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Factors Influencing Soil Erosion Management Practices in Ejersa Lafo District, West Showa Zone, Oromia, Regional State, Ethiopia

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ABSTRACT: Soil erosion by water is the major Agricultural problem, which results in reduction of agricultural productivity. This study focused on farmer perception of soil erosion and factors influence soil erosion management practices. A cross sectional data was used to assess information about soil erosion perception and factors influence soil erosion management practices. The Ejersa Lafo district was purposively selected from the districts of West Shoa Zones. A total of 142 sample respondents were randomly selected. Interview questionnaire, focus group discussion and survey of field observation were used as data collection tools. Data were analyzed using descriptive statistics and econometric model. Result from descriptive statistics show that majority of the respondents perceived soil erosion problem and its consequence on farmland. Both biological and physical soil erosion management practices in the area. Binary logit model estimation result shows that education level, landholding size, slopes of the land and land ownership type were most significant to soil erosion management practices in the area. Therefore, taking these factors into account in setting appropriate soil erosion management measures may help policy makers and farmers to couple with erosion problem. The study recommended a need for the government to enforce effective policies to control and prevent soil erosion problem.

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Soil erosion is a main environmental and agricultural problem that affects worldwidly more than 10 million hectares per year (World Economic Forum, 2010).Likewise Mohamed (2015) recognized that soil erosion is serious environmental problems in the world and is responsible for 80% of the current degradation of agricultural.Soil degradation induced by water erosion in sub Saharan Africa (SSA) is mainly concerned because of its consequences on subsistence agriculture, from which about 85% of the population derives their livelihoods (Erkossa *et al*., 2015; Tully *et al*.,2015).It is a major threat to development in most economies of the world (Erkossa*et al.*, 2015; Taguas *et al*., 2015; Keesstra *et al*., 2016). About 15% of land worldwide is degraded, of which 16% is in Africa (Jarecki, M. K, 2003; Kumar, K. V. *et al*., 2008). Similarly TesfaandMekuriaw (2014) indicated that natural resource degradation is the environmental problems which resulting for decline of agricultural productivity.According to Assogba *et al*.,(2017) revealed that in the many agroecological areas, erosion has leach the top soil.According to Kidane and Alemu (2015) concluded that soil erosion problem is more severe in the highlands of Ethiopia.Among the Sub Saharan Africa countries, Ethiopia has a suffered by high level of soil erosion (Mekonnen*et al*., 2016; Simachew A.*et al*., 2016). Soil erosion and nutrient depletion are two particularly common sources of declining agricultural productivity in Ethiopia. Empirical studies have linked low and declining crop yield to the existence of severe soil erosion (Amdihun, *et. al.*, 2014;BrkalemShewatatek, 2015). However, factor affecting soil erosion management practices were not studied in the study area. Therefore, the study aimed to identify farmers perception of soil erosion and factors influencing implementation of soil erosion management practice in EjersaLafo District.

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MATERIALS AND METHODS

*Discription of the Study Area:*The study was conducted in Western Shoa Zone in EjersaLafodistrictwhich is located in Eastern part of west Shoa Zone of Oromia National regional State Ethiopia. It covers an area of 35,176.09 ha and has a population of 45,895. Administratively the district is divided into 17 rural and 3 urban kebeles totally 20 kebeles. Crop farming and livestock rearing are the major sources of livelihood for the population of the district, like many other rural areas of the region. The farming system is a typical cereal-based crop-livestock mixed farming system(Figure 1a and b).

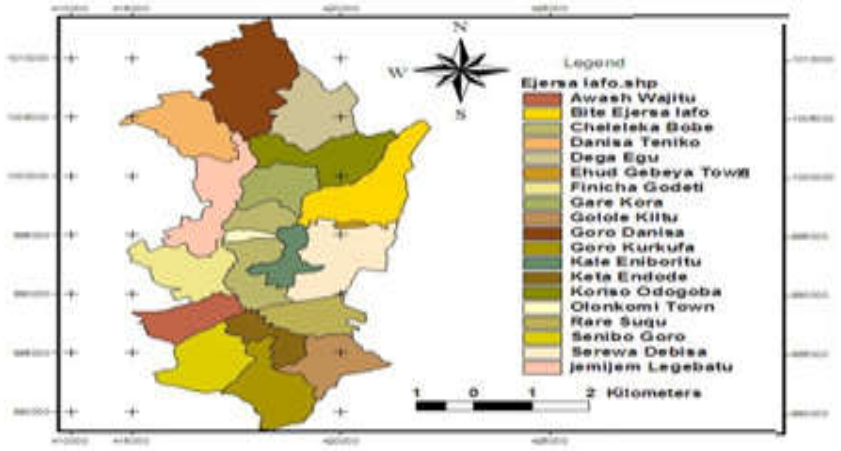

Fig: 1a. Map of Ejersa lafo district

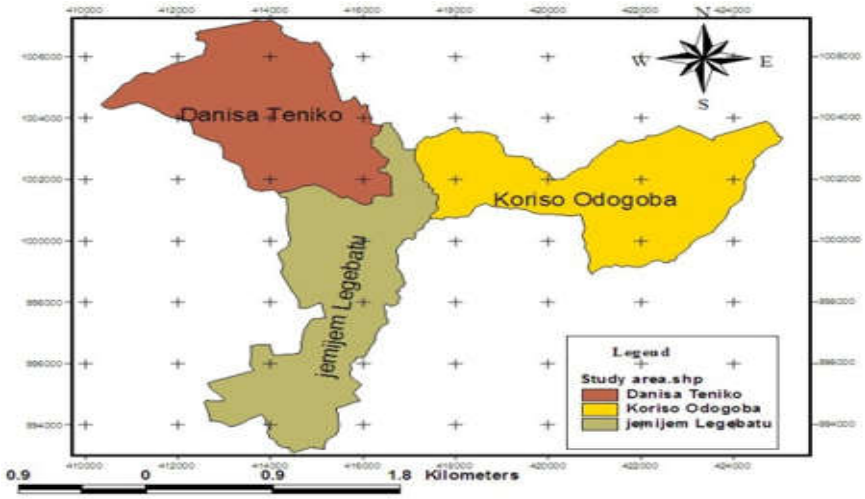

Fig: 1b. selected kebeles of the study area

*Sample size and Sampling technique:*TheEjersaLafo district was purposively selected on the basis of the soil erosion management practice with utilizing of different project like sustainable land management project (SLMP) and Agricultural growth production (AGP). Further, there is no research undertaken in the study area about farmer perception of soil erosion and factor hinders soil erosion management practice in the area. Once the district is select as a study area, sample of peasant association were selected by using simple random sampling technique. In this case, among the existing 20 kebeles, only three kebeles, namely (DanisaTanco, Jemjem legebatu and Korisoodogoba) were randomly selected. The sample frame for selected kebeles would be prepared and the desired number of sample size was determined. The data used in this study came from detailed household and plot surveys of 142 farm households. To determine the required sample size Yamane (1967) was employed at 95% confidence level, with a 0.05 degree of variability and 8% level of precision (margin error) can be determined as follows.

$$n = \frac{N}{1 + N(\mathbf{e})2}$$

$$n = \frac{1567}{1+1567(0.08)2} = 142$$

Where: n = sample size, N= Total number of household e = designate maximum variability or margin of error 8% (0.08 adapting be reviewing various literature), 1=designates the probability of the event occurring. Therefore, total sample size is 142 out of this (51) from Danisa Tanco, (49) from Jem jem legebatu and (41) from Korisoodogoba were selected based on proportion to number of household.

Table 1: Sampling frame and sample size

Name of Sampled kebeles	Total No. of HHs		Total	Sampled HH		Total
	MMale	Fe Female		Male	Female	
DanisaTanco	400	170	570	36	15	51
Jemjem legebatu	438	100	538	40	9	49
Koriso odogoba	381	68	449	35	7	42
Total	1229	338	1567	111	31	142

*Data sources and Methods of data collection:*Both primary and secondary data was used.Primary data on the demographic characteristics sample of households, extension services, income, education level, marital status, land size, land ownership, consequences of soil erosion, farmers' perception of soil erosion and soil control practice (biological and physical soil erosion management) while secondary data were obtained from the reports, books, journals, and documents from offices of Agricultural Development and Water Resources, Land and Environmental Protection at Zonal, District and kebeles level.Questioner survey, interview, focus group discussion and participant observation data collection tools were used. The questionnaire was designed and pre-tested in the field for its validity and content and to make overall improvement of the same and in line with the objectives of the study.

*Method of Data Analysis:*Descriptive statistics and econometric analysis were employed to analyze the data collected from sample respondents to meet the objectives of this study.

Descriptive statistics: Descriptive statistics frequencies, percentages and standard deviationand chi-square test were used to describe demographic characteristic and association between farmers` perception of soil erosion and explanatory variable.

*Econometric model:*Model specification is based on the nature of dependent variable. Since dependent variable was dummy variable, which takes a value Zero [0] if farmers not control/ manage/ soil erosion problem and [1] if farmers control /manage/ soil erosion problem. Under such condition binary logit and probit model was used to explain variation withsoil erosionmanagement and no soil erosion management practices by smallholder farmer.The reason why binary logit model was selected for this study over the logit model is because it has some advantage when sample size is small.In this study, the odds ratio is the ratio of the probability that the soil erosion management[Pi] to the probability that he/she will be on soil erosion management measure[1-Pi].

$$pi = f(Zi) = f(\alpha + \beta i \chi i) \quad \text{……[1]}$$

$$(1 - pi) = \frac{1}{1 + e^{Zi}} \quad (\frac{pi}{1 - pi}) = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{Zi}$$

$$(\frac{pi}{1 - pi}) = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{(\alpha + \Delta\beta i + \chi i)}$$

Taking the natural logarithm from above equation

$$Zi = \beta 0 + \Sigma\, \beta 0\, Xi + Ui \text{..... [2]}$$

A binary logistic regression model was fitted to estimate the effect of expected explanatory variables on the probability of a farmer being control soil erosion (or not).

RESULTS AND DISCUSSION

*Farmers' perception of soil erosion:*Survey results indicated that about38 % of farmers understood thatsoil erosion ashigh problem in farmlands while 29.6% of farmers demonstrated the intensity of soil erosion isslow in cropland. This entails inventiveness to manage soil erosion through sustainable land management technologies and involvements of local communities. This implied that perception to soil erosion positively correlated with soil erosion management practices/ technologies. Farmers with better perception of soil erosion will develop good initiations towards soil erosion management.

Table 2: Farmer perception of soil erosion problem

No	Perceived soil erosion	Frequency	Percent	Chi square ($\chi 2$)
1	Low problem	42	29.6	
2	Medium problem	46	32.4	0.046
3	High problem	54	38	
	Total Respondents	142	100	
	Mean	2.77		
	Std deviation	1.081		

The findings indicated that most of the respondents either agreed or disagreed that the rate of soil erosion is sometimes a problem for all of our cultivated field with a mean of 2.7, so, it is important to apply soil erosion management practices for minimizing the rate of soil erosion. Chi square test also shows statistically significant difference between the farmers perception of soil erosion status in the study area ($\chi 2 = 0.046$; $P < 0.05$).

Demographic characteristics of the respondents: Respondents' distribution by gender: The total households in EjersaLafo district of three Kebeles were selected 142 of which about 111 were male headed and 31 by females. This implies that greater percentages of the farmers in the research area are male. Conditions that suggest gender discrimination with respect to agriculture, and farming activities are

male dominated in the study area. However, the smaller percentage of female farmers sampled is reflective of the fact that women in general, and in the study area in particular depend on their husbands for a livelihood. The women rarely claim ownership of farms and usually regard males as the owners of the family farm land.

Respondents distribution by age: As survey study indicated the average age of sampled farmer were with age 31-40 , 41-60 and above age of 60 were 33.1, 56.3, and 10.6 %, respectively.This suggests the farmers are still in their economically active stage of agefarmers of middle-aged generally, influence many farming activities, especially in terms of increased hectares of farmlands and soil erosion management practices. Moreover, the peasant administrations (PA) of middle-aged are more enthusiastic and have more physical vigor and family responsibilities than the young and old farmers.

Respondents distribution by educational status: Majority of the respondents (40.1%) were illiterates, the rest are reading and writing through basic education and religious schools(13.4%), other (36.6%) respondents were primary school. The greatest percentage of farmers sampled are illiterate. The low proportion of literates in the respondent's groups implies that the majority of them arenot aware or understand soil erosion management practices.

*Respondents' distribution by marital status:*The 58.5% of the sampled farmers are married, 18.3% unmarried while, only 17.6% and 5.6% were divorced/widowed and unmarried respectively.

*Land holding size of respondent:*All of the interviewed farmers owned land. The mean holding farm size is about 0.5 ha. The significances variation in the size of land holding among sampled households. Majority farmer (42.3%) possessed above 2 ha of lands where 21.1%e about 1.5ha - 2 ha, at 16.2% farmers e 1ha-1.5ha, at 14.1% about 0.5ha-1ha and 6.3% approximately 0.5 ha.

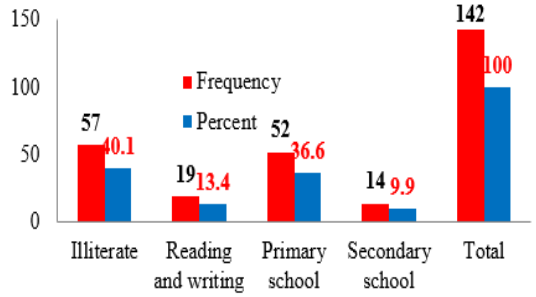

Fig: 2. Education level of respondent

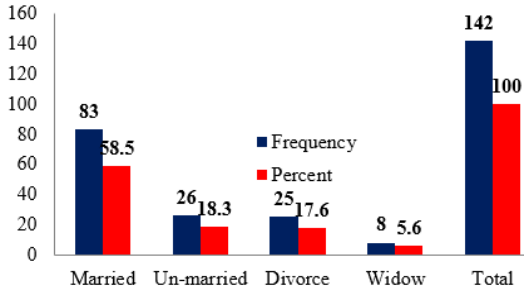

Fig: 3. Marrital status of respondents

Distance of cultivation land from Homestead: Distance from cultivation land to homestead influence the soil erosion management practices. The feasible explanation is that the nearer the cultivation fields to the homestead, the frequent the land management and soil and water conservation measures and the higher will be practice of conservation measures (Assefa 2009). It was indicated that farmers having land far from their residence usually do not visit to their cultivation field except during harvesting and planting season. In other side of these, there were farmers whose land is here and there, but the field that exists far fromhomestead has been given for share cropping and left for grazing mostly without soil erosion management practices. Only 23.2% of respondents 5-10 minutes' walk, 69 % with 10-20 minutes' walk and 7.7% with 20-30 minutes walks.

Land ownerships **:**Survey result show that soil bund were poorly maintenance specially those who rented land (8.5%), share cropping (8.5%) from landholder.Farmers does not give attention for maintenance of already constructed soil bunds due to need of immediate return and they believe that bunds can decrease their farm size and inherited from parent (83.1%) give more attention.

*Extension services/ training:*The 82 respondents (57.7%) were having access to the soil erosion management extension services while 42.2% were not having access to the soil erosion management extension services.

*Slope of land:*Survey result show that about 45.6, 35.6 and 18.8% of farmlandwere steep, flat and medium slope respectively in the study area.

*Farmer perception to causes of soil erosion:*Survey result show that about 23.9, 19.7, 16.9, 9.2 and 4.9% of sample respondents reported inappropriate land use, overgrazing, intensity of rainfall, deforestation and lack of ground water respectively as the major cause of soil erosion. Moreover, 23.9 and 19.7 % of the

farmers considered inappropriate land use and the overgrazing respectively as the major cause of soil erosion on their land. Moreover 31.6 % of the respondents reported population growth as the major cause of soil erosion. Chi square test also shows statistically significant difference between the causes of soil erosion in the study area ($\chi 2 = 0.034$; $P < 0.05$)

Table 3: Causes of soil Erosion identified in the study area

Causes of soil erosion	Farmers responses		Chi square($\chi 2$)
	No	Percent	
Inappropriate land Use practices	34	23.9	0.034
Overgrazing	28	19.7	
Deforestation	13	9.2	
Intensity of rainfall	24	16.9	
Lack of ground cover over winter time	7	4.9	
Population growth	45	31.6	
Total	142	100	

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*Farmers' perception to consequences of soil erosion:*The most of the respondents were aware of 45.9 % loss of agricultural productivity. The loss of productivity due to loss of topsoil by 33%, siltation of waterways by 24.6%, contamination of drinking water by 20.4%, reproduction of gullies by 12.7%, Biodiversity loss by 10.5 %, and impacts on strategic reservoirs by 7%. The major consequences of soil erosion in the study area are loss of productivity, loss of topsoil and siltation of water ways respectively.Chi square test also shows no statistically significant difference between the farmers' perception on consequences of soil erosion in the study area ($\chi 2 = 7.32$; $P > 0.05$). This implies that soil erosion had similar negative effect in the study area.

Table 4: Consequences of soil erosion in the study area

Consequences of soil erosion	Farmers responses		Chi square ($\chi 2$)
	No	Percent	
Loss of Biodiversity	15	10.5	7.32
Impacts on strategic reservoirs	10	7.04	
Contamination of drinking water	29	20.4	
Reproduction of gullies	18	12.7	
Siltation of waterways	35	24.6	
Loss of topsoil	47	33	
Loss of productivity	51	45.9	
Total	142	100	

*Biological soil erosion management practices:*Some of the biological soil erosion practices that practiced by the kebeles were crop rotation, intercropping, grass strip residue recycling and contour farming.The use of crop rotation (28.2%) and residue recycling (30.3%) helps to increase soil organic matter, reduce erosion and bring biological diversity back to the soil. Intercropping system is a form of agronomic practices employed by farmers where different kinds of annual crops are planted in alternating rows for soil conservation to reduce soil erosion risk by providing better canopy cover than do sole crops (Moges and Holden, 2007, Kagabo *et al*., 2013).

Table 5: Biological soil erosion management in the study area

Biological soil erosion management	Farmers responses	
	No	Percent
Crop rotation	40	28.2
Inter cropping	14	9.9
Grass strip	25	17.6
Residue recycling	43	30.3
Contour farming	20	14.1
Total	142	100

*Physical soil erosion management practices:*Survey result identified that types of physical soil erosion control structure in the study area. these are soil bund(29.6%), mulching (21.1%), Cut-off drains(16.2%), waterway (23.2%) and Strip cropping (9.9%) of the farmers have used these physical soil erosion management practice respectively. Moreover, soil bund and cut-off drain a major physical soil erosion management structure in the study area.

Table 6: Physical soil erosion managementin the study area

Physical soil erosion management	Farmers responses	
	No	Percent
Soil bund	42	29.6
Mulching	30	21.1
Cut-off drains	23	16.2
Water ways	33	23.2
Strip cropping	141	9.9
Total	142	100

*Econometric analysis of factors affecting soil erosion management:*Before running the logistic regression analysis, the existence of multicollinearity among the explanatoryvariables was checked using variance inflation factor (VIF). The VIF values for all the explanatory variables were very small (much less than 10) indicating that absence of multicollinearity between the explanatory variables. and if VIF is greater than 10, then multicollinearity exists (Oddendo *et al*., 2010). Therefore, multicollinearity was not found to be a problem to this analysis.The likelihood ratio, goodness of fit test shows a good fit for the model. The $\chi 2$statistics testing that the coefficients of the model excluding the constant term, are highly significant (at $P \leq 0.001$) supporting the specification. The results are reported using odd ratio. The result of binary logit model show that from the total of nine independent variable assume to be factors affect soil erosion managements, four explanatory variable were significantly affect soil erosion management practices.

These are education level, landholding size, slope of the land and land ownership types are statistical significant to soil erosion control in the study area. The interpretation of the four significant explanatory variables is discussed below:

*Land holding size:*Negatively influenced soil erosion management practicetindicate that decrease in land holding size, increases farmers' soil erosion control. The small farms in the study area frequently cultivated with soil erosion control. Theodd ratio for this variable shows that keeping other variables remain constant, the marginal effect suggests one unit decrease in land holding size would causes an increase soil erosion control by 1.88 percent. This is in line with the finding reported by Odendo*et al.* (2010) in rural Ethiopia, indicating indirect relationship between farmers` level of perception on soil erosion and their respective land holding size.

*Educational level of household head:*Education level of the household head was found to be positively significant influence on the soil erosion management practices. This implies that educated household head better understanding the problem of soil erosion and easily understood the new technology to land management. The odd ratio value for education shows that keeping all factors constant an increase in education by one year, the probability of soil erosion management practices household head is increased by 0.027. The study in line with the finding of Mbaga-Semgalawe and Folmer(2000) and Lapar and Ehui (2004) also observed that education has a positive impact in the adoption of improved soil conservation technology.

*Slope of the land:*Positively influence soil erosion management practices at 1% significant level. The significant positive terms in erosion management practices indicate that farmers invest conservation practices where their farm plots are located on steep slopes. The odd ratio value for slope of farm plot shows that keeping all factors constant, an increase in slope from flat to steep slope, the probability of investing soil erosion control structure is increased by 0.013.

*Land ownership:*Land ownership positively correlated with soil erosion management. Land belongs to own the farmer more managed than rented, crop shared one. The lack of title to land is one important factor affecting soil erosion management practices because lack of land ownership means that people are unwilling to invest soil erosion management technology on land which they do not formally own. In references to rented and share crop land, the odd ratio in favour the probability of investing soil erosion control on owned land is increased by 3.1446.

Table 7: Binary logistic estimate of factors influencing soil erosion management practices

Variable	*Coef.*	*Std. Err.*	*P>|z|*	*Odd ratio*
Sex	-.6216763	.5835799	0.287	-.0155823
Age of respondent	-.016866	.0230585	0.465	-.0004021
Education level	1.133602 **	.3466843	0.001	.0270283
Marital status	-.1038469	.6341202	0.870	-.0022945
Land size	-.9006707**	.3211383	0.005	.0188438
Slope	**	.12272	0.000	.0131701
Income	.5762166	1.114486	0.605	.0120556
ESE	-.0146374	.0134353	0.276	-.0030638
Land ownership	.000015 **	7.0666	0.000	3.1446
Log likelihood = -16.451, N= 142, LR chi2(9) = 107.55, P ≤ 0.001				

*Conclusion:*This study attempted to assess farmers' perception of soil erosion problem and factors that influence soil erosion management practices in the EjersaLafo Districts.Even if biological and physical soil management practices, the problem of soil erosion was increase time to time in the study area. To addresses the proble identified factors influencing soil eriosion management is crucial.The results obtained from binary logit model indicate thateducation level, landholding size, slope of the landand land ownership types are significantly affect the probability that farmer managesoil erosion problem.it is suggested that government and non government supporters are needed to encourage soil erosion management practices on the agricultural lands through take into the account the significant variable identified and discourage uncontrolled cropping of agricultural use on affected agricultural land areas. Therefore, policies aiming at promoting sustainable soil erosion management practices need to emphasize the crucial role of continuous investment by providing information on better management practices to enable farmers to increase agricultural production.

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