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DETERMINANTS OF FARMERS' LAND MANAGEMENT PRACTICES: THE CASE OF TOLE DISTRICT, SOUTH WEST SHEWA ZONE, OROMIA NATIONAL REGIONAL STATE, ETHIOPIA.

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ABSTRACT

This study attempts to identify factors that determine farmers' decision to use certain land management practices aimed at achieving sustainable development – terracing and manure application - in Tole District of Oromia National Regional State in Ethiopia. Primary data for the study were collected through household questionnaire surveys, focus group discussions, key informants interviews and personal observations while secondary data were collected from relevant local authority reports and records. The findings of the research showed that the district is experiencing increasing land degradation. Gullies and rills are common features rendering some areas out of use. Binary regression model results reveal that educational status of farmers and their access to extension services have significant positive impact on farmers' use of both terracing and manure. Age of farmers and livestock holding have significant positive influence on manure application, but not on terracing. Access to credit also has significant negative influence on terracing. Other remaining factors such as farmers' perception on land degradation on their own farmland, farm size and number of economically active household members are found not to have significant influence on both terracing and manure application. The study concludes that in making interventions in land management, there should be active participation of local stakeholders, primarily the farmers. This helps to integrate indigenous land management practices and the new techniques and enhance easy adoption and sustainable use of effective introduced practices.

Keywords: Farmers, land degradation; land management practices; terracing; sustainable development; Ethiopia.

INTRODUCTION AND STATEMENT OF PROBLEM

Agriculture is the backbone of the Ethiopian economy and is given special attention by the Government to spearhead the economic transformation of the country. However, land degradation in general and soil erosion in particular still remain the major challenges that are adversely affecting the agricultural performance of the country; hence the call for improved land management practices (Woldeamlak, 2003).

The World Bank (2007b) defines land degradation as a reduction of resource potential, the loss of utility or potential utility resulting in temporary or permanent lowering of current or future productive capacity of land. It has been attributed to one or a combination of natural and human processes that act on the land such as water erosion, wind erosion, a long-term reduction in the amount or diversity of natural vegetation, salinization, or sodification.

The broad concept of land management practices refers to activities on the ground that use appropriate technologies for the improvement or maintenance of productive capacity of the land. This includes activities such as soil and water conservation, soil fertility management and
controlled-grazing. Thus sustainable land management approach emphasizes finding economically viable, socially acceptable and ecologically sound solutions at a local level, which could promote participatory land management practices to deal with land degradation. In doing this due emphasis is given to the use of appropriate technologies (Hurni, 2000 cited in Yilkal, 2007).

In Ethiopia, a significant number of studies have been done on land degradation and determinants of land management practices in different parts of the country. These works mainly focus on nature of land degradation, traditional farmers' land management practices, soil and water conservation by government and other actors, farmers' perception on soil fertility change and on causes of land degradation (Aklilu, 2006; Habtamu, 2006; Eyasu, 2002; Yohannes, 1999; Pender & Berhanu, 2008). This study complements these and other studies that deal with the above issues. It intends to add to the status of knowledge on the factors that determine farmers' decision to use certain land management practices.

The general objective of this micro-level study is therefore to identify factors that determine farmers' decision to use certain land management practices. It was necessary to ask the following research question: What social, economic, institutional, and demographic factors determine farmers' decision to use two land management practices - terracing and manure application - in Tole District, Oromia Regional State? The study district was purposefully selected because it is one of the Ethiopian Highland Districts that experience challenges of land degradation (OBoFED, 2007).

The study adopts Pender, Jagger, Nkonya, & Sserunkuuma (2001)'s conceptual framework that postulates that land management is determined by household and village level factors, among others. Household factors include physical, human and social capital, whereas village level factors include population pressure, access to markets, agricultural potential, local markets, presence of programs and local institutions. The framework generally shows the complex interplay of these factors at different levels and how they influence land management practices which in turn affect agricultural production.

The study is significant in that the identification of effective determinant factors of land management practices will inform decision makers and instruct policy on successful food security enhancement practices. As for the academics, knowledge of the factors that determine of farmers' decision to use certain land management practices can enhance their ability to craft sustainable land management intervention measures to improve the food security situation in general.

REVIEW OF RELATED LITERATURE ON LAND MANAGEMENT PRACTICES AND THEIR SUSTAINABILITY IN ETHIOPIA

Land Management Practices in Ethiopia

In Ethiopia, since the 1970s, considerable efforts have been made to reverse the problem of land degradation. What were once considered to be sustainable land management practices such as soil and water conservation, soil fertility management, controlled-grazing and other land management practices were introduced. However, the impact of those efforts did not curb the impact of land degradation in a meaningful and sustainable manner. Various reasons are often given for the lack of success. Among these the most commonly cited factors include failure to consider indigenous land management practices, high initial costs which are not affordable to poor farmers and also trying to apply uniform techniques in different agro-ecological regions (Aklilu, 2006).

Traditionally through time, farmers have developed different soil conservation and land management practices of their own. With these practices, farmers have been able to sustain their production for centuries. Even up to now, it has been acknowledged that these technologies, which include ploughing of narrow ditches on sloping fields to control run-off, farmland terraces, traditional ditches and furrows, contour ploughing, fallowing, crop rotation, farmyard manure and agro-forestry continue to play a significant role in the production of subsistence agriculture (Betru, 2003).

Several soil and water conservation measures were introduced in the early 1970's to improve land management practices. These projects were supported by development food aid USAID and the World Food Program (WFP). The main activities under those projects were reforestation and soil and water conservation in the drought prone areas of the country. In the 1980s, the WFP consolidated its support to include rehabilitation of forest, grazing and agricultural lands. On government's part, the watershed or catchment approach became it key strategy. The major elements of the soil conservation activities were a range of physical structures such as farmland and hillside terracing, cut-off drains and waterways, micro-basins, check dams, water harvesting structures like ponds and farm dams, spring development, reforestation, area closure and management and gully rehabilitation (Betru, 2003).

However, efforts made up to the early 2000 were considered inadequate as they covered only 7% of the total land area that needed treatment, and at that rate, it was estimated that treating all the remaining land could take seven decades. Evaluations of efforts made concluded that the interventions were ineffective, insufficient and unsustainable (Woldeamlak, 2003; EEA/EEPRI, 2002).

Determinants of Land Management

It is becoming increasingly clear especially in the case of Ethiopia that land management practices are a complex issue requiring further investigations as they are influenced by different factors operating at different scales. These factors include government policies, programs, and institutions at many levels. Infrastructure development, agricultural extension, conservation technical assistance programs, land tenure policies, and rural credit and savings programs affect awareness, opportunities, and constraints at the village or household level which may further influence land management (Pender, Ehui

& Place, 2006). There are also household-level factors such as households' endowments of physical assets, human capital, social capital, financial capital and natural capital that could determine households' land management practices (ibid).

Recent empirical studies on sustainable land management practices further highlight this complexity. A study conducted in Beressa watershed of Ethiopian Highlands by Aklilu Amsalu (2006) identified factors that could influence adoption of different sustainable conservation techniques. This study was done using quantitative and qualitative research methodology and identified farmers' age, farm size, perceptions on technology profitability, slope, livestock size and soil fertility to have an influence in the adoption of stone terraces. It further indicated the decision to continue using the practice was influenced by actual technology profitability, slope, soil fertility, family size, farm size and participation in off-farm work. Factors such as perception of erosion problem, land tenure security and extension contacts were identified to have no significant influence.

Another study by Habtamu (2006) focused on the adoption of physical soil and water conservation structures in Anna watershed of Hadiya Zone. He also used qualitative and quantitative methodology to identify factors that affect adoption of the introduced soil and water conservation measures to cultivated fields. This study identified perceptions about soil erosion problem, farmers' attitude to try new technology, participation on conservation training, plan of a farmer to continue in farming career in the following five years and farmers' perception about effectiveness of the technology in arresting soil erosion to have significant positive influence on farmers' decision to retain conservation structures. Farmers' contact with development agents, educational attainment of the household head and land tenure security were identified to have weak and positive influence on the farmers' decision to retain the introduced structures. Age of the household head and land holding size were identified to have significant negative influence, whereas variables such as livestock holding, off-farm employment and distance from farm plots were identified to have weak negative influence.

This study complements these and other studies devoted to addressing issues related to sustainable land management practices in Ethiopia. It focuses on a district that has not been previously studied, the Tole District in Oromia Regional State, Ethiopia.

DESCRIPTION OF THE STUDY AREA

The study is conducted in Tole district, which is one of the fourteen districts located in South West Shewa Zone of Oromia Regional State (Figure 1). The administrative center of Tole district, Bantu town, is located at a distance of 80 kilometers from the Zonal capital, Woliso town, and 86 kilometers south west of Addis Ababa the capital city of Ethiopia (OBoFED, 2007).

The study district is located between $8^0$28' and $8^0$47'N latitudes and $38^0$17' and $38^0$29'E longitudes. It is bounded by Ilu and Sebeta Hawas districts in the north, Becho district in the west, Saden Sodo district in the south west, Kersa Malima district in the east and Sodo Dachi district in the south and south east (ibid).

The largest part of Tole district is part of the central Oromia highlands. Its relief is mainly characterized by plateau land with lower slopes. Tole's altitude ranges from 2,150 to 3,100 meters above sea level (m.a.s.l.). The lowest elevation is found in the northern part of the district, while the highest elevation is in the southern part (OBoFED, 2007).

Based on its agro ecology, the district is divided into two: the mid-highland (*bada daree)*, which lies below 2,500 m.a.s.l., and highland (*bada)* which is above 2,500 m.a.s.l. Eighty percent of the district's area is covered by mid-highland agro-ecology, while the remaining 20% is under highland (ibid). The mean annual temperature in mid-highland ranges from 18 to 20^0c, while that of highland agro-ecology areas ranges from 13 to 18^0c.

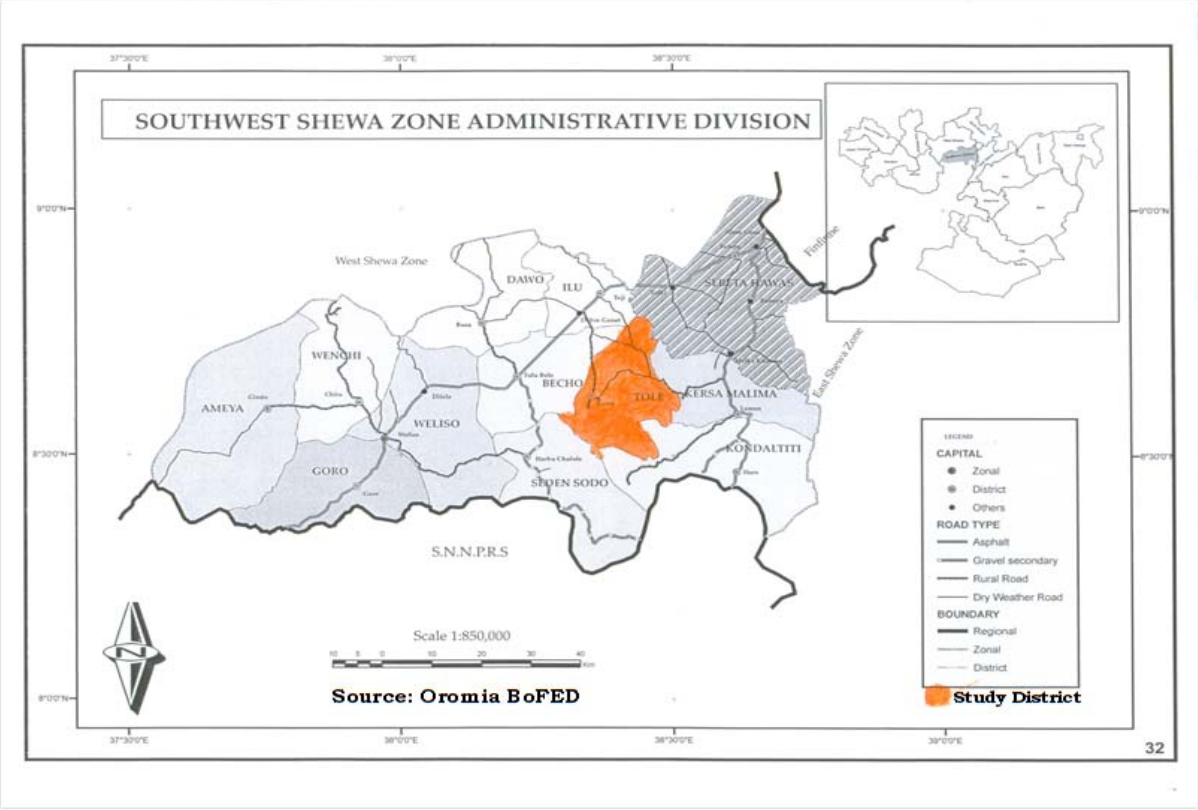

Figure 1: Map of South West Shewa Zone of Oromia Regional State

Source: (OBoFED, 2007).

The area has a bi-modal rainfall, where the short rainy season (*arfasa)*, is from March to May while the long rainy season (*ganna)*, is from June to September. The annual precipitation varies from 900 to 1300 millimeters. Given the physical profile of Tole district, the district is mainly characterized by the tertiary of volcanic Magdala group which consists of trachytes, rhyolitic, ignimbrites, agglomerates and basalt rocks that make it conducive for farming activities (OBoFED, 2007).

The natural vegetation cover in the district, like other parts of the region as well as the country, is highly disturbed through human intervention. Consequently, only 4.9% of the land is occupied by forest (ibid).

METHODOLOGY

In this study, a multi-stage sampling approach is employed. Initially, all the 24 rural villages (*kebeles)* in Tole District are classified according to the two agro-ecological regions of the study area - temperate highland agro-ecology (*beda)* and sub-tropical mid-highland agro-ecology (*beda-dare*). In the next stage, one *kebele* is selected from the highland agro-ecology while three are from mid-highland agro-ecology using the principle of proportional representation of the *kebeles*. Subsequently, one '*got' (*smallest administrative sub-division under kebele) is randomly selected from each of the selected villages. A total of 120 household heads - 30 from the highland and the remaining 90 from mid-highland agro-ecologies - are selected using systematic random sampling technique. In selecting the 90 household heads from villages in mid-highland agro ecology, the principle of proportional representation is applied. Lists of household heads from District Inland Revenue Office are used as thee sampling frame in order to randomly select the 120 sample households.

Tools used for primary data collection include questionnaires, key informant interviews, focus group discussions and personal observations while secondary data were obtained from records of the District Administration Office, and publications from the Central Statistical Authority (CSA), Oromia Bureau of Finance and Economic Development (OBoFED), South West Shewa Zone Finance and Economic Development Office (FEDO).

Regarding the household survey, structured questionnaires, with both open and closed ended questions were designed. These solicited information on background socio-economic characteristics of the respondents, the nature of land degradation, land management practices employed by farmers, determinants of land management practices and other related issues. The questionnaires were pre-tested to check their validity and adjustments made where necessary. Since farmers in the study area speak *Afan Oromo*, the questionnaires that were initially prepared in English were translated to *Afan Oromo*. Four enumerators, all diploma holders, were recruited from the study area and a one day induction course was given to them.

Four focus groups with six to eight persons from different backgrounds were established. Check-lists were prepared and these focused on the problems of land degradation, land management practices by farmers, determinants of land management practices and other related issues. These facilitated in obtaining detailed qualitative information and also triangulating data from household survey.

Key-informants were drawn from all development agents (DAs) working in the sample *kebeles*, District Administrator's Office, District Agricultural and Rural Development Office (ARDO), District Natural Resources Management and Oromia Agriculture and Rural Development Bureau.

Personal observations, together with photographs, were also employed in order to fully understand the realities on the ground, particularly the nature of land degradation and land management practices.

In analyzing quantitative data, both descriptive and inferential statistical methods were applied. For that, Statistical Package for Social Sciences, SPSS version 15.0 for windows was used. Descriptive statistics were used in analyzing demographic and

socio-economic characteristics of households, the nature of land degradation and the land management practices employed by farmers. For analyzing determinants of farmers' land management practices, binary logistic regression was applied. The qualitative data obtained in the focus group discussions and from key informant interviews were analyzed thematically.

RESULTS AND DISCUSSIONS

To recap, general objective of this research was to identify factors that determine farmers' decision to use certain land management practices in the study area. This section discusses the results relating to the socio-economic characteristics of the respondents, the nature of land degradation, land management practices employed by farmers and their determinants.

BACKGROUND CHARACTERISTICS OF THE RESPONDENTS

Demographic characteristics

The survey results indicate that out of the 120 sample household respondents, the majority (91.7%) are male and the remaining (8.3%) female. With regard to age structure of the respondent household heads, 15.8% are above 55 years old, 77.5% between the ages of 25 and 55 years, while only 6.7% are below 25 years old. The mean age of the respondents is 41, with minimum and maximum ages of 19 and 78 years, respectively.

The family size of the respondent households ranges from 1 to 13 members. The majority (71.7%) have family sizes of five and above. The mean family size is about 6 indicating that the survey respondents have relatively large household sizes.

Regarding the sex of family members, survey results indicate a total of 742 members, of which 53.5% are male, while the remaining 46.5% are female. As for the age structure of the total sample members, 48.5% are below the age of 15; 49.6% in the age group 15-64; while 2% are in the above 64 years age group. Worth noting here is that the below 15years age group percentage figure of 48.5% is higher than the regional and national averages of 47.6% and 44.9%, respectively (Central Statistical Authority, 2008). This may indicate higher future pressure on resources in this district.

The educational status of a society, particularly literacy level, is among the key factors determining development and growth (Todaro and Smith, 2009). Survey results indicate that the education level of the respondents is low: 49.2% are illiterate; 18.3% can read and write without attending any formal schooling; 21.7% got up to grade 4; while the remaining 10.9% attained above 4^{th} grade. This may indicate some incapacitation in their ability to adopt new ideas and technologies.

Economic characteristics

Regarding economic activities, survey results show that agriculture is the mainstay of the study area and that all the sample respondents have access to land. The average land holding size for the respondents is 2.8 hectares of which on average, 2.2 is for crop farming and 0.6 for grazing. Focus group discussions revealed that respondents do not have sufficient land to feed their families. The need for additional land varies from 0.50 hectare to 3 hectares based on the family size and current land holding size of the needy households.

As for the trend in land holding size over the years, the majority of the respondents (65.80%) indicated that there was no change in their land holding; 19.20% reported a decline while 15% reported an increase. The major reason cited for the declining trend is sharing of land with new household formations. Some respondents also reported that their land holding sizes had declined because their land was taken by government for infrastructure development. Those who indicated that their land holding sizes had increased cited inheritance from parents and redistribution of communal land by *kebele* administration as the major sources of the land.

On the tenure status of their lands, all survey respondents indicated that the owner of land is government and farmers have *usufruct* rights and also that they can bequeath to their offsprings. Survey respondents cited various reasons for supporting the current land tenure: easy access to land through share cropping and renting; increased tenure security than before due to land certification and declining trend in land redistribution.

Survey respondents, focus group discussants and key informants were asked whether privatization of land is more helpful for better utilization of land by improving land management practices and enhancing investment on land. All the three groups were unanimous in emphasizing the problem associated with privatization, and how it can harm the community rather than benefit it. It was highlighted that privatization of land would make the farmers landless since households may be forced to sell their land in time of crisis and end up landless. This would eventually lead to concentration of land in the hands of few individuals who have the capacity to buy land: an aspect likened to bringing back the land lord and tenant relation system of the past.

Another aspect highlighted on the current land tenure system which puts land under public custodianship is that it is supposed to provide checks and balances on land management practices. This is supposed to done through government regulations that require proper land management practices for continued use of land, otherwise legal action will be instituted against those who perpetrate bad practices. However, key informants revealed that there are no clear guidelines on enforcement procedures in the existing rules and regulations. Hence, so far, no action has been taken on those that have misused their land. Personal observations also showed that land degradation is prevalent in the area as no one seems to enforce proper land management practices.

On long term investment on the land, only 11.7% reported practicing long-term investment on their plots. The type of investment includes mainly the planting of trees - eucalyptus and to some extent junipers - around homesteads. It was highlighted that trees are used for construction purposes, and to generate income from sale of poles with residues used to supplement energy needs.

Crop and livestock farming

Survey results indicate that the survey respondents grow a variety of crops which include *teff*, wheat, chickpea, barley, bean and pea. *Teff* and wheat which are the major staple crops are grown by the majority of the respondents. Chickpea and barley production are also practiced by a large proportion of respondents throughout the district. However, the proportion of farmers

that are growing bean and pea is less, and such crops are commonly grown in highland agro-ecology of the district. Furthermore, key informants and focus group discussions indicated that farmers in highland agro-ecology also produce *enset*. In this highland agro-ecology, *teff* production is less, but dominant in mid-highland agro-ecology.

Respondents of the survey were asked about the trend in crop yields during the past five years. About 91.75% indicated an increasing trend in crop yields per hectare; 7.5% indicated a decline while one person indicated that there was no change. They were also asked the factors that resulted in the change of trend in crop yield. The reasons cited included better application of chemical fertilizer, better farming practice, application of improved seed, compost application and better weather conditions. On the other hand, the reasons mentioned by respondents that reported a declining trend in crop yield were the increasing cost of chemical fertilizer and frequent cultivation of land. These trends were also highlighted during focus group discussions.

The majority of survey respondents (97.5%) keep livestock and these include cattle, ruminants/shoats such as goats and sheep, and equines – donkeys, horses and mules. Tropical livestock units (TLU) are used in this study and the conversion factors used are: calf 0.25, weaned calf 0.34, heifer 0.75, cow and ox 1.00, horse and mule 1.10, donkey 0.70, sheep and goat 0.13 (Storck et al., 1991 in Misganaw, 2008). Survey results indicate that 18 (15%) of the respondents have 0.01 to 2.00 TLU 33; (27.5%) have 2.01 to 4.00 TLU; 66 (55%) have more than 4 and 3 (2.5%) have no livestock at all. The average TLU is 5.29. According to focus group discussants, the communities perceive having large number of livestock as disadvantageous because of the shortage of livestock feed.

Key informants revealed that previously, the major livestock feed in the study area was grazing, but now that has changed and crop residues have become the most important source of livestock feed. They highlighted that increasing human population has resulted in the encroachment of grazing areas by crop farming. Key informants however lamented the use of crop residue for livestock feed: they noted that it aggravates soil nutrient depletion as it diverts crop residue that would have been used for soil fertility management. Complete removal of crop residue can cause a large drain on the nutrient stock, decline in soil fertility.

All the 117 survey respondents who own livestock reported selling some for various purposes: 79 (67.5%) use proceeds to buy agricultural inputs such as fertilizers and seeds; 67 (57.3%) pay taxes and other social obligations; 13 (11.1%) buy oxen; and 9 (7.7%) for other uses which include covering expenses of wedding ceremonies of their children, to buy clothes for family members and to pay for land rent.

Regarding access to extension services, about 65% of the respondents reported having access to such facilities. These services include technical advice on the utilization of chemical fertilizer, improved seed and pesticides; and better farming methods. Focus group discussions revealed that extension workers focused mostly on the promotion of inorganic chemical fertilizer and improved seed utilization. Key informants further revealed that there are efforts to supply improved variety of heifers and poultry and also provide technical assistance on animal fattening and poultry.

Farmers' training was identified as a challenge. Survey results indicate that only a few farmers have attended farmers training courses and these are mostly of short duration hence impinging on their effectiveness. Only 28 survey respondents have ever participated in farmers' trainings: 23 were trained for 1 to 4 days; while 5 were trained for relatively longer periods. The trainings focused on issues like construction of physical soil and water conservation structures (check dam and terrace construction), seedling raising and planting of trees, application and use of chemical fertilizers and preparation of compost manure. While the courses offered are of good nature, their minimal implementations seem to impinge on farmers' ability to apply sound land management practices.

Characteristics of farmland and nature of land degradation

Characteristics of farmland are among the key factors that affect land use type and nature of land degradation in a given area. In view of this, farmland characteristics of the sample household heads are considered, mainly in terms of slope. Survey results show that 51 (42.9%) of the respondents cultivate flat land; 12 (10.1%) gently sloping; 43 (36.13%) moderately sloping and the remaining 13 (10.9%) steep sloping.

Key informants and focus group discussions revealed that more than half of the farmers are cultivating erosion prone areas. It was revealed that there are some sloppy areas that shouldn't be under cultivation due to their nature, but are now coming under cultivation due to population pressure. This is a major challenge that seems to exacerbate land degradation.

The level of land degradation in the study area is high. Rills and gullies are commonly observed on farm and grazing lands. Focus group discussions further highlighted that they are aware of the problems of land degradation in their respective *kebeles*. They noted that some parts of land have gone out of use due mainly to soil erosion. They cited the improper use of natural water ways used to drain excess water from farm plots as they are considered communal property: the water ways are turning into big gullies, and yet, households are not taking initiatives to protect and rehabilitate these gullies (Figures 2; 3).

Figure 2: Gully in Kursity and Arada Leka *Kebele*

Figure 3: Degraded Area in Tume Yeya *Kebele*

Asked what measures can be instituted to alleviate the problem of land degradation most of the key informants and focus group discussants suggested stronger commitment by concerned government bodies to deal with the issue. Such efforts should include budgetary provisions for land degradation awareness campaigns, construction of physical conservation structures such as construction of check-dams, terraces and ditches, cut-off drains and contour ridges, aspects that are currently undertaken as 'token' measures.

Farmers' land use and management practices

The respondents were asked the major factors that influenced them in deciding specific use of each piece of land in order to achieve sustainable land management practices. One hundred and nine (90.8%) cited soil fertility levels as the primary determinant factor in deciding land use type; 25 (20.8%) cited livestock holding size; 22 (18.3%) economic status; and 11 (9.2%) labor availability.

Regarding land management practices with relatively long term effects that they practice, survey results show that the application of organic manure seems to be the dominant practice with 67.5% of the respondents citing it. Ditch excavations (62.5%); terracing (61.7%); cutting of drains (38.3%) and check dam construction (18.3%) are some of the major land management practices used (Table 1).

Table 1: Land management practices with relatively long-term effects

Land Management Practices	Frequency	Percentage
Manure application	81	67.5%
Terrace application	74	61.7%
Check dam construction	22	18.3%
Cut off drain	46	38.3%
Leaving crop residues on farm land	5	4.2%
Ditch	75	62.5%
Planting trees	12	10.0%

Worth noting is the fact that only 5 (4.2%) of the respondents' leave crop residues on farm land in-order to maintain or improve productivity of land and that 12 (10%) of the respondents reported planting trees. This indicates little practicing of these measures in the study area. Focus group discussions further reiterated that the low level of crop residue application is not due to lack of knowledge of its importance, but that it is now a primary source of livestock feed with the increasing scarcity of grazing land. It was further revealed that manure is now gradually becoming more used as a source of fuel than for use in fields due to shortage of firewood.

Determinants of Farmers' Land Management Practices

In this study, inferential statistical analysis are applied on such factors as educational level, age, livestock holding, access to extension services, land holding size, number of economically active members of the household, training, access to credit facilities and farmers perception on existing land degradation problems as these are assumed to be potential determinants of land management practices.

An attempt is therefore made to find out the relationship between these factors and two land management practices - manure application for fertility management practices and terracing for erosion protection measures. The two land management practices are taken as dependent variables, whereas the listed factors mentioned are the independent variables.

Binary logistic regression model is applied to analyze the relationship between independent and dependent variables (Appendix 1). The dependent variables predict the presence or absence of characteristics or outcomes based on the value of a set of predictors or independent variables

Before proceeding to the analysis, model fitness is considered both for terracing and manure application. The Hosmer and Lemshow Statistical Test indicates that the model adequately fits the data in both cases (terracing and manure application) as the significance value in both cases is greater than 0.05. It is 0.108 in case of terracing and 0.743 in case of manure application.

Educational status of farmers

The first variable that is considered as independent variable is educational status of the respondents. It is expected to have significant positive influence on different land management practices due to its impact in raising the level of farmers' awareness and improving their planning horizon.

Consistent with this expectation, binary logistic regression showed educational status of farmers to have a predictive power in explaining application of terracing. Using the odds of terracing among illiterate farmers as a reference, farmers with better educational status have much higher chances of applying terracing. It indicates that a one unit increase in the educational level of farmers leads to an increase in the odds of terracing by a factor of 2.228. This result is statistically highly significant ($p<0.001$) (Table 2). The finding of positive association between farmers' educational status and terracing is consistent with initial assumption and it is also similar to findings by Habtamu (2006) which identified educational status of farmers to have positive influence on farmers' decision to retain introduced soil and water conservation structures.

Table 2: Binary logistic regression for terracing

Assumed Independent Variables	Wald	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
				Lower	Upper
Educational status	13.122*	.000	2.228	1.444	3.438
Age category	2.562	.109	1.300	.943	1.792
Sex	4.055**	.044	.235	.058	.962
Access to extension services	5.277**	.022	2.475	1.142	5.363
TLU holding category***	.042	.838	1.024	.816	1.285
Farm size	.092	.761	1.056	.741	1.506
Number of economically active household members	.261	.609	1.065	.837	1.355
Farmers' Training	5.950**	.015	3.698	1.293	10.577
Access to credit services	8.193*	.004	.328	.153	.704
Perception of degradation problem on own farm land	1.305	.253	1.623	.707	3.728

*, ** significant at 1 % and 5% levels, respectively.

***Conversion factor used for TLU was: Calf 0.25, Weaned calf 0.34, Heifer 0.75, Cow and Ox 1.00, Horse and Mule 1.10, Donkey 0.70, Sheep and goat 0.13 (Storck et al., 1991 in Misganaw, 2008).

For manure application, similarly the binary logistic regression showed educational status of farmers to have predictive power, though the relationship is less strong.

A one unit increase in the farmers level of education leads to an increase in the odds of manure application by a factor of 1.527 and the result is statistically significant ($p<0.05$) (Table 3). This less strength in the relation of farmers' educational status with manure application could lead to the conclusion that farmers with better educational status focus more on new land management practices than the indigenous ones.

Table 3: Binary logistic regression for manure application

Assumed Independent Variables	Wald	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
				Lower	Upper
Educational status	4.813**	.028	1.527	1.046	2.228
Age category	3.968**	.046	1.419	1.006	2.002
Sex	.750	.386	2.027	.410	10.033
Access to extension services	4.673**	.031	2.396	1.085	5.290
TLU holding category	10.696*	.001	1.616	1.212	2.154
Farm size	1.350	.245	.801	.551	1.164
Number of economically active household members	.230	.631	1.063	.827	1.367
Farmers' Training	6.724*	.010	5.357	1.507	19.050
Access to credit services	.092	.761	.888	.412	1.913
Perception of degradation problem on own farm land	1.305	.253	1.667	.694	4.004

*, ** significant at 1 % and 5% levels, respectively.

Age category of farmers

Binary logistic regression model showed that there is no significant relationship between age of farmers and terracing, but the relationship is positive since the value of Exp (B) is greater than 1 (Table 2). This is inconsistent with previous study conducted by Aklilu (2006) which showed the age of farmers to have positive and significant influence on adoption of the introduced stone terraces.

However, it is observed that binary logistic regression model indicates age of farmers to have predictive power in manure application. A one unit increase in the age of farmers is found to have increased odds of manure application by a factor of 1.419 and the result is statistically significant ($p<0.05$) (Table 3). The positive and significant relationship could be explained by the fact that older farmers have better experiences in indigenous land management practices.

Sex of farmers

Most of the land management practices require more labor force. Hence, male headed households are expected to better undertake different land management practices, as better endowed with labor. Women are often faced with more labor constraints than male farmers and male-headed households. Women are also sometimes inhibited from making decisions about land management practices while their husbands are away (Benin, 2006). In addition, women are commonly busy in household activities and their prime responsibility is usually child rearing. In this research too, negative and significant

relationships between sex of household heads and terracing is observed and the result is statistically significant ($p<0.05$). For the analysis, male sex is given a code of 1 and for female sex code 2 is given. Taking male headed households as a reference group; the odds of applying terracing among female headed households was only .235 times that of the male headed households (Table 2). The finding is in conformity with the assumption that men are more likely to practice terracing than women.

With regard to the relationship between sex of household head and manure application, no significant relationship is observed.

Access to extension services

Access to extension services is assumed to improve farmers' attitude towards land management practices. This is because farmers with access to extension services are expected to have better access to information which could play a significant role in improving land management practices. As per expectation, the analysis indicated farmers' access to extension services to have predictive power in terracing. Using the odds of terracing among farmers' with no access to extension services as a reference, farmers with access to extension services have much higher chance of applying terracing. Farmers with access to extension services are found to have increased odds of applying terracing by a factor of 2.475 higher when compared to farmers with no access to extension services and the result is statistically significant ($p<0.05$) (Table 2). This is consistent with initial assumptions and the findings of previous research which found participation in extension to contribute positively to farmers' behavior to build terraces (EEA/EEPRI, 2002; Benin, 2002).

The analysis further shows farmers' access to extension services to have predictive power in manure application. Using the odds of manure application among farmers' with no access to extension services as a reference group, farmers' with access to extension services have much higher chance of applying manure. Farmers with access to extension services are found to have increased odds of manure application by a factor of 2.396 higher when compared to farmers with no access to extension services. The result is statistically significant ($P<.05$) (Table 3).

Livestock holding

Farmers' livestock holding size could be considered as one indicator for better availability of resources or resource endowments. On the other hand better availability of resources is assumed to have positive impact in farmers' land management practices. Hence, greater livestock holding is expected to have positive influence in farmers' behavior to improve their land management practices.

Between livestock holding and terracing, no significant relationship is observed. This is inconsistent with a previous study which indicated farmers' livestock holding size to have significant negative influence on the adoption of stone terraces (Aklilu, 2006). In case of manure application, the analysis indicates larger livestock holding of farmers to have predictive power. Using the odds of manure application among farmers with no livestock holding as a reference, farmers with livestock holding have a higher chance of applying manure. A one unit increase in livestock holding is found to lead to an increased

odds of manure application by a factor of 1.616 and the result is statistically significant ($p<0.01$) (Table 3). This could be explained by the fact that farmers with more livestock have better availability of manure which could be more than what they need for cooking fuel.

Farm size

Farmers with larger farm sizes are expected to practice better land management practices. This is because when farmers have larger farm sizes, they can plan different management practices due to the large land holding size. In this study, there is no significant relationship observed between farm size and both terracing and manure application.

This is not consistent with initial assumptions and findings of previous studies. Earlier studies conducted by EEA/EEPRI (2002) indicate that farmers with larger farm size were less likely to be engaged in long-term land management practices. Insecurity feeling of farmers with greater holding was presented to be justification for the negative effect of large farm size. But for this study, insecurity was not an issue since the sample households reported that they did not have security problems on their holding. Another previous study indicates farm size to have positive and significant influence on adoption of introduced stone terraces, but the same study identified farm size to have significant negative influence on continued use of introduced stone terraces (Aklilu, 2006).

Number of economically active household members

Households with larger number of economically active labor are supposed to be better in undertaking different land management practices, since they are less likely to have shortage of labor which is required to do land management activities. Contrary to this assumption, logistic regression analysis indicates that there is no significant relationship between number of economically active household members and application of both terracing and manure application.

This unexpected finding could be explained by the fact that larger numbers of economically active household members are found in households with relatively larger household sizes, where there are also larger number of dependent household members. Hence, they are likely to be busier in accomplishing short-term objectives of feeding the large household members than being engaged in long-term land management practices.

Farmers' training

Farmers' training is among important institutional supports that are likely to significantly improve farmers' land management practices. In line with this assumption, farmers' training is observed to have predictive power in terracing. By taking odds of terracing among farmers with no training as a reference, farmers with training have higher chance of applying terracing. Farmers with training are found to have increased odds of terracing by a factor of 3.698 higher when compared to farmers with no training and the result is statistically significant ($p<0.05$) (Table 2).

Farmers' training is also observed to have predictive power in manure application. Based on odds of manure application among farmers with no training as a reference, farmers with training have much higher chance of applying manure. Farmers'

training is found to have increased odds of manure application by a factor of 5.357 higher when compared to farmers with no training and the result is statistically significant (p=0.01) (Table 3).

Access to credit services

Resource availability is generally expected to positively influence farmers' land management practices. Hence, access to credit is expected to have positive relationship with farmers' land management practices.

However, the analysis indicates that farmers' access to credit services is negatively associated with application of terracing. Farmers with access to credit services are found to be statistically different from farmers with no access to credit in their practice of terracing and the relationship is highly statistically significant ($p<0.01$). Accordingly, the odds of applying terracing by farmers with access to credit were only .328 times that of farmers with no access to credit services. With regard to the relationship between farmers' access to credit services and manure application, no significant relationship is observed.

The observed relationship could be due to the fact that those farmers that are commonly taking credit are the poor ones, with less land holding and other resources. For this group of people the priority is in feeding their families than planning for long-term benefits.

Perception of degradation problem on own farmland

There is a general understanding that the better the farmers perceive problems of land degradation, the better they can act to achieve sustainable land management practices. Nonetheless, no significant relationship is observed between farmers' perception of degradation problem on their own farmland and their practices of both terracing and manure application.

This insignificant relationship might be due to the fact that though they are aware of the degradation problem on their land, yet they might not feel the real impact of the problem, that is, a decline in yield. For more comprehensive understanding, there might be a need to conduct further research. The insignificant relationship is consistent with a previous study that indicated perceptions of erosion problem to have no significant influence on the decision of farmers to continue using introduced terraces (Aklilu, 2006).

CONCLUSION

The general objective of this research is to identify factors that determine farmers' decision to use certain land management practices in this case - terracing and manure application in Tore District, Oromia Regional State. The findings of the research seem to show that the district is experiencing increasing land degradation. Binary regression model results point to the fact that educational status of farmers, farmers' access to extension services and farmers' training have significant positive impact both on terracing and manure application. Age of farmers and livestock holding are also identified to have significant positive influence on manure application, but not on terracing. Access to credit is identified to have significant negative influence on terracing and male headed households are more likely to practice terracing. Other remaining factors such as farmers'

perception on land degradation problem on their own farmland, farm size and number of economically active household members are found not to have significant influence.

It can therefore be concluded that in making interventions in land management practices, there should be active participation of local stakeholders, primarily the farmers. This helps to integrate indigenous land management practices with the new techniques and enhance easy adoption and sustainable use of effective introduced practices.

However, in designing sustainable land management programs, local specific factors need to be given due attention. Thus, a comprehensive study at macro or national level on determinants of farmers' land management practices can have a significant role in getting better understanding on the issue. Such macro-level studies can also serve as a guide to local level studies on determinants of farmers' land management practices. Hence, concerned actors should give due attention to the importance of conducting research specific to determinants of land management practices at national level.

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APPENDIX 1: DEFINITIONS OF VARIABLES IN BINARY LOGISTIC REGRESSION

Variables	Definition
Dependent Variables	
Terracing	Application of terracing by the farmers; 0 if the farmers don't apply terracing and 1 if apply.
Manure	Application of manure by the farmers; 0 if the farmers don't apply manure and 1 if apply.
Explanatory/Independent Variables	
Education	Educational Status of HH heads; 1 if illiterate, 2 if literate, 3 if grade 1to 4, 4 if grade 5-8, 5 if grade 9 to 10 and 6 if above grade 10.
Age	Age of HH heads measured in years
Sex	Sex of HH heads; 1 if male and 2 if female.
Access to Extension	Dummy, 0 if household doesn't have access to extension services and 1 if the household has access.
Livestock Holding	Number of livestock in TLU
Farm Size	Farm size in hectare
Economically Active Labor	Number of Economically Active HH Members in the HH
Farmers' Training	Dummy, 0 if the HH didn't take part in training; 1 otherwise
Access to Credit	Dummy, 0 if the HH doesn't have access to credit; 1 otherwise
Perception	Dummy, 0 if the HH head didn't perceive erosion problem on own farm; 1 otherwise