8847*** (0.0261) -0.8075$^+$	0.8839*** (0.0252) 0.9553$^+$
Location Variable	0.0039*** (0.0011) 0.1321$^+$	0.0359 (0.5523) 0.1442$^+$	- 0.0261*** (0.01002) -0.3082$^+$	- 0.0341*** (0.0037) 0.0576$^+$
Constant	0.4226** (0.2000) 0.2600$^+$	1.8842** (0.8244) 0.122$^+$	0.4809* (0.2782) 0.1026$^+$	0.5876 (0.5269) 0.0021$^+$
Number of adopters	183	192	191	202
Number of non-adopter	217	208	209	198
Chi-square	118.65***	245.74***	211.42***	254.4***
Log-Likelihood ratio	- 276..03***	-268.65***	- 266.28***	- 264.52***
Pseudo R^2	0.5610	0.5861	0.6824	59.40

***Significant @ 10%; **Significant @ 5%; *Significant @ 10%; + = Marginal effect value for the coefficient of each variable. Figures in Parenthesis are standard error of the coefficient.

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