ASSESSMENT OF SUSTAINABLE LAND MANAGEMENT PRACTICES AMONG FOOD CROP FARMERS IN NIGER STATE AND FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

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ABSTRACT
The study assessed the use of sustainable land management practices among food crop farmers in Niger State and Federal Capital Territory, Nigeria. Multistage sampling procedure was used to select a total of 350 farmers and primary data were collected using questionnaire. Descriptive statistics and multivariate probit regression model were used to analyze the data. The results reveled that the sustainable practices mostly undertaken by the farmers under agronomic practice was sole cropping (81.43%), the most undertaken cultivation practice was ridge tillage (92.00%), structural and mechanical erosion control practice mostly carried out was construction of ridges across field slopes (23.14%), and soil management practices (fertilizer application (93.43%) were the structural and mechanical erosion control practice mostly carried out. The results of multivariate probit showed that the significant determinants of land management practices among the farmers include membership of farmers' association (p≤0.10), source of information (p≤0.01), years spent in school, age (p≤0.01), days unable to go to work or farm (p≤0.01), years of farming experience (p≤0.05), distance from home to nearest market (p≤0.01), rainfall sufficiency for crop production (p≤0.05), adequacy of soil fertility (p≤0.05), tenancy security of farm land (p≤0.10) and access to extension (p≤0.01). It was recommended that more sustainable land management practices should be adopted by the farmers.

KEYWORDS: Land, Sustainable practices, Farmers, Niger, FCT

INTRODUCTION
Degradation of land is a serious problem worldwide. It has caused poverty and general under employment because of its devastating effects on agricultural production in developing and underdeveloped nations (Chabela *et al.,* 2014). According to Nkoya *et al.* (2016), land degradation affects about 30% (about 2 billion hectares) of total global land area and about three million people reside on degraded lands. The annual global cost of using land management practices on degraded lands is about 300 billion USD (FAO, 2013). Sub-Saharan Africa constitutes the largest share (22%) of the total global cost of land degradation (FAO, 2014).

Babalola and Olayemi (2013) also reported that settlements in southern part of Nigeria have had more than 10% of their land area destroyed by degradation and still exposed to possibility of destruction on more productive land area soon. Ademola *et al.* (2020) revealed that about 15% and 18% of agricultural land in Niger State and FCT is degraded even though government and development agencies such as Food and Agricultural Organiation (FAO) as well as nongovernmental organizations have done much within and outside Nigeria on sensitization and creation of awareness to educate people in urban and rural areas to control land degradation. This is because areas where land degradation occurs are yet to witness significant change due to inappropriate policy formulation and implementation, misallocation of resources, insufficient monitoring and evaluation concerning control of land degradation and its negative impact (Sale *et al.,* 2018).

Udoh (2002) and Feder (2005) suggested that Land Management Practices (LMPs) aimed at reducing the menace of land degradation for the benefit of small-scale farmers will be more interesting if differences in farmers' area of production is considered while formulating the LMP policies and this could enhance farmers' productive capacity of land since the destruction of land can be controlled using sustainability practices.

Curtailing land degradation through sustainability practices becomes possible through the combination of suitable livelihood strategies which are achievable given available household assets to the small-scale farmers (Samatar, 2015). It therefore becomes pertinent to carry out research on sustainable land management practices among food crops farmers in Niger State and Federal Capital Territory, Abuja, Nigeria. The objectives of this study were to identify the sustainable land management practices adopted by the farmers and to analyze the factors influencing their choice of land management practices in the study areas.

The destroyed natural environment can be reclaimed through implementation of suggestions of this research on sustainability practices. It is envisaged that more agricultural output is likely to be realized through implementation of findings of this research as degradation will be controlled. Contribution of the findings of this research towards documentation on the subject matter in the study area would guide stakeholders and policy makers in further policy making on livelihood combination and sustainability practices to control land degradation and guarantee economic and environmental efficiency. The research will also add to the existing literature which serves as a guide to aid further research on the subject matter.

METHODOLOGY

The Study Area: The study was conducted in Niger State and the Federal Capital Territory (FCT), Abuja, Nigeria. Niger State lies between Latitudes 8°20′N and 11°30′N and Longitudes 3°30′E and 7°20′E (Ojo *et al.,* 2009). It has land area of 76,363km^2. Niger State lies in the Guinea Savannah vegetation zone of the country with favorable climatic conditions for crop and livestock production. The topography is predominantly plain lands with interrupted undulations, and the soil ranges from sandy to clay loam (Niger State Agriculture and Mechanization Development Authority (NAMDA, 2014). The population of Niger State according to 2006 population census was 3,950,249 which could have increased at an annual population growth rate of 3.8% to give a projected value of 6,666,293 at the end of 2018. About 85% of the population of Niger State are crop farmers who sometimes combine this with rearing of livestock such as local poultry, ducks, sheep and goats which are marketed in order to supplement revenue from the cultivation of crops such as yam, rice, maize, cassava, melon and millet (NAMDA, 2014).
FCT, Abuja on the other hand lies on Latitudes 8°23′N and 9°20′N and Longitudes 6°45′E and 7°39′E. It has six Area Councils with projected population of 6,424,262 by 2018 according to United Nations Population Commission (UNDP), (2014). FCT-Abuja has a land mass of approximately 7,315km^2 of which the actual city occupies 273.3km^2. It is situated within the Guinea Savanna region with moderate climatic conditions. The natural resources available in the area are marble, tin, clay, mica, and tantalite (Tsue *et al.*, 2014).

Sampling Procedure and Sample Size

Multi-stage sampling procedure was used to select respondents for this study. Following Abu (2019), the proportionate sample allocation technique specified in equation (1) was adopted to select a total of 282 food crop farmers from Niger State while 68 were selected from FCT giving a total of 350 farmers for the study.

$$S_h = \frac{n \times Nh}{NT} \quad (1)$$

S_h =Number of household heads to be selected,
n= Total number of household heads for the survey,
N_h= Farming households in each selected Sub-Cells, and
N_T= Sum of the farming households in the selected sub-Cells

Method of Data Collection

Primary data were collected from the respondents through the use of questionnaire with the assistant of trained enumerators. The sampling unit was the farm households in the study area. Household heads were visited at

farms and home and multiple visits were made in some cases. Information were collected on parcel and plot levels including land tenure, cropping patterns and crop production use of labor and other crop production inputs.

Analytical Tools

Descriptive and inferential statistics such as frequency distribution, percentage, mean and multivariate probit regression model (inferential statistics) were used to analyze the data collected. Multivariate probit regression model was used to examine the determinants of adoption of land management practices and the model is presented in equation (2) following Green, (2000) and Mugisha and Alobo (2012).

$$Yi^* = \beta \boldsymbol{X}i + Ei \quad (2)$$

Where;

Yi^* = Latent variables that index the land management options on a given plot, that is, LMP (i.e.,Stuctural and Mechanical Erosion Control Practice (SMECP), Agronomic Practice (AP), Soil Management Practice (SMP) and Cultivation Practice (CP)),

Xi = Vectors of independent variables,

β = vector of parameter to be estimated and

Ei= stochastic term error.

The explicit form of the model is as follows in equation (3);

$$Y_i = \alpha + \beta S_i + \beta H_i + \beta F_i + \beta P_i + \beta N_i + \beta R_i + \beta I_i + \beta L_i \quad (3)$$

Where;

Yi = Latent variables that index the land management options on a given plot i.e., LMP (i.e. SMECP, AP, SMP and CP);

S_i, H_i, F_i, P_i, N_i, R_i, I_i, and LS_i are the determinants of adoption of land management practices (Independent variables, Xs)

S_i=Social capital variables

S_1 = Farmers' participation in government agricultural program (number)

S_2=Access to adult education program, (1 for access, 0 otherwise)

S_3= Association membership of farmers (1 for membership, 0 otherwise)

S_4=Access to information (number)

H_i= Human capital variables

H_1= Education of the household head (years),

H_2= Age of farmer (years),

H_3= Health status (number of days unable to go to work or farm),

H_4= Farming experience (years), and

H_5 =Family labour (man-days).

F_i = Financial capital variables

F_1= Amount of credit (₦),

F_2= Savings (₦),

F_3 = Amount of pension (₦),

F_4 = Income (₦), and

F_5 = Access to insurance (1 for access, 0 otherwise).

P_i=Physical capital variables

P_1= Value of Physical assets (₦)

P_2=Access to good road (yes=1, No=0), and

P_3 =Distance from home to market (km).

N_i= Natural capital variable

N_1= Size of farmland (ha),

N_2 = access to wildlife (1 for access, 0 otherwise),

N_3 = Rain fall sufficiency for crop production (1 for sufficient, 0 otherwise), and

N_4 = Adequacy of soil fertility (1 for adequacy, 0 otherwise).

R_i = Parcel- level factors

R_1= Percentage of cultivated farm land over borrowed land (ha),

R_2=Topography of farmland (sloppy farm land=1, 0 otherwise), and

R_3= Tenancy security of farmland (owned land=1, 0 otherwise).

I_i =Institutional factor

I_1= Extension contact (number), and

I_2= Access to new crop varieties from research institutes (1 for yes, 0 for no).

L_i=Livelihood Strategies

LS_1=Staple crop/off-farm income, (1 for participation and 0 for non-participation),

LS_2=Staple crop/wages and salary, (1 for participation and 0 for non-participation),

LS_3 = Staple, fruit and vegetable crops and livestock production and off-farm income, (1 for participation and 0 for non-participation), and

LS_4 = staple crop, fruit, vegetables and tree crops, livestock production and off-farm income. (1 for participation and 0 for non-participation). The staple crops in consideration are cereals, legumes and tuber crops.

RESULTS AND DISCUSSION

Sustainable land management practices of the respondents: Descriptive statistics of sustainable land management practices undertaken is shown in Table 1. The results show the pooled sample of respondents that undertook agronomic practices; sole cropping (81.43%), crop rotation (68.86%) and mixed cropping (68.45%) were the major agronomic

practices undertaken by the smallholder farmers. Strip cropping (2.00%), agroforestry (2.57%) and bush fallowing (2.57%) were the least undertaken agronomic practices. This could be due to efforts to either control erosion or for nitrogen fixation among food crop producers. The practice of sole cropping, crop rotation, and mixed cropping in pooled could be attributed to the condition of cultivable lands which determines the crop grown and quest to achieve increase in yield. Result of agronomic practice shows that crop rotation, multiple cropping, mixed cropping, and sole cropping were carried out more among respondents in Niger State than in FCT. While strip cropping, leguminous cropping, cover cropping, agro forestry, bush fallowing and shifting cultivation were carried out more among respondents in FCT. This agrees with report of Abdullazeez *et al.* (2013) who reported that crop rotation, mixed cropping and sole cropping were the agronomic practice mostly carryout among small scale farmers in the study area. The possible reason for carrying out primary tillage, ridge tillage and zero tillage could be that most small scale-farmers utilized primitive tools which are suitable for ridge tillage. They also carryout zero tillage practice because it is cheaper considering the reality that it allows cultivation of large farm size within a short period. In the same vein, possible access to tractors through agricultural programmes maybe among reasons why they chose primary tillage more among other tillage practices. The result is in agreement with finding of Oyeneke and Mmagu (2017) who reported that small holder farmers mostly carryout primary, ridge and zero tillage practice among other sustainability practices.

Result on structural and mechanical erosion control practices (SMECP) showed that construction of ridges across field slopes (23.140, contour bunds (2.86%) and land grading (4.29%) were the most undertaken among food crop producers. This may be because arable lands available to farmers were water lodged or prone to erosion which must be sustained to achieve growing of crops. Land grading could be due to sloppy nature of farm land to control erosion and grow crops with minimal losses. The choice of those practices was the same in Niger State and FCT separately. Erosion control measures were undertaken more among respondents in FCT than Niger State. The undertaken measures of structural and mechanical erosion control practices were land grading, construction of ridges across field slopes and contour bunds. This finding is in contrast with Frank *et el.* (2010) who reported that terraces, wind breaks and construction of ditches were the major structural and mechanical erosion control practices undertaken in Uganda and this could be ascribed to the regional difference in research areas.

Result on soil management practice (SMP) in Table 1 showed use of fertilizer (93.43%), mulching (56.29%) and composting (33.43%) as the most utilized practices. The least carried out practices were application of farm yard manure and green manure as reported by 22.57% of the respondents respectively. The practice of composting and mulching is usually done by farmers whose cultivable land requires nutrient replenishment to achieve more crop yield but could not afford fertilizers, while that of fertilizer application could be due to interventions by government and nongovernmental organizations towards making fertilizer accessible by the farmers. Fertilizer application was the most practiced soil management measure among respondents in Niger State while composting, organic/farm yard manure, mulching and green manure were carried out more among food crop farmers in FCT. The report of Amusa *et al.* (2015) concurs with this finding that mulching, composting and use of fertilizer are among the frequently practiced soil management measures among farmers

Determinants of Land Management Practices (LMP): Results of multivariate probit regression model is shown in Table 2. The significant determinants of land management practices include membership of farmers' association ($p \leq 0.10$), source of information ($p \leq 0.01$), years spent in school, age ($p \leq 0.01$), days unable to go to work or farm ($p \leq 0.01$), years of farming experience ($p \leq 0.05$), distance from home to nearest market ($p \leq 0.01$), rainfall sufficiency for crop production ($p \leq 0.05$), adequacy of soil fertility ($p \leq 0.05$), tenancy security of farm land ($p \leq 0.10$) and access to extension ($p \leq 0.01$) accordingly.

Coefficient for farmer's association signifies that as farmers belong to more associations

which serves as source of information, the more their likelihood to carryout agronomic practices. This could be due to the fact that farmers obtain important information from associations on farming activities which could be useful in production. This agrees with stated *a priori* expectation. Information that farmers easily accept are disseminated by other family members or members of association who they rely on and thus acceptance of such idea is easy among them.

The result also indicated that the more the years farmers spent in school, the more likely they are to participate in agronomic practices. This could be because a farmer who has spent more years in school is expected to have acquired more education as well as easy understanding of new farm technologies. Such a farmer will likely choose to adopt new farm practices such as the sustainable land management practices which could reduce the number chosen and carried out.

Also, the older the farmer, the more the likelihood to carryout agronomic practice. Age of farmer is synonymous to experience which play a role in decision making. Important decisions are most times taken based on age which could include more participation in agronomic practice. The finding is in agreement with stated *a priori* expectation. The results concur with the findings of Muvendo *et al.* (2016), who reported that, level of education, farming experience, access to information as well as distance to nearest market influences the adoption of sustainable agricultural practices in Zimbabwe.

Days unable to go to work or farm were also a significant determinant of land management practice. Good health status contributes to productivity of individual. A farmer whose health status is good would be more productive than the one with threatened health. Generally, good health status would allow a productive person to carryout production many days and times compare to an ill-heath individual. The more days one is unable to go to work or farm, the less his participation in agronomic practice. Experience is a good quality in general life endeavor. Experience guides during decision making among farmers. Also, the more the farming experience of the farmer, the less the likelihood to carryout agronomic practice because of age and farming experience. These contribute to level at which farmers take decision on choice of new farm technology. This disagrees with the *a priori* expectation but is in line with the finding of Ndem (2015) who reported that the older the farmer, the more the days he is unable to go to farm but have farming experience which guides during number of practices carried out on farm.

The coefficient for cultivation practice shows that participation in government agricultural programmes was significant at 1%. The implication is that increase in access to government agricultural programmes could lead to increase the likelihood continuous participation in cultivation practices. This is in line with the stated *a priori* expectation. Agricultural programmes are organized by government on agricultural policies most times to teach farmers about new technologies, and to help them produce more output. This goes further to improve the well-being of the farmer and to make food available for the nation. Similarly, soil management practice was also influenced by participation in government agricultural programme implying that, the more the farmers participate in government agricultural programmes, the more the soil management practices undertaken by the farmer. This could be because government agricultural programme towards increasing farmer's output may include making fertilizer available, training on composting and use of organic manure among others to increase output. Thus, participation in such programmes may increase farmers participation in soil management activities.

Source of information was significant at 1% which implies that increase in access to information leads to increases the likelihood of the farmers involving in cultivation practice. In addition, more sources of information increase awareness of farmers which lead to acceptance of new practices on the farm. This agrees with *a priori* expectation. In line with the findings of this study, Balalola and Olayemi (2013) revealed that community-based organization and source of information of farmers positively determined the choice of sustainability practices.

The coefficient for percentage of owned land over borrowed land was also significant at 5%.

Increase in percentage of owned land over borrowed land will lead food crop producers to carryout less cultivation practice. On the other hand, an individual with secured tenancy (i.e., the percentage of own land over borrowed land is more) is relatively tenancy secured could put the land to use for nonagricultural purposes where cultivation will not be needed. Tenancy security and access to new crop variety from research institute were both significant at 10% in line with stated *a priori* expectation. Tenancy security allows owners to exercise right including choice of enterprise to practice and as such, cultivation practice will also increase in order to grow crops in the interest of the farmer. Due to tenancy security, cultivation could be carried out to grow biennial or perennial crops. Mugagga *et al*. (2013) also reported that long term conservation technique could be hindered by tenure insecurity among farmers.

Coefficient for source of information was significant at 1% and also concurs with *a priori* expectation. Sources of information mostly available to farmers include farmer's association, extension agents, Radio, neighbors/family members and Television among others. New technologies are disseminated through these media to the farmers. In some instances, trainings are carried out to enable participants to grasp the new concept. Increase in access to source of information will increase the likelihood of farmers carryout the soil management practice. The more farmers are exposed to sources of information, the more they become aware of good management practices including soil management practice.

The older the farmer the more likelihood to participate in sustainable land management practice. This is due to the fact that older farmers are more experienced and they may have carried out land management practices in the past. More so, older farmers may pay more attention to soil management practices such as composting, mulching, manuring than younger ones since those are relatively traditional methods close to rural dwellers.

The distance from home to all season road was significant at 5%. The implication is the more the distance from home of the farmer to all season road could increase the likelihood of the farmer carrying out soil management practices. This also applies to distance from home to the nearest market which was significant at 1%. Soil management inputs and contacts on soil management consultants are accessed in urban areas, this implies that the less the distance from homes of the farmer to the nearest market, the more the likelihood of such farmer to carryout soil management practice to control degradation. This disagrees with the started *apriori* expectation. Results on age, savings, farming experience and source of information agrees with results of Muvendo *et al.* (2016).

Access to wild life was significant at 1% and negatively signed and this is at variance with the started *a priori* expectation while tenancy security was significant at 1% but positively signed. It implies that as farmers have more access to wild life which serves as source of food and income, the less the likelihood to carryout soil management practices. This is because wildlife access serves as a means of meeting needs for food and income to individual. Wildlife comprises wild plants and animals which serve as food and medicine. In addition, it may decrease the level of soil management practice as farmer's attention maybe diverted to wildlife as livelihood.

Access to extension service and access to new crop varieties were significant at 1% each in line with stated *a priori* expectation. The coefficient for extension contact implies that increase in access to extension service will increase the likelihood of the farmers to invest in soil management practice. Farmers who have less access to extension service are most likely not to accept new farm technologies because extension officers who are farmer's friends are also major source through which farmers are convinced about new technologies. Muzan *et al.* (2012) revealed that institutional factors such as access to extension determine choice of sustainability practices by small farm households in Sub-Sahara Africa. While, the more the access by farmers to new crop varieties from research institutes, the more the likelihood of the farmer to remain in carrying out soil management practice. New crops varieties accessed by farmers could be a factor of encouragement to carry out soil management measures.

Coefficients for livelihood strategies one, two and four were significant. This implies that

increase in participation on each livelihood strategy will increase the likelihood of the farmers to remain participatory in land management practices because as each livelihood activity is carried out, more income could be generated which may be invested in the chosen land management practices. This is in line with stated *a priori* expectations. The result conforms the report of Misganaw *et al*. (2019) who reported that participation of farmers on different livelihoods enable them to invest in sustainability practices.

Covariance for determinants of land management practices of food crop producers: Coefficients of CP/AP was significant at 1%, SMP/AP significant at 5%, SMECP/AP significant at 1%, SMP/CP significant at 1%, SMECP/SMP significant at 1% respectively as shown in Table 3. positively signed sustainability practices are complements, while negatively signed are substitutes.

Coefficient for CP/AP implies that increase in cultivation practice will increase the likelihood of the farmers to carryout agronomic practices. This also means CP and AP complement each other. In addition, as CP is carried out more nutrients from organic materials which decomposes add nutrients to the soil. This is among reasons why AP such as leguminous planting which adds nitrogen to soil is carried out. Each time cultivation is carried out then planting will take place. Cultivation practice and Agronomic Practice are complements.

Soil management practices and agronomic practices (SMP/AP) were significant and positively signed. It implies that increase in soil management practice will increase probability carrying out agronomic practice. Farmers must not manage nutrient of soil if idea of growing crops is not conceived. Cover cropping and leguminous plants are measures of soil management since they fix Nitrogen to soil. Composting, manuring and fertilizer application among other soil management practices serve the same function with agronomic practice. It therefore means that SMP/AP are complements to each other as both are measures to retain soil nutrients as crops are grown as well.

Soil and mechanical erosion control practice and agronomic practice (SMECP/AP) was significant and negative, implying that increase in soil and mechanical erosion control practice will decrease the likelihood of the farmer to remain in carrying out agronomic practice. Agronomic practice such as legumes and cover crops also control erosion as SMECP, therefore, agronomic practice could replace structural and mechanical erosion control practice as substitute.

Soil management practice and cultivation practice, that is, SMP/CP or TP was also significant and positively signed. The implication is that increase in soil management practice will increase the probability of farmers engaging in cultivation practice or tillage practice to grow crops. Also, SMP/TP or CP are complements because SMP restores soil nutrient as TP, they are complements to each other.

Structural and Mechanical Erosion Control Practice and Soil Management Practice were significant at 1% and negatively signed implying that, SMECP and SMP were not complementarities but substitutes because as SMECP is carried out (use of legumes and cover cropping to control erosion), then soil management is also achieved.

Table 1: Distribution of farmers according to sustainable land management practices

Sustainable land management practices	Niger State (n=282) Frequency	FCT (n=68) Frequency	Pooled (n=350) Frequency
Agronomic practice (AP)			
Sole cropping	233 (82.6)1st	52 (76.47) 1st	285 (81.43) 1st
Crop rotation	209 (74.11) 3rd	37 (54.41) 3rd	246 (70.28) 2nd
Multiple cropping	109 (38.65)	19 (27.94)	128 (36.57)
Strip cropping	4 (1.41)	3 (4.41)	7 (2.00)
Cover cropping	70 (24.82)	38 (55.88) 2nd	108 (30.85)
Legume planting	97 (34.39)	37 (54.4)	134 (38.29)
Mixed cropping	212 (75.1) 2nd	28 (41.17)	240 (68.45) 3rd

Agro-forestry	6 (2.12)	3 (4.4)	9 (2.57)
Bush fallowing	5 (1.77)	4 (5.8)	9 (2.57)
Shifting cultivation	23 (8.15)	10 (14.70)	33 (9.42)
Cultivation Practice (CP)			
Ridge tillage	276 (97.87) 1st	46(67.64) 2nd	322 (92.00) 1st
Primary tillage	143 (50.70) 2nd	63(92.64) 1st	206(58.85) 2nd
Conventional tillage	12 (4.25)	22 (32.35)	34(9.71)
Minimum tillage	12 (4.25)	23 (33.82)	35(10.00)
Zero tillage	121 (42.90) 3rd	29 (42.64) 3rd	150(42.86) 3rd
Mold tillage	42 (14.89)	21 (30.88)	63(18.00)
Structural and mechanical erosion control practice			
Construction of ridges across field slope	63 (22.34) 1st	18 (26.47) 1st	81 (23.14) 1st
Landing grading	9 (3.19) 2nd	6 (8.82) 2nd	15 (4.29) 2nd
Contour bunds	8 (2.83) 3rd	2 (2.94) 3rd	10 (2.85) 3rd
Soil Management Practices			
Fertilizer application	273 (96.80) 1st	54 (79.41) 2nd	327 (93.43) 1st
Mulching	135 (47.87) 2nd	62 (91.17) 1st	197 (56.28) 2nd
Composting	74 (26.24) 3rd	43 (63.23) 3rd	117 (33.43)
Organic manure/farm yard	62 (21.98)	17 (25.00)	79 (22.57) 3rd
Green manure	43 (15.24)	36 (52.94)	79 (22.56)

Source: Field survey, 2018. (Figures in parentheses are percentages)

* Multiple responses were recorded

Table 3: Covariance of multivariate probit analysis for determinants of LMP of food crop producers

Variables of **interaction**	**Coeff.**	**Z-value**
Cultivation Practice (CP) and Agronomic Practice (AP)	0.4751981	3.18***
Soil Management Practice (SMP) and Agronomic Practice (AP)	0.3630378	2.73**
Structural and Mechanical Erosion Practice (SMECP) and Agronomic Practice (AP)	-0.802759	-5.45***
Soil Management Practice (SMP) and Cultivation Practice (CP)	0.352837	3.10***
Structural and Mechanical Erosion Practice (SMECP) and Cultivation Practice (CP)	-0.6138417	-4.10
Structural and Mechanical Erosion Practice (SMECP) and Soil Management Practice (SMP)	-0.1730288	-1.61***

***: 1% level of significance, **: 5% level of significance, * : 10% level of significance
AP = Agronomic practice, CP = Cultivation practice, SMP = Soil management practice, SMECP = Soil and mechanical erosion control practice.

Table 2: Determinants of land management practices

Variables	AP Coeff/ (Z-value)	CP Coeff/.(Z-value)	SMP Coeff./(Z-value)	SMECP Coeff./(Z-value)
Participation in gov't Agric program	0.0030(0.04)	0.2104(2.67)***	0.0813851(1.66)*	-0.2004(-3.17)***
Access to adult education program	0.1824(0.74)	-0.0606(-0.24)	0.3333(0.104)	0.0779(0.35)
Membership of farmer's association	0.4190(1.82)*	-0.1037(-0.44)	0.1504(0.425)	0.4050(1.73)*
Source of information	0.8545(7.26)***	0.6675(7.71)***	0.2104(3.00)***	0.0764(0.89)
Years spent in school	0.0507(2.41)**	-0.0343(-1.64)	-0.0077(0.660)	0.6445(3.30)***
Age	0.0452(2.91)***	0.0007(0.05)	-0.0497(-3.88)***	-0.0265(-1.97)**
Days unable to go to work or farm	-0.0150(-4.23)***	-0.0045(-1.08)	0.0045(0.136)	0.0050(1.40)
Years of farming experience	-0.0402(-2.48)**	-0.0086(-0.59)	0.0324(2,71)***	0.0131(0.99)
Family labour	-0.0038(-1.48)	0.0013(0.52)	0.0031(0.161)	0.0024(1.01)
Amount of credit	-1.32e-06(-0.77)	1.28e-06(0.72)	2.24e-05(0.139)	6.18e-07(-0.35)
Savings	8.29e-07(0.95)	-7.97e-07 (-0.81)	1.62e-06(2.09)**	3.48e-07(0.44)
Pension	4.85e-05(0.00)	-1.12e-6(-0.97)	-20.93e-04(0.977)	07.32e-06(1.06)
Income	2.19e-07(-0.59)	-9.88e-08(-0.31)	1.90e-07(0.466)	1.67e-07(0.51)
Access to insurance	0.6982(1.15)	4.413455(0.01)	4.8362(0.980)	-4.5456(-0.01)
Physical assets	9.64e-07(0.03)	5.93e-07(-0.03)	4.96e-07(0.692)	8.97e-08(0.80)
Distance from home to all season road	-0.0249(-0.74)	-0.0333(-0.96)	0.06421(2.23)**	0.3792(1.09)
Distance from home to nearest market	-0.0682(-2.70)***	-0.1755(-4.90)***	-0.0633(-2.69)***	-0.0862(3.93)***
Farm size	0.07615(1.51)	0.0278(0.70)	0.0051(0.868)	-0.0197(-0.51)
Access to wildlife	0.3968(1.62)	-0.0598(-0.25)	-0.7524(-3.41)***	-0.2216(-1.04)
Sufficiency of rainfall	-0.7798(-2.21)**	-0.1455(-0.50)	0.2678(0.281)	-0.6853(-2.61)***
Adequacy of soil fertility	0.5585(2.27)**	-0.3803(-1.62)	-0.1885(0.342)	0.0752(0 .35)
Percentage of owned land over borrowed land	-0.1308(-0.75)	-0.3733(-1.99)**	-0.4485(0.770)	0.2133(1.31)
Topography of farmland	0.1283(0.48)	0.2932(1.17)	0.3234(0.133)	0.2301(1.00)
Tenancy security of farm land	-0.4587(-1.91)*	0.2823(1.79)*	0.5702(2.86)***	-0.3430(-1.61)
Access to extension	0.06746(2.93)***	-0.0117(-0.62)	0.4053(2.66)***	-0.0172(-0.92)
Access to new crop varieties from research institution	-0.3269(-1.26)	0.4610(1.70)*	0.6007(2.73)***	0.2049(1.00)
Livelihood strategy 1	-0.2039(-0.43)	0.5292(1.00)	0.3541(0.922)	0.8267(1.79)*
Livelihood strategy 2	-0.5094(-0.87)	0.3013(0.43)	-0.3038(0.512)	1.2371(2.26)**
Livelihood strategy 3	-0.2135(-0.43)	0.6874(1.27)	-0.0086(0.981)	0.6775(1.43)
Livelihood strategy 4	-0.6144(-1.12)	0.0039(0.01)	-0.2164(0.615)	1.2371(2.31)**
Constant	-1.0330(-1.31)	-0.4266(-0.50)	-0.1175(0.855)	-1.7599(-2.36)

AP=Agronomic practice, CP=Cultivation practice, SMP=Soil management practice, SMECP=Soil and mechanical erosion control practice

Source: Author's Field survey (2018). ***= 1% level of significance. ** = 5%level of significance and * =10%level of significance

CONCLUSION AND RECOMMENDATIONS

Fertilizer application in (Soil Management Practice), sole cropping (Agronomic Practice), ridge tillage (Tillage/Cultivation Practice), and construction of ridges across field slopes (Soil and Mechanical Erosion Control Practice) were the sustainable land management practices mostly carried out among the respondents Livelihood strategy one, two, three and four, household assets, institutional factors and parcel level factors affected choice of sustainability practices among food crop producers. Thus, the study recommended that; sustainable land management practices such as strip cropping, agro forestry, conventional tillage, minimum tillage, green manure, bush fallowing, and shifting cultivation, construction of ridges across field slopes, wind breaks and ditches should be practiced among respondents. The farmers should use of organic material as source of fertilizer due to its availability and affordability to control degradation of land.

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