Journal of Agriculture and Environmental Sciences
December 2019, Vol. 8, No. 2, pp. 75-85
ISSN: 2334-2404 (Print), 2334-2412 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jaes.v8n2a10
URL: https://doi.org/10.15640/jaes.v8n2a10

Socio-Economic Factors Influencing Participation by Farm Households in Soil Erosion Management in Chepareria Ward, West Pokot County, Kenya

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Abstract

Soil is a vital resource for survival for many rural populations. However, soil erosion negates the ecosystem function, productivity, livelihoods and national economy. To enable sustainable functioning of the ecosystem, it necessitates a need for proper management. There is a need for understanding socio-economic dynamics in soil erosion management. Therefore, this study sought to test the hypothesis that socio-economic factors significantly influence the participation of farm households in management of soil erosion in Chepareria Ward, West Pokot County. The study was anchored within the Diffusion of Innovation and Social-ecological System theory which supports social and economic capital assessments underlying individual decision in con serration plans to attain sustainable co system services. A household survey was undertaken and a total of 100 households were sampled. Data was analyzed in descriptive and binary logit regression model using the SPSS software. The results obtained indicate that age, education level of the respondent, cost of technology and land acreage were the possible predictor factors that showed significant influence at $p<0.05$ level of significance, hence supports the hypothesis tested. The study findings and recommend at ions will immensely help the land use planners and policy makers to encourage community participationandexecutesitesustainablemanagementpracticestoimprove ecosystem functioning at national and local environment thus improving participation of rural community as the primary stakeholder and achievement of sustainable development on natural resource management.

Key words: Soil erosion, participation, farm households, soil erosion management, ecosystem function.

1. Introduction

Soil erosion is a major environmental problem and threat to rural development in Kenya which covers about 22% [9] as it results to loss of productive land [15]; food insecurity, compromised ecosystem and lower the quality life of most dryland communities [2]. Furthermore, humans obtain more than 99.7% of their food from the land and less than 0.3% from the oceans and other aquatic ecosystems [3], hence loss of land results to inadequate food production. Therefore, recognition of the potential benefits of lands has necessitated the efforts for soil management with interdisciplinary regulatory approach, hence provides an enormous challenge to policy makers, scientists and land users [7]. In line with SDG 15, many attempts to rehabilitate degraded lands have a limited success in Chepareria since the initiatives placed more importance on the technicality of the interventions than the socio-economic status of the people [27]. Insufficient attention has been given to examine the socio-economic attributes that may influence the uptake of these management measures. This study therefore aims to fill this gap since, following the stages of technology uptake, there exist constraints (social, economic, physical, or logistical) affecting different groups of end users [6].To date, it has been revealed that most ecosystem management studies have focused primarily on biophysical approaches and assessment, while few studies have explored the intangible social and economic factors underlying their decisions [19]. Hence, investment in soil erosion management could be influenced by livelihood assets which include social factors such as age, gender, household size, education level and economic factors such as lands size, farm and off-farm income, cost of technology and credit accessibility.

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Participation enable the collective responsibility in community development agenda and guaranteeing its sustainability. This study sought to examine the social and economic factors that influence participation by farm households in soil erosion management.

Justification of the study

The findings of this study will aid decision makers, the local community, individual farmers, researchers, land planners and other practitioners in intervention strategies of Soil Erosion Management better tailored to the needs of the farmers in Chepareria and other areas with conditions similar to West Pokot. Also, help the rural community to understand of their responsibilities and the possible outcomes of SEM. In addition, it will develop a theme of change; Soil erosion management will enhance ecosystem functioning thus improving soil production capacity and food, nutritional security, household welfare and will in turn positively affect the national economy.

Problem Statement

Soil is an essential resource in agriculture which feeds and provides required needs for the entire life [6]; hence it needs much attention in its use and management. However, in view of the increasing effects of degraded ecosystem on economy, there is need for more targeted research on ecological-economic interaction and to review the national policies and action plans to give more attention to land use policies and sustainable land management to prevent land degradation and loss of productive lands. Hence, it is important to understand such factors in order to enhance development and implementation of management strategies that are ecologically viable over both the long and short-term while also being sensitive to the needs of community members. Community participation is a key paradigm for rural development in Kenya as it is enshrined in World Vision Kenya, 2010hence require effective co-ordination of local activities to enable people come together to achieve common development goals. Participation enables the collective responsibility in development agenda and guaranteeing its sustainability taking a center role in planning, implementation, monitoring and maintenance, hence enhancing community development. The rural community has a limited understanding of the full range of their roles and responsibilities as primary stakeholders and this limits their effective and meaningful participation in soil erosion management. Economic and social attributes have influential roles in farmers' decisions on innovative measures in different areas of Kenya, which has not yet been studied in Chepareria, West Pokot County.

2. Methodology

2.1 Study Area

The study was conducted in Chepareria Ward, West Pokot County, Kenya. The ward lies between latitude 10 15' and 1055' N and longitude 350 7' and 35027' E. Its altitude range from1200 to1600M above sea level. The rainfall average is 600 mm. The average annual temperature ranges from 24°C to 28°C. It has a long history of livestock keeping and the livelihoods have also partly shifted to agro-pastoralism in which they grow beans, millet, sorghum, maize and most recently fruits (banana and mango). The figure below shows the study area

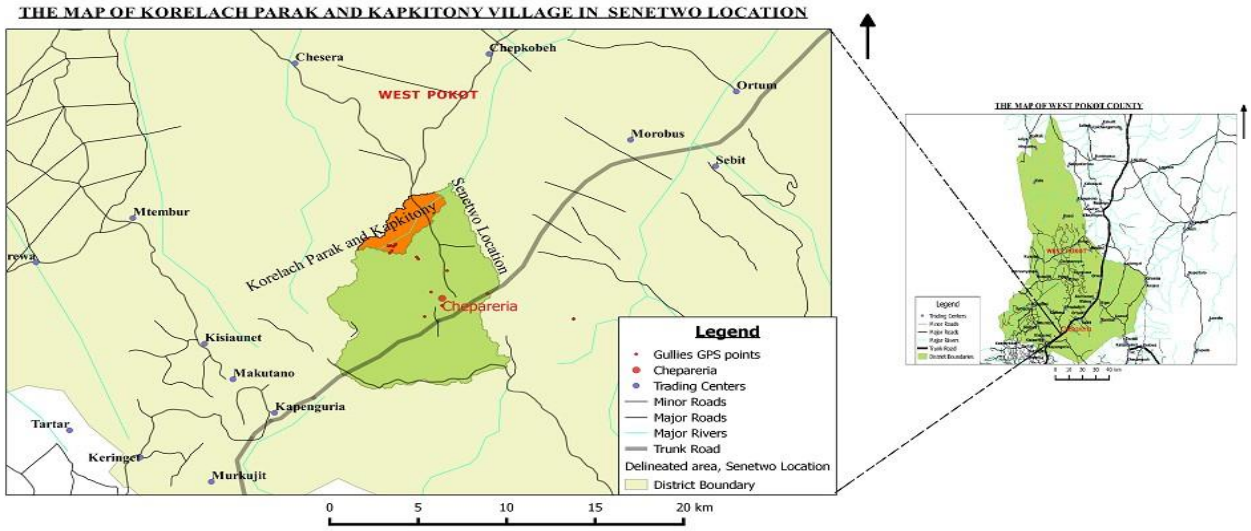


Figure 2.1 Source: Field study, 2018.

2.2 Research Design and Sampling Technique

The study employed a survey research design. The targeted population was the farm households who were mostly severed by the erosion effects. The selected ward for the study has 7,495 households [10], which constituted a unit of analysis for the study. This is because decision of farm management activities is done by the household head as the decision maker at household level among the Pokot community. Thus, household heads or their representatives were the respondents for this study. A number of 100 farm households were sampled from a formula adopted by [17]. This study employed a simple random sampling technique to select the respondents until the desired number(n=100) was achieved within Senetwo and Chepturnguny locations. The selected villages for the study was Cheseto (20), Taparach (24), Korellach (10), Koloswo (20) and Tingwoi (26). Primary data was collected during the actual field study to obtain specific and first-hand information which was required in achieving the objectives of this study. Secondary data also was collected to provide the necessary support to the primary data. This was gathered from existing literature reports, books, research journals, Ministry of Agriculture.

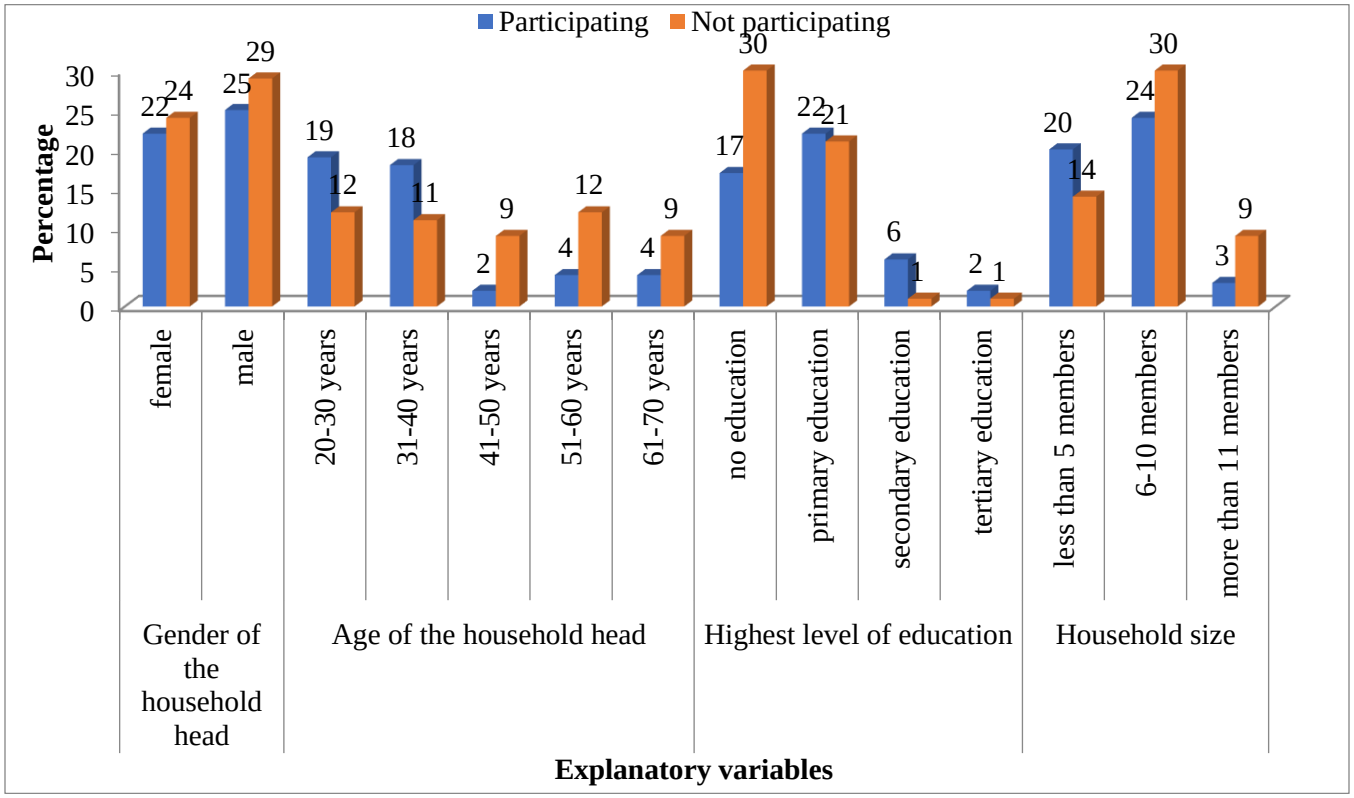
2.3 Data Collection Instrument and its Reliability

The questionnaire was used as a primary instrument to collect primary data from the selected farm households. To ensure consistency of the instrument, a pilot study was done prior to the main study, in the adjacent ward to the study area using simple random sampling whereby 10% of the study sample size subjects were selected. Subsequently, on the basis of the results obtained from the pretest, necessary modifications were made on the questionnaire to improve its reliability and accurate assessment on whether the respondents understood and able to participate during the survey. It was then used in the socio-economic survey.

2.4 Data Analysis

The study adopted both the quantitative and qualitative analysis in order to achieve the objective of the study. Descriptive analysis was computed using the Statistical Package for Social Sciences (SPSS) software version 20 and was presented in frequencies. Binary logit model used to test hypothesis and draw the conclusions showing the effect of socio-economic factors on participation by farm households in soil erosion management.

Figure 3.1 Descriptive Analysis of Social Variables



Source: Field Survey, 2018

Gender of the respondent

The researcher interviewed both male and female respondents to identify any variation on gender roles in regards to soil erosion management. Table 1 above shows the large number of men who were interviewed was 54% may be due to the fact that men are the heads of the households as they are identified as the ultimate decision makers. This agrees with [18] which confirmed that men have the sole power of decision-making and planning of farm activities. However, 46 % of female being involved in land management explained the affirmation that women are gradually taking over the decision making on the land management. This could be also attributed by the fact that most women are active members of farmer groups in the study area in which they can learn from other member's experiences and thus taking concern on soil erosion management. Furthermore, 24 male and 22 female respondents confirm that they take part in the soil erosion management activities, hence they contribute nearly equal in the same activities.

Age of the respondent

The study sought to probe the age of the respondents to determine their experiences and interest on soil erosion management. The frequency of respondent's age in relation to participation on soil erosion management activities shows that the majority of the respondents(79%) were from age category of 20-40years.Themiddle-agedfarmersfromtheage category of 41-60years who took part in soil erosion management was 13%respondents and the minority of the participants was 9% respondents which was from the age category of 61-70years who are regarded as older farmers. This group implies that they are no longer actively engaged in soil conservation activities due to their advancing age and they have left the responsibilities to the young members of the family.

Education level of the respondent

The study also sought to investigate the level of education of respondents to assess their knowledge on soil erosion and the participation on its management. This study revealed that majority of the respondents was 47 % had no education, 43 % had attained the primary education, 10% of the respondents had attained beyond secondary education. This reflects some handicap in education standards in West Pokot County which requires further research because such low levels of education can constrain the uptake of soil erosion management techniques among farm households.

Household Size

The research endeavored also to find out about family size within the respondent's farm households to assess their capability to participate in soil erosion management in terms of labour. The results show that the majority of households (53 %) had 6-10 members. This findings shows that most households have moderate family sizes that require large amount of food that would force the family heads to engage more in other income generating activities to feed the large families and possibly remain with a surplus for income. However, it is evidently depicted that, labour constraints is delimited in relation to soil erosion management since most farm households have adequate household sizes.

3.1.2 Economic Factors on participation

Explanatory Variables	Category	Percent n=100	Participating in SEM	Not participating in SEM
Farm Income	Lessthan10000	81	38	43
	10001-20000	11	4	7
	20001-30000	3	2	1
	Morethan30000	5	3	2
Off-farm Income	Lessthan10000	63	29	34
	10001-20000	2	2	0
	20001-30000	2	0	2
	Morethan30000	0	0	0
Land Acreage	Lessthan5 acres	39	14	25
	6-10acres	30	14	16
	11-15acres	20	12	8
	Morethan15acres	11	7	4
Costof Technology	None	61	8	53

	Lessthan5000	2	2	0
	5001-10,000	3	3	0
	Morethan10,000	34	34	0
Credit Accessibility	Access credits	70	34	36
	Have no access to credits	30	13	17

Source: Field Survey, 2018

Income Status

The study sought to evaluate the income sources which support the livelihood of the respondents since the ability of farmers to invest in sustainable soil erosion management requires financing. The majority of the respondents earn an average of less than 10000 Ksh per month i.e 81 % from farm income and 67 % from the off- farm activities. 42 respondents, who have average farm income of less than 20000 per month, engage themselves in soil erosion management activities, while 50 respondents who earn the same average income do not take part in the same activities. The findings also show that most respondents (31%) who earn an average off-farm income of less than 20,000 Ksh participates in soil erosion management practices, while 34 respondents do not take part in these activities. This shows that income levels of the farm households do not dictate participation in soil erosion management.

Land Size

Land is one of the most important resources as it is the base upon which agriculture activities are carried out. Table3.1shows that majority of the respondents (39%) owned less than five acres of land. Households which owned 6-10 acres of land represents 30%,11-15acres represents 20% and11% represents the lesser number of households owned more than15 acres of land. This shows that there are variation inland size distributions.

Credit Accessibility

Farm households who has access to and use of credit can overcome their financial constraints and can invest in soil conservation measures since these activities are labour intensive and costly. Based on this argument, access to and use of credit was hypothesized to have significant relationship with participation on soil erosion management. The results show that 70 % of the respondents access the credits and 30 % of the respondents do not have access to credits. From the findings, most of the farm households earn the income of less than five thousand; hence they have little capability of incurring in costly technology such as structural measure such as sand dams, terraces among others.

3.2 Regression Analysis

3.2.1 Empirical Model

Binary logit model was an appropriate statistical tool used to allow the study make predictions of relationships between the variables and to validate conclusions. This study quantifies the probability of the factors that significantly influence farmers' decision to participate in soil erosion management. In the logistic model, the coefficients are compared with the probability of an event occurring or not occurring and bounded between 0 and 1. The odds ratio and predicted probability of the independent variables indicate the influence of these variables on the likelihood of participating in soil erosion management if other variables remain constant. Therefore, to test the hypothesis, binary logit model was used which identified the socio-economic variables that influence participation of farm households in soil erosion management in Chepareria Ward. Following [23], the cumulative logistic probability model is econometrically specified as:

$$P_{i=} F(Z_i) = F(\alpha + \sum_{i=1}^{n} \beta_1 X_1) = \frac{1}{1+e^{-zi}} \qquad \text{(Equation1)}$$

Where, **P** is the probability that a farm household participate in soil erosion management. The subscript $\boldsymbol{I}$ denotes the $\boldsymbol{i^{th}}$ observation in the sample, **X** represents the explanatory variables; $\boldsymbol{e}$ denotes the base of natural logarithms, which is approximately equal to 2.718; $\beta_1 \ldots\ldots \beta_n$ are the coefficient of the parameters to be estimated. The estimated coefficients do not directly indicate the effect of change in the corresponding explanatory variables on probability (P) of the outcome occurring. Rather, the coefficients reflect the effect of individual explanatory variables on its log of odds. Where the expression for log of odds is given as

$$Ln\frac{P_i}{1-p_i}$$

Central to the use of logistic regression is the logit transformation of **P** given by **Z.** That is, to get linearity, the research thesis takes the natural logarithms of odds ratio equation 1, which results in the logit model is given by:

$$Z_i = Ln\frac{P_i}{1-p_i} = \alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3\ldots\ldots+\beta_nX_n \quad \textbf{(Equation 2)}$$

Where Z_i is the indicator of a farm household participating in controlling soil erosion or not, **P** is the probability of participation of farm household, **1-P**$_i$is the probability of not participating. β_0 is the intercept term (constant), β_1, β_2..... $\beta_n$are the coefficients of the explanatory variables $X_1, X_2 \ldots\ldots X_n$which are the corresponding vectors of regression. Finally, taking the natural log of the equation **2** with introduction of disturbance term ***e***, the logit model becomes;

$$Z_i(1,0) = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\ldots\ldots+\beta_nX_n + e \quad \textbf{(Equation 3)}$$

Therefore, taking the predictor variables of the study, the regression formula that best describes the relationship between the variables, from the findings, is as defined below.

$$\textbf{PARTSEM} = \beta_0 + \beta1(\text{GEN}) + \beta_2(\text{AGE}) + \beta_3(\text{EDU}) + \beta_4(\text{HHs}) + \beta_5(\text{FARM}) + \beta_6(\text{O/FARM}) + \beta_7(\text{CRDT}) + \beta_8(\text{COST}) + \beta_9(\text{L SIZE}) + e \quad \textbf{(Equation 4)}$$

$$\textbf{PARTSEM} = 0.866+0.82X_1+-1.349X_2+-2.118X_3+2.502X_4+-0.411X_5+-0.469X_6+-6.481X_7+19.532\,X_8+-1.76X_9$$

Where Z= participation on soil erosion management (1 Participating in SEM or0 if not participating.; X_1=Gender of the respondent (binary, 1 if Male of 0 if female); X_2=Age of the respondent (in years) ; X_3=Education level; X_4= Household size(number of members); X_5=Farm income(Ksh /month); X_6=Off-farm income (Ksh /month);X_7=Credit accessibility (binary, 1 if have access or 0 if havenoaccesstocredits;X_8=Cost of technology;X_9=Land size (in hectares).

3.2.2 Model Multi-Collinearity Test

The variables included in the binary logistic regression model were tested for multi-collinearity by using linear regression analysis. The tolerance value and the Variance Inflation Factor (VIF) were checked. A tolerance value <0.1 indicates extreme collinearity [13] and a VIF >5 is of greater concern. When variables included in the model are linearly dependent, they inflate the standard errors, thus weakening the power of the analysis. From the analysis of this study, the tolerance values of all the variables were > 0.1 and VIF was <5 (Table 3.2). This indicates that there was no multi-collinearity between the explanatory variables of the study.

3.2.3 Model Test of Goodness of Fit

The model Chi-square and the Chi-square Hosmer Lemeshow Test was used to test the goodness-of-fit of the model. There is a poor fitness if the significant value is < 0.05 [13]. In addition, [11] also explained that a high Chi-square value indicates that the variables in the equation significantly impact the dependent variable. The overall Chi-square value from the findings was 1.0 (>0.05) and the model chi-square 122.0, this translates to good fitness of the model (Table 3.2). To measure the strength of association, Nagelkerke pseudo R^2 was used which states that values from 0 (shows the weakness in predicting the dependent variable) to 1(the model accurately predicts the dependent variable). From the study findings, the NagelkerkeR^2 was **0.942,** hence the model showed a more accuracy in predicting the effect of dependent variable.

Table 3.2: Regression Analysis of the Selected Socioeconomic Variables on Participation in Soil Erosion Management.

				Collinearity statistics	
VARIABLES	**β**	**p-value**	**Odd Ratio**	**Tolerance**	**VIF**
GEN(X_1)	0.82	0.879	2.271	0.876	1.142
AGE (X_2)	-1.349	0.003*	3.852	0.903	1.107
EDU(X_3)	-2.118	0.015*	0.12	0.847	1.181
HHs (X_4)	2.502	0.132	12.208	0.811	1.234
L SIZE (X_6)	-1.76	0.036*	0.172	0.923	1.083

FARM I(X_7)	-0.411	0.605	0.663	0.783	1.277
O/FARMI(X_8)	0.469	0.902	1.598	0.845	1.184
CRDT(X_9)	-6.48	0.631	0.002	0.596	1.677
COST(X_{10})	19.532	0**	3.048	0.905	1.105
CONSTANT	0.866	0	0		

Model Chi square= 122.0 **Cut value=**0 .5 **NagelkerkeR^2=** 0.942

Hosmer and Lemeshow test

Chi-square 0.459 **Observation=**100

Significance 1.000 **Adjusted R**=73.5%

Source: Field Survey, 2018

Inferential statistics results of the study

1. Gender of the Household Head

Gender of the household head was also hypothesized to influence participation in soil erosion management in this study since the household heads are regarded as the primary decision makers in all the planning of farm activities. However, from the regression findings, gender was found to have no significant influence on participation (β= 0.82; p=0.879) at 5% level of significance (p>0.05). This correlates with a study by [20] which confirms gender have no significant influence on adoption of soil and water conservation technologies in Nguciuma sub-catchment.

2. The age of the Respondent

Age show a negative significant influence on participation in soil erosion management (β=-1.349; p=0.003) at 0.001% significance level. This shows that as the age of a farmer increases, the probability of taking part in soil erosion management decreases. This could be contributed by the loss of interest as most of the old farmers explained. This findings concurs with [16; 1] which explained that younger farmers are typically less risk-averse and are more willing to try new techniques since they have longer planning horizon and hence may more likely to invest in soil and water conservation. However this disagrees with study done in Embu West by [14] on farmer's characteristics, agricultural extension and technology specific factors showed that older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate new information than younger farmers.

3. Education Level

This regression analysis also shows that level of education reported a negative significant effect (β=-2.118; p=0.015) on participation in soil erosion management at 0.05%significancelevel. This shows that farmers who have attained higher education level are 0.12 times less likely to invest in soil erosion management activities. This could be attributed by the fact that there is low level of educational attainment of farmers in the area, while most of the respondents who had no education and some with primary education were mostly confined in the farms due to their obligations ofmeetingfooddemandsfortheirfamiliesso,takingconcerninsoilerosionmanagement.Inaddition,they have the indigenous knowledge and can acquire other information from farmer to farmer visits as it was founded from this study, hence increase in participation. The study findings also disagree with [22] which explains that as formal education increases, the level of technology uptake and utilization increases since the educated can read, understand and comprehend information about available technology and make choices than those who have no formal education

4. Household size

Family is one of the social institutions that has vital role in the process of information sharing and performing collective work hence family size was hypothesized to have influence on soil erosion management since it could contribute labour force. However, from the results of this study, household size was found to have no significant influence on participation in soil erosion management at 5%level of significance (β=2.502; p=0.132). this could be

because households with small members number and large number contributed nearly same in participation on Soil erosion management in the area.

5. Land Size

Land is one of the most important resources as it is the base upon which agriculture activities are carried out. Resource endowment is one of the factors affecting farmers' decision to adopt improved seeds, fertilizer, and natural resource management technologies in Kenya [26]. Hence, this study sought to find out its influence on participation by farm households in soil erosion management. The study revealed that land acreage has a negative significant influence in soil erosion management (β=-1.76; p=0.036). This explains that the farmers owning smaller land acreage are 0.172 times more likely to take part in soil erosion management. This may be because they devoted their time and much concern on soil erosion management on the small farms they own to acquire maximum benefits since they have no other farms. Hence these findings disagrees with the study by [21;25] which explained that adoption of Soil and Water Conservation technologies increased with increase in acreage of land as farmers with large farms are likely to be keener in searching for information on improved technologies.

6. Income Status

Income status of the farm households was hypothesized to influence participation on soil erosion management in this study. Farm income (β= -0.411; p=0.605) depicted no significant influence on participation on soil erosion management at 5% level of significance. This disagrees with a study [24], which argue that a greater income from the land encourages farmers to participate in soil conservation measures. It also disapproves [30] which concluded that off-farm employment earns incomes that would make the farmers more likely to afford the cost involved in new innovations.

From the analysis also, it is confirmed that off-farm income (β= 0.469; p=0.902) have no significant influence on participation at 5% level of significance (p>0.05).

This finding agrees with [5] which found a negative influence of off-farm income on adoption of soil and water conservation practices in Nabajuzi watershed of the Lake Victoria Basin, Uganda. They further explained that off-farm income activities reduces the economic significance of the erosion issue because farmers will have less time, less labour and less interest for implementation of new and maintaining the existing SWC practices. Therefore, the findings clearly show that income levels, do not dictates the participation of the farmer as it is depicted in the findings across the four age categories because there were many participants and also non-participants of soil erosion management in each category.

7. Credit Accessibility

In this study, the hypothesized proposition of access to credits on participation in soil erosion management was not supported since access to credits represents (β=-6.48; p=0.631 at 5% level of significance (p>0.05) which is translated to insignificant influence.

8. Cost of Technology

From the study findings also, the cost of technology shows a greater significance on participation by farm households in soil erosion management activities (β=19.53; P=0.00) at 0.001% level of significance. This study disapproves [12] which stated that technologies that are capital intensive are only affordable by wealthier farmers and hence the adoption of such technologies is limited to larger farmers who have the wealth. From the study findings, the lower the cost of technology, the greater the participation level of the farmers in soil erosion management. Hence, the more expensive the technology increases the probability of farmers' participation by 3.04 times than the technologies which are cheaper. This could be because most of the households explained that they summed up the income they get from farm and off farm activities to afford the sustainable management measures such as ditches which they regard them as expensive.

Conclusion

Understanding the factors that influence or hinder participation of farm households in soil erosion management practices is essential in planning and executing environment management programmes in the development of policy instruments for targeting improvement of soil conservation in West Pokot County. Socio-economic factors play a major role in determining farmer's decision to participate in SEM. Hence, in order to invest and take part in soil erosion management sustainably, the government and NGO's in collaboration with the development partners should take into consideration the involvement of local community when designing management interventions and accommodating their socio-economic status and needs.

The study findings show that majority of the participants were young farmers and middle-aged groups of farmers with low education level were regarded as active and energetic farmers who could engage in soil erosion management activities. Hence the government should implement the policies which will support the young and middle-aged farmers and introduce a capacity building program so that these active participants can be able to be inducted on sustainable soil management techniques.

Recommendation

- Increased support for trainings about soil erosion impacts and possible management outcomes to the rural community thus, encouraging participation.
- The adjusted R2 was 74.2% Thus, further studies on other variables such as biophysical, topography, technology attributes.
- Similar studies should be replicated in other dryland areas for validation of these findings.

Acknowledgement

Sincere gratitude to McKnight Foundation Collaborative Crop Research Program for their immense financial and logistical support which made this study possible in favour of the first author. Also special thanks to Farmers Research Network Drylands project team members for their endless intellectual guidance and useful suggestions which were instrumental for this study. We are also indebted to farmers and research assistants who participated during this study.

Authors Contribution

Author1designed the study, performed the statistical analysis, and wrote the first draft of the manuscript. Author2 and author3 managed the analysis of the study and the literature reviews and author4 guide on data analysis and interpretation of data, literature searches and previews. All the authors read, substantially revised and approved the final manuscript.

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