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Journal of Agricultural Extension and Rural Development

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Full Length Research Paper

Analysis of farmers' perception on the impact of land degradation hazard on agricultural land productivity in Jeldu district in West Shewa Zone, Oromia, Ethiopia

Tesfaye Samuel Saguye

Department of Disaster Risk Management and Sustainable Development, Institute of Cooperatives and Development Studies, Ambo University, Ambo, Ethiopia.

Land degradation is increasing in severity and extent in many parts of the world. Success in arresting land degradation entails an improved understanding of its causes, process, indicators and impacts. Various scientific methodologies have been employed to assess land degradation globally. However, the use of local community knowledge in elucidating the causes, process, indicators and effects of land degradation has seen little application by scientists and policy makers. Land degradation may be a physical process, but its underlying causes are firmly rooted in the socio-economic, political and cultural environment in which land users operate. Analyzing the root causes and effects of land degradation from local community knowledge, perception and adapting strategies perspective will provide information that is essential for designing and promoting sustainable land management practices. The main objective of this study was to analyze the perceptions of farmers' on the impact of land degradation hazard on agricultural land productivity decline, associated with soil erosion and fertility loss. The study used a multistage sampling procedure to select sample respondent households. The sample size of the study was 120 household heads and 226 farm plots managed by these farmers. The primary data of the study were collected by using semi-structured Interview, focus group discussions and field observation. Both descriptive statistics and econometric techniques were used for data analysis. Descriptive results show that 57% of the respondents perceived the severity and its consequence on agricultural land productivity. The following indicators of soil erosion and fertility loss were generally perceived and observed by farmers' in the study area: gullies formations, soil accumulation around clumps of vegetation, soil deposits on gentle slopes, exposed roots, muddy water, sedimentation in streams and rivers, change in vegetation species, increased runoff, and reduced rooting depth. The direct human activities which were perceived to be causing land degradation in the study area include: deforestation and clearing of vegetation, overgrazing, steep slope cultivation and continuous cropping. The farmers' possibility of perceiving the impact of land degradation hazard on agricultural land productivity was primarily determined by institutional, psychological, demographic and by bio-physical factors. Farmers who perceive their land as deteriorating and producing less than desired, tend to adopt improved land management practices. On the other hand, farmers who perceive their land to be fertile tend to have low adoption of conservation practices. In order to overcome this land degradation and its consequent effects, the study recommended a need for the government to enforce effective policies to control and prevent land degradation and these policies should be community inclusive /participatory founded up on indigenous and age-honored knowledge and tradition of farmers' natural resource management as well as introduced scientific practices.

Key words: Farmers' perception, land degradation, impact of land degradation, agricultural land productivity.

INTRODUCTION

Ethiopia is one of the Sub-Saharan Africa countries most severely affected by land degradation problem. Among the SSA countries, Ethiopia has a high level of soil erosion (FAO, 2011; World Bank, 2012; Tesfa and Mekuriaw, 2014; Aklilu, 2006). Agriculture is the economic mainstay of the overwhelming majority of Ethiopian people and will continue to remain so in the near future.

However, the on-going land degradation has threatened undermining the sustenance of their livelihood. Land degradation is a major cause of the country's low and declining agricultural productivity, persistent food insecurity, and abject rural poverty (FAO, 2006; Million and Belay, 2007). The minimum estimated annual costs of land degradation in Ethiopia range from 2 to 3% of agricultural GDP (FAO, 2010). This is a significant loss for countries where agriculture accounts for nearly 45% of GDP, 90% of export revenue, and is a source of livelihood for more than 82% of the country's 100 million people (Bewket and Sterk, 2003; FAO, 2010).

In Ethiopia, land degradation, low and declining agricultural productivity, and poverty are severe and interrelated problems that appear to feed off each other (Tesfaye et al., 2014; Haregeweyn et al., 2015; Bewket and Teferi, 2009; Seid, 2009). If urgent measures are not taken to arrest Ethiopia's serious land degradation, the country is headed for a "catastrophic situation" (Pender and Gebremedhin, 2006). Programs addressing land conservation are not succeeding where they are most needed (Tesfaye et al., 2014; Haregeweyn et al., 2015). Understanding, preventing and mitigating Land Degradation (LD) at the local scale seem to require more than technical knowledge and perception by external agents such as agricultural advisors and government officials.

Land degradation is a dangerous hazard and slow process therefore need by farmers to perceive its severity and the associated yield loss before they can consider implementing soil and water conservation (SWC) practices (Tesfa and Mekuriaw, 2014). Land and water degradation and its effect on agricultural activities may be unintentional and unperceived; it may result from carelessness or from the unavoidable struggle of vulnerable populations, for the necessities of survival (Teshome et al., 2016). Understanding the local people's perceptions on environmental issues is thus a prerequisite in making successful and sustainable resource management strategies (Assefa, 2009; Alemayehu et al., 2013; Achamyeleh, 2015; Pender, and Berhanu, 2004; Wagayehu and Drake, 2003; Tesfaye et al., 2014; Haregeweyn et al., 2015; Bewket and Teferi, 2009). Any effort towards this direction should begin from research which aims at exploring location specific factors influencing the adoption of land management practices.

Statement of the problem and rationale of the study

Land degradation is an insidious, gradual process of farmers may not easily perceive its severity. The smallholder farmers' decision-making procedures are strongly based on their perceptions of the forces that drive degradation (Tesfaye et al., 2014; Haregeweyn et al., 2015; Bewket and Teferi, 2009) and its consequences on their lives and livelihoods. Perception will partly control awareness, goals and practical actions. Local perception refers to the causes and status of land degradation as farmers detect and express it as occurring on their lands. Both perception and knowledge guides decision making and consequently, farmers' action on land conservation and adoption of sustainable land management practices (Bewket and Sterk, 2003; Amsalu and de Graaff, 2007). Interpretations of environmental change are culturally constructed and need to be thoroughly examined for a sound understanding of farmer behavior.

In addition to limitations presented by availability of technology and the capacity for learning, other elements including perceptions and knowledge considerations within society fundamentally limit agricultural land management (Bekele et al., 2009; Woodfine, 2009). For farmers to decide whether or not to adopt a particular measure to cushion themselves against the potential livelihood losses, they must first perceive that land degradation has actually occurred and showed its severe effects on agricultural land productivity (Wagayehu and Drake, 2003; Tegene, 1992; Bewket and Sterk, 2002). Before a problem can be addressed, it must be perceived. Addressing soil erosion with the adoption of conservation practices is no exception.

Unfortunately, the literature on determinants of the adoption of conservation technologies has given little attention to perception variables (Tesfa and Mekuriaw, 2014). Agricultural technology adoption studies in Ethiopia started in 1970's, but few of them were considered as a role of farmer perceptions in the adoption of improved varieties (Pender and Gebremedhin, 2006; Bekele and Drake, 2003; Bewket and Sterk, 2002; Haregeweyn et al., 2015). A better understanding of farmer perceptions regarding severe

effect of land degradation and benefits of adoption sustainable implementation of sustainable land management (SLM) measures and their determinants, will be important to influence policy for future successful adaptation of the agricultural sector (Tegene, 1992; Tesfaye et al., 2014; Gebremedhin, 1998). Therefore, to enhance policy towards tackling the challenges that land degradation poses to farmers, it is important to have full understanding of farmers' perception on land degradation and its severe effects on their agricultural productivity (Tegene, 1992; Tesfaye et al., 2014).

Perception of soil erosion as a hazard to agricultural production and sustainable environment is the most important determinant of effort at adoption of conservation measures. Theoretically, those farmers who perceive soil erosion as a problem, having negative impacts on productivity and who expect positive returns from conservation are likely to decide in favor of adopting available conservation technologies (Tesfa and Mekuriaw, 2014). On the other hand, when farmers do not acknowledge soil erosion as a problem, benefits from controlling erosion will not be expected and it is very likely that they will decide against adopting any conservation technologies.

Perceptions are important in the introduction of sustainable farming techniques at farm level (Haregeweyn et al., 2015). A review of the relevant literature points to the fact that a number of empirical studies have been undertaken on technology adoption under Ethiopian context. However, in environmental conservation and management studies farmers' perceptions have often been overlooked. As a matter of fact, the farmers' perception is highly a certain socio-culture context specific in its very nature. Therefore, this study was conducted in view of bridging this gap.

The specific objectives of the study are: 1) to analyze farmers' perception on the causes, indicators and impacts of land degradation on agricultural land productivity; 2) to analyze the determinants of farmers' perception on the impact of land degradation on agricultural land productivity reduction in Jeldu district, in West Shewa zone of Oromia regional state, Ethiopia.

METHODOLOGY

Description of the study area

The study was conducted in Jeldu Woreda (District), West Shewa Zone, Central Ethiopia (9°02' 47" to 9°15' 00" N and 38°05' 00" to 38°12' 16" E which is delineated by Meta Robi, Dendi and Ejere woredas in East, Gindeberet Woreda in West, Abuna Gindeberet Woreda in North and Eliphata Woreda in South. It has an elevation range of 2500 to 3200 m above sea level (masl). Undulating slopes divided by V-shaped valleys of seasonal and/or relatively permanent streams characterize the topography of the study area.

Steep slopes are found along the valley sides, where slopes greater than 30% are very common. Rainfall pattern is bimodal with the main rainy season from June to September and the short rainy season from February to March. The mean annual rainfall of the area ranges from 1800 to 2200 mm. The maximum and minimum temperature of the area ranges from 17 to 22°C. The farming system of the area is mainly rain-fed. The soil type is characterized as clay and clay-loam type, but the riverbed has a loam and sandy-loam type of soil. A eucalyptus globule is the main tree planted in the area. Jeldu's 202,655 people are scattered across a highly variable landscape of highlands (45%), midlands (30%) and lowlands (25%) covering an area of 139,389 hectares (ha). The majorities of residents lives on ridge tops and cultivate steep valley slopes of up to 80°C, of which oxen are replaced by hoes for tilling.

Data collection techniques and tools

Data for the study were collected from both primary and secondary sources. Primary data were collected by using the following data collection techniques and tools:

Semi- structured questionnaires

The household survey was conducted using semi structured questionnaires and covered detailed information at the household, plot and village levels. The data collected included information on demographic and socio-economic characteristics, institutional services, biophysical characteristics, plot level characteristics, various land management practices used by farmers (collectively or singly), resources farmers use in the practices and farmers' perceptions and attitudes on consequences and impacts of land degradation on agricultural productivity and yield.

Ten enumerators, who had experience in data collection, know the area and the communities' languages which were recruited and trained for two days by the researcher. The questionnaire was pre-tested by administering it to selected ten respondents. On the basis of the results obtained from the pretest, necessary modifications were made on the questionnaire.

Focus group discussion (FGDs)

In this study, six focus group discussions consists eight to twelve participant farmers who were selected randomly, conducted in the study area. The FGDs were conducted in order to get some in-detail information on land degradation nature, causes and consequences, commonly practiced land management practices, community perceptions on land degradation and its effects on agricultural activities and agricultural performance in general and constraints, of adoption of SLM practices.

The major issue which was explored during the group discussion includes: the extent of the farmers' participation in the SLM practices in reference to their awareness and perception of erosion hazards, and the effectiveness of the technologies under implementation. Here the researcher was limited to facilitating the discussion using a checklist of topics to guide the sessions in an orderly way. These informal techniques helped to acquire useful and detailed information, which would have been difficult to collect through the questionnaire interview.

Field observation

Field visits involved observations of various land degradation features, such as soil erosion and sedimentation, surface runoff, sandiness of soils, crop vigor, presence of indicator-plant species; and agricultural practices, including among others, types of crops grown, cropping patterns and on-farm soil conservation measures.

Field observation was conducted throughout the whole process of the research, in order to ensure the validity of information obtained from the farmers through interview schedule. This helped to capture some points that were not clearly obtained from the interview.

Sampling design of the study

This study employed a multi-stage sampling procedure. First, Jeldu district was purposively selected because it is one of the highly degraded highland areas in the country, in terms of soil erosion and fertility loss. The district is a highland area with steep slopes, intensely cropped hillsides and high population densities. Second, representative Kebeles were purposively selected based on topographical class. The study area was classified in to four topographical zones: steep, moderately steep, moderate/gentle slope and flat.

The number of kebeles (Seriti, Kolu Galan and Chillanko) selected were proportional to the land area covered by each class, and the number of households selected in each village was proportional to the number of households in each village. Thirdly, the sample respondent households were selected using systematic random sampling techniques. The survey covered 120 farm households managing 226 plots during the 2015/2016 cropping season. With regard to the sampling technique, proportional simple random sampling technique was used to select sample respondents from each kebeles.

Methods of data analysis

The study employed a combination of both descriptive and inferential statistics to analyze data collected from the sample respondents. To run statistical analysis, data were coded and entered in to SPSS version 20. The information generated through focus group discussions was used to substantiate the augment findings from the quantitative analysis of the structured questionnaires.

Specification of empirical models

The determinants of farmer perceptions on land degradation can be analyzed using qualitative response statistical models. The simplest of these models has a binary dependent variable, so the outcome of interest can take on the values 0 or 1: 1 if erosion is perceived and 0 if it is not. The binary response models focus on the factors that determine the probability of perception. It is assumed that, they exists a perception function, Y, which governs whether erosion is perceived (Y=1) or not (Y=0). The probability that observation Yi takes on the value 1 can be represented as a function of a vector of explanatory variables, Xi, representing the physical setting, the farm household and the institutional environment. In general, the probability of perception of a given condition can be represented as:

$$P_i = Prob(Y_i = 1) = F(X_i, B) + e_i, \text{ for } i = 1, 2, ..., n$$

Where Xi is a vector of explanatory variables, B is a vector of unknown parameters (to be estimated), andeis a random error term. Assuming the model's random disturbance term, which follows the normal probability distribution (0 and 2), the probability of perception can be defined in terms of an index which is converted into a probability value through the cumulative normal distribution function. The probit model takes the form P[Y=1] = F (b'X), where P

is probability of perception and F (.) is the normal cumulative probability distribution function. The statistical relationship P(Y) = F (b'X) is estimated using maximum likelihood estimation. The marginal effect of an additional unit of some X variable can be computed using the estimated parameter coefficients.

In order to analyze how farmers perceive the productivity effect of land degradation, farmers were asked to estimate the perceived proportion of yield reduction due to land degradation (1=no reduction, 2= 20% reduction, 3=25% reduction, 4= 33% reduction, and 5=50% reduction) on each of their farmlands during a normal cropping year before any conservation measures had been taken on.

These responses were represented both as continuous and ordinal values in separate models. The continuous values are the perceived rates of yield reduction. Ordered probit was used for the ordinal variable, and ordinary linear regression (OLS) was used for the continuous variable. In order to investigate the determinants of farmer perceptions of the impact of land degradation on agricultural productivity, the two models were estimated using the same explanatory variables.

Variables identified

From previous empirical researches, literature reviews and the researcher personal experience explanatory variables of the study were identified. Accordingly, explanatory variables included: biophysical/ village level biophysical factors (rainfall, topography and level of land degradation) and field level biophysical level factors (soil type, slope, shape of slope, and location of plot) that may aggravate soil erosion; socio-economic factors (number of livestock owned), household demographic characteristics (education, age and gender.) and socio-institutional factors,(contact with the agricultural extension service affecting access to information), availability of soil and water conservation (SWC) project in the village, prior public conservation campaign works on the farmer's own land (for demonstration effects), and the current tenure status of the field.

The physical factors that aggravate soil erosion, such as higher rainfall intensity, steep slopes and erodible soils, are hypothesized to raise farmer perceptions of soil erosion by aggravating soil loss. Distance of plot from homestead is expected to reduce perception, as distant plots are less frequently observed by farmers. The period of time the plot has been operated by the current owner is expected to raise erosion perceptions for the opposite reason. Field area (size) should raise perception since the absolute amount of soil and crop yield losses may be higher from larger plots.

Farmers who have contact with extension services are expected to have higher erosion perception, since extension is expected to serve as a source of technical information to farmers. The availability of a resource conservation FFW project in the village is expected to raise erosion perception through its demonstration effect, on the need for conservation measures. The effect of public campaign conservation work, on the farmer's own plot is ambiguous; it may raise erosion perception through its demonstration effect or reduce perception through its effect on soil loss (Table 1).

RESULTS AND DISCUSSION

Socio-economic and demographic attributes of respondents

The average land holding size in the study kebeles was about 1.2 ha. There was no report of landless farmers in

Table 1. Definition and units of measurement of explanatory variables used, included in the model.

Explanatory variables of the study	Variable type	Unit of measurement
Age of the household head	Continuous	Measured in years
Gender of the household head	Dummy	1 if the household head is male otherwise 0
Education level of the household head	Continuous	Measured in years
Frequency of extension contacts per annum	Continuous	Measured in number of contact per year
Family size (adult equivalent)	Continuous	Measured in number
Participation in public SWC (days)	Continuous	Measured in number of days participated
Livestock size owned by the household (tropical livestock unit)	Continuous	Measured in number
Landholding size	Continuous	Measured in hectares
Land ownership/tenure system	Dummy	One if owned 0 otherwise
Plot distance to residence	Continuous	Measured in minutes
Position of plot in watershed, upper part	Dummy	1 if the plot found at upstream, 0 otherwise
Position of the plot in watershed, middle part	Dummy	1 if the plot found at middle part , 0 otherwise
Position of the plot in watershed, lower part	Dummy	1 if the plot found at lower part , 0 otherwise
Neighboring plots have SWC measures	Dummy	1 if neighbor plot has SWC measures, 0 otherwise
Plot received public SWC improvements	Dummy	1 if the plot received public SWC interventions, 0 otherwise
Age of plot (number of years since plot was cultivated by current owner)	Continuous	Measured in years

any of the three villages. But there was a significant variation in the size of land holdings among households in the study area. Of the sampled households, the majority (48.33%) possessed between 0.5 to 1.0 ha land. Only 9.4% had more than 2 ha and some 33.33% had less than 0.5 ha (Table 2). Out of the total sample respondents 29.2, 30.97, 22.57 and 17.26% respondents reported that the status of their farm plots, slope steep, gentle steep and hills, moderate and flat/plain, respectively.

The average family size per household in the study kebeles was reported to be 6 (table 2) persons per household. The respondents from all the three kebeles that labour, is available throughout the year but varies from season to season. Family labour is the main source of farm labour except for potato production for which farmers commonly use hired labour. Labour is highly demanded during planting and harvesting seasons in the study area. Due to shortage of agricultural land in the area, some farmers may also leave their village looking for employment in other places during the months of September to December.

Livestock are an integral part of the farming system in the district as well as in the study villages. 83% of the sampled households owned livestock while 17% did not. The main purpose of keeping livestock is for draught power. Livestock products such as milk and meat have secondary importance to the farmers. Small ruminants are mainly used as income sources as well as for household consumption. The livestock production system commonly found in the villages is an extensive system where open grazing is the main style of feeding.

The district is characterized as a mixed crop livestock production system. Land preparation is mainly done by ox-drawn plough. The area has a bi-modal rainfall pattern with two distinct rainy and cropping seasons. The main rainy season (*meher*), which is also the main cropping season, extends from June to September. The short rainy season, known as "*belg* rain", usually covers the period from February to April. The respondents indicated that the small rainy season has become less dependable for cropping during recent years. As a result, better off farmers depend on irrigation for their farming operations during this period.

The main crops grown in the study areas include wheat (*Triticum aestivum*), tef (*Eragrostis tef*), broad bean (*Vicia faba*), barley (*Hordeum vulgare*) and potato (*Solanum tuberosum*). As the survey data reveals about 72. 5% of the respondents produces potatato while 69.17,65, 55.83 and 51.83% produces wheat, barley, teff and bean respectively (Table 3). Most of the available crop land is allocated for production of wheat, which indicates that it is the most preferred crop in the area. Crop residues are used as major sources of livestock feed during the dry season. However, small amounts of crop residues are sold as an income source and are also used for house construction, particularly for plastering of walls and thatching of roofs. Some farmers also use crop residues for mulching purposes to enhance fertility of the soil. Despite the importance of fodder crops as livestock feed, farmers in the area hardly grow improved forage crops. Moreover, the extension service to support forage development in the area appears to be weak and non-functional.

Table 2. Demographic and Socio-economic attributes of the Respondents (n=120).

Characteristics		Frequency	Percentage
Sex	Male	87	72.5
	Female	33	27.5
	20-30	17	14.17
	31-41	21	17.7
Age	42-52	47	39.17
	53-63	27	22.5
	>63	8	6.46
	No formal	27	22.5
Education	Primary	52	43.3
	Secondary	33	27.5
	Certificate and above	8	6.67
	1-10	18	15
Farming experience (Years):	11-21	35	29.16
	22-32	42	35
	>32	25	20.83
	<0.5	40	33.33
Landholding size(ha)	0.5-1	58	48.33
	>1	22	18.33
	0-2	37	30.83
Livestock ownership (TLU)	3-5	56	46.67
	>5	27	22.5
	2-4	38	31.67
Family Size	5-7	60	50
	>7	22	18.33
Extension Service	Access	78	65
	No access	42	35
Credit service	Access	16	13.33
	No access	104	86.67
	Steep	66	29.2
Slope of the plots	Gentle Steep	70	30.97
	Moderate/gentle	51	22.57
	Flat/plain	39	17.26

Credit sources for purchase of livestock and crop production are not satisfactory. Although credit facilities are available from microfinance institutions such as Oromia saving and credit share company and Busa gonofa microfinance, most farmers do not use the services because of fear of risks associated with crop and livestock performance failures that could lead to failure of repayment of the loan. As survey, result shows only 13.3% of the respondents used microfinance service(Table 2). Moreover, the credit services provided by the micro-finance institutions are group based; which makes individual farmers accountable for the group

Table 3. The main crops grown in the study areas.

Crops farmers produce in the study area	Frequency	Percentage
Wheat	83	69.17
Barley	78	65
Teff	67	55.83
Bean	62	51.67
Potato	87	72.5

* Note: A multiple response frame was used. Hence, total count is more than the number of respondents.

members, who are unable to pay their loan. It was also indicated that, the service provision is limited to only once per year so that it may not be available when it is needed most.

The district is characterized as a mixed crop livestock production system. Land preparation is mainly done by ox-drawn plough. The area has a bi-modal rainfall pattern with two distinct rainy and cropping seasons. The main rainy season (*meher*), which is also the main cropping season, extends from June to September. The short rainy season, known as "*belg* rain", usually covers the period from February to April. These respondents indicated that the small rainy season has become less dependable for cropping during recent years. As a result, better off farmers depend on irrigation for their farming operations during this period. The main crops grown in the study areas include wheat (*Triticum aestivum*), tef (*Eragrostis tef*), broad bean (*Vicia faba*), barley (*Hordeum vulgare*) and potato (*Solanum tuberosum*). As survey data reveals 72.5% of the respondents it produces potatato while 69.17, 65, 55.83 and 51.83% produces wheat, barley, teff and bean, respectively.

Most of the available crop land is allocated for production of wheat, which indicates that it is the most preferred crop in the area. Crop residues are used as major sources of livestock feed during the dry season. However, small amounts of crop residues are sold as an income source which is used for house construction, particularly for plastering of walls and thatching of roofs. Some farmers also use crop residues for mulching purposes to enhance fertility of the soil. Despite the importance of fodder crops as livestock feed, farmers in the area hardly grow improved forage crops. Moreover, the extension service to support forage development in the area appears to be weak and non-functional.

Farmers' perception on land degradation hazard

Response to the inquiry on whether the study area households perceived land degradation, problem in their farm lands have shown (Table 4) that 72% of the surveyed respondents perceived land degradation as being a serious problem in their farming and grazing plots. As indicated (table 4), the major cause of land degradation mentioned by 98% farmers was lack of conservation structures.

The farmers' perceived various causes of land degradation in their farmland and surrounding landscapes. Overwhelming majority of farmers' in the study areas were aware that land degradation in various forms and levels was happening on their farm lands as well as in the surrounding landscapes. Table 4 presents the locally perceived land degradation causes that were mentioned by the respondents as being the contribution of the farming practices to the observed land/soil degradation in the study areas. About 35% of the respondents associated land degradation to low adoption and sustained implementation of soil and water conservation measures used in their farmlands while, 32.5, 30.83, 28.33, 27.5, 25.83 and 18.33% considered cultivation of marginal areas and steep slopes, overgrazing and continuous cropping, torrential rains (high intensity rainfalls), expansion of eucalyptus trees, deforestation and clearing of vegetation and soil erosion vulnerable soil type, reported to be responsible for the land degradation and soil erosion proms, respectively.

This finding clearly corroborates with Tesfa and Mekuriaw (2014) report, which elucidates those vast areas of the highlands of Ethiopia, and could be classified as suffering from severe to moderate soil degradation. Increasing intensification and continuous cultivation on sloping lands without supplementary use of soil amendments and conservation practices poses a serious threat to sustainable land use. In addition, Seid (2009) stated that the apparent increase of soil erosion over the past generation is not the result of a decline in the skills of farmers but rather the result of the pressures on farmers to produce more. Hence, farmers of the study area were aware of soil erosion which is forced to intensify and produce more food crops for their basic livelihood.

However, as the FGD participants elucidated, the major factor catalyzing soil erosion on the steep slopes was that, farmers are increasingly destroying contour bunds on terraces to pave way for more farmland. As a result,

Table 4. Farmers' perception on land degradation and soil erosion, in the study area.

Farmers' perceived causes land degradation	Frequency (n=120)	Percentages
Overgrazing and continuous cropping	37	30.83
Deforestation clearing of Vegetation	31	25.83
Cultivation of marginal and steep slope areas	39	32.5
Low adoption of conservation measures and practices	42	35
Torrential rains/high intensity of rainfall (extreme weather events)	34	28.33
Erosion vulnerable soil type	22	18.33
Expansion of Eucalyptus Trees	33	27.5

*Note: A multiple response frame was used. Hence, total count is more than the number of respondents.

soil erosion has been accelerated which in periods of heavy rainfalls results in silting and flooding of the valley-bottom fields and landslides are also becoming very common. This regular practice has reduced the attraction of placing more long-term erosion control devices such as grass lines or hedgerows of agro-forestry species. Also, FGD participants explained that land has been cultivated frequently to produce food crop for rapidly growing population. Particularly, owning small size and increasing demands for food crop production forced farmers to cease long-stayed traditional ways of soil fertility management such as fallowing, manuring, terracing, and leaving crop residues on the fields. Fallowing was nearly absent due to land shortage and manuring which was rare, as it is used as source of energy. Crop residues were used for other purposes like forage and construction and otherwise some farmers burn immediately after harvest.

Farmers' perceived indicators of land degradation

Farmers were asked to respond how they distinguish when land degradation occurs on their farmlands in open-ended questions. Some of the responses were elucidated: when there is overflow of constructed ditches and damage their crops, when there is siltation in and out of their field mostly at the lower field border, when rills appeared on their fields, when the color of soil in the upper part of the field goes to red whereas the lower part goes to black. So the result from this study reveals that there are numerous long-established traditions communities use to estimate and to elucidate the condition of the land and the soils they are cultivating.

Generally, a healthy and vigorous crop growth, reflected by a good crop stand in the field, was used as an important indicator that the soil is fertile enough, if moisture and other factors are not limiting. Under such circumstances, even if the weather conditions worsen during the growing season such that final yields are poor, the farmer would have realized the potential fertility of a

certain piece of land. A stunted crop with less vigorous growth in the field when other factors such as moisture are considered not limiting, was locally perceived to indicate a high probability that soils on which the crop is growing are of low quality and infertile. Majority of respondents (57.5%) considered crop yields as the best measure to comprehend land/soil status. Although it was noted that, declining crop productivity could be a clear indicator of declining soil fertility, and hence soil degradation and land degradation. As survey result reveals (Table 5), about 30.83, 30, 28.33, 27.5 and 24.16% of the respondents perceived stunted crop, grasses, vegetation and tree growth decline in soil fertility/ loss of top soil. Absence of grasses and vegetation cover, gullies and rills formation/development and Presence of exposed roots were the indicators of land quality perceived by farmers, respectively.

The majority of the farmers reported that, the occurrence of gully and rill erosions were the principal land degradation indicating feature (27.5%) on their farmlands (Table 5). But not all the respondents perceived sheet erosion as a problem, which has been estimated in the literature to the contribution to soil up to 30% of actual soil loss (Tesfaye et al 2014; Assefa and Hans-Rudolf, 2016). Farmers have awareness of identifying soil fertility and land quality and classify soils based on their fertility, consistence, color and moisture. 21.67% of the farmers (table 4) explained the occurrence of land degradation/soil erosion in the study area in general and their farms by the presence of accumulated soil at the bottom of conservation structures and lower positions.

When the runoff lacks the capacity to transport the uploaded soil, this tends to unload it at the middle or end of the channel as sediment. If the deposit is black in color, farmers consider it as removal of fertile soil from some elsewhere in the watershed. In addition to these, farmers mentioned slope steepness and root exposure (observation of roots of trees on the surface) as indicators of existence of soil erosion on their lands. 20% of respondents elucidate land quality status which can be

Table 5. Farmers' perceived indicators of land degradation.

Farmers' perceived causes land degradation	Frequency (n=120)	Percentages
Declining crop yield and productivity	69	57.5
Gullies and rills formation/development	33	27.5
Change in the colour of the soil	24	20
Sedimentation of soil and sandy materials	26	21.67
Decline in soil fertility/ loss of top soil	36	30
Absence of grasses and vegetation cover	34	28.33
Presence of exposed roots	29	24.16
Stunted crop, grasses, vegetation and tree growth	37	30.83

*Note: A multiple response frame was used. Hence, total count is more than the number of respondents.

recognized by color change of their plots soil from dark black to redish color when losing the top fertile soil. These results conform to those of Bewket and Sterk (2003) who reported that elucidates the existence of severe soil erosion problem by observing the stoniness of soil and color of soil, changing from dark/black to red one.

The consciousness of these indicators could confirm that, rural communities are aware of their environment and its related problems, and particularly with those which affect the farm productivity and/or those that resulted into more visible landscape changes such as soil erosion. However, some of the respondents argued that soils are naturally infertile which suggests that productivity has declined significantly within living memory and people were unaware that, their yields were probably rather low from the outset.

Farmers' perception on severity of land degradation and its consequences on land productivity

From the total respondents, their perception on the extent of land degradation problem were assessed and about 47.5% of the sampled households perceived it as severe, while 33.3% as moderate; 11.67% as minor problem. Only about 7.5% of farmers indicated that there is no land degradation problem on their plots of lands (Table 6).

The farm households were also asked their perception about the consequences of land degradation 68, 22, and 10% mentioned yield decline, reduced farm plot and both, respectively. This might lead the farmers towards the perception of underlying and proximate causes of soil fertility decline and at the end to the adoption decision on various options of fertility enhancing technologies of physical soil and water conservation practices. This perception may be influenced by differences in socio-economic characteristics inherent among the local people.

Determinants of farmer perceptions on impacts of land degradation on agricultural productivity reduction

Frequency of extension contact

As hypothesized, extension contact is found to have a significant positive influence on the perception of the severity and productivity impact on agricultural productivity. Farmers with more frequent contact with extension agents were more likely to perceive impact of land degradation on agricultural productivity decline in their plots as compared with those who had lesser extension contact frequency. This may be explained by the fact that scientific information and research result reports that farmer gain from extension agents help them to be aware and understand the severity and effects of land degradation on agricultural productivity.

Therefore, Farmers who had frequent contact with extension agents perceived productivity decline, associated with land degradation. Farmers with more frequent contact with extension agents were more likely to perceive severe land degradation in their plots as compared with those who had less extension. The number of contacts that farmers had with agricultural extension agents was found to be positively and significantly (p<0.01) which affect farmers perception of land degradation impact (Table 7).

Availablity of SLM project in the village

Implementation of SLM project in the village positively influences and aware farmers about the risk of decline in agricultural land productivity due to land degradation and soil erosion. This could justified by SLM projects effort of attempt to participate the farmers in processes and awareness creation and capacity, building through experience sharing from other successful project areas. Participation/training on agricultural land management

Table 6. Farmers' perception on the level of severity of land degradation hazards.

Land Degradation Hazard Level of Severity	Frequency of Response	Percentage
Severe	57	47.5
Moderate	40	33.3
Slight/minor	14	11.67
No land degradation problem	9	7.5

* Note: A multiple response frame was used. Hence, total count is more than the number of respondents.

SWC measures etc has a positive and significant effect on conservation perceptions. Farmers who participated in training by development agents on SWC works were more aware of soil erosion and conservation than those who did not participate.

In their finding, Assefa and Hans-Rudolf (2016) in Ethiopia reported that training of farmers and their participation in extension workshops improves their perception of soil degradation problem and facilitates the adoption of improved technologies. This is precisely because those farmers who have plots within the catchment have the possibility to meet the project staff and be well informed about the consequences of soil erosion than those who own land outside the catchment. An anticipated, farmers' perception of soil erosion problem (PERCEPTN) affects the adoption of soil conservation measures positively and significantly. The implication is that farmers who feel that their farmlands are prone to soil erosion are more likely to adopt physical soil conservation measures than those who do not perceive the problem of soil erosion.

Age of household head

The output from the model reveals that age of the household head has a negative influence on the perception of the risk of decline in agricultural land productivity, due to land degradation and soil erosion. This could be because of aged farmers tended to perceive severe yield loss or productivity decline, in contradiction to other finding that younger farmers perceived higher erosion.

Educational level of household heads

Education of the head of the household significantly and positively determined farmers' perception of the risk of decline in agricultural land productivity due to land degradation and soil erosion. Older household heads were ess likely to perceive erosion. Those younger farmers were more prone to perceive erosion which may be due to greater education, higher acess to information and a longer planning horizon, or simply the fact that older farmers might have grown accustomed to soil erosion, considering it a normal process. Farmers with higher level of formal educational attainment were most likely to perceive land degradation risk in their plots as compared with less educated farmers with other factors held constant. Farmers with more education were more likely to perceive severe land degradation in their plots as compared. With less educated farmers (coef. = 0.136, p < 0.01), with other factors held constant (Table 7).

Possible explanation is that educated farmers tend to be better access to research output reports and generally to update information about the risks associated with land degradation and soil erosion and hence, tend to spend more time and money on soil conservation. This is because literate farmers often serve as contact farmers for extension agents in disseminating information about agricultural technologies from government agencies. The odds ratio also suggests that if a farmer is educated, other factors held constant, the likelihood of awareness will be two times higher than an illiterate farmers. My findings reveals that, the level of education attained by household heads was more likely to facilitate farmers in perceiving the risk of land degradation impact on agricultural productivity in their plots, which is in agreement with the findings of previous studies (Ervin and Ervin, 1982; Asrat et al., 2004).

Slope of the plot

Farmers also perceived greater yield loss on steeper plots and on plots with slope shapes that aggravate soil loss. These factors were associated with higher erosion perception. Slope was found to have a positive significant effect (p < 0.1), implying that farmers with plots in steeply sloped areas are more likely to perceive the impact of plot gradient on severity of soil erosion. This finding is in agreement with that of Teshome et al. (2016), who found a positive relationship between slope and soil erosion severity. The shape of the plot in terms of slope was also significant.

The perception of yield impact of erosion was not influenced by soil type or location of plot. More distant plots were associated with lower yield reduction, consistent with the result that such plots were also associated with less likelihood of perceived soil loss. The

Table 7. Regression results for farmer perceptions of productivity decline impact of land degradation.

Variable	Impact of land degradation on agricultural productivity (std.err) (Ordered probit)	Impact of land degradation on agricultural producion tivity (robust std.err)'' (Ordinary linear regressLS)
Sandy soil (If plot has sandy soil,(.0,1))	0.180 (0.136)	-0.024 (.030)
Silt soil (If plot has silt soil,(.0,1))	-0.168 (0.224)	0.027 (0.26)
Loam soil (If plot has loam soil,(.0,1))	-0.175 (.122)	-0.022(.017)
Degree of slope (Degree of plot slope)	0.031 (.010)***	0.004 (.001)**
Convex slope (If shape of plot slope is convex,(.0,1))	0.363 (0.231)	0.062 (0.029)**
Concave slope (If shape of plot is Concave,(.0,1))	0.417 (0.196)**	0.057 (0.032)
Mixed slope (If shape of plot is mixed,(.0,1))	0.173 (0.186)	0.26 (0.028)
Distance from residence	-0.346 (0.133)**	-0.053 (0.019)***
Land holding size(ha)	-0.12 (.003)***	-0.001 (.002)***
Location at upper slope (If plot is located at upper slope of watershed,(.0,1))	-0.13 (.002)***	-0.001 (.001)***
Location at lower slope (If plot is located at middle slope of plot,(.0,1))	0.026 (0.276)	0.008 (0.016)
Location at lower slope (If plot is located at lower slope of watershed,(.0,1))	0.286 (0.153)	0.037 (0.017)
Hilly village If village is predominantly hilly ,(.0,1))	0.228 (0.268)	0.037 (.026)
Dung as fuel (If dung is used primarily as fuel wood in village,(0,1))	-0.418 (.151)**	0.034 (.024)
Distance to fetch fuel wood (round trip (in walking hours))	-.066 (.206)	-.009 (.013)
Age of household head (years)	-0.12 (.003)***	-0.001 (.002)***
Male head of household (0,1)	0.279(0.142)***	0.020(0.023)
Literate head of household (0,1)	0.269 (0.136)***	-0.010 (.029)
Age of plot (number of years since plot was cultivated by current owner)	-0.006 ().011	-0.011 (.002)
Owner operator (If plot is owned by current operator))	0.149 (.012)	0.021 (.022)
SLM available (If SLM project is available in village,(.0,1))	0.286 (.151)**	0.037 (.022)***
Extension contact (If household had extension contact,(.0,1))	-.344 (.111)***	-.050 (.016)***
Constant	--------	0.293 (.040)
Chi-square/F	88.44	6.52
Prob >chi-square/ F	0.0000	0.0000
Pseudo R-square/ R-square	0.0458	0.2685
N	120	120

, * Significant at 5 and 1%, respectively.

model output reveals that the upstream areas were more likely to be perceived and affected by soil erosion, whereas the downstream farmlands were less likely to be perceived in that manner. These results conform to those of Bewket and Sterk (2003) and Tefera and Sterk (2010), who

reported that the perceived severity of soil erosion was site specific, that is, relatively higher in upstream areas and lower in downstream fields.

Distance from residence

Distant plots were perceived to be more prone to soil erosion, probably because the farther the plot from the farmer's residence, the less attention it receives and the likelihood of severe soil erosion increases. This explanation is consistent with the results of Teshome et al. (2016) and Tefera and Sterk (2010), who found that more distant plots received less care as compared to nearby plots.

Moreover, Teshome et al. (2016) reported that, plots receiving less care were very likely to become eroded because of soil nutrient depletion, particularly organic matter content, and increased soil loss through water erosion.

Farmholding size

Farm holding size was also an important factor. The larger the farm holding size, the higher is the likelihood of witnessing rills, surface runoff, sediment deposition and redeposition by farmers (Bewket and Sterk, 2003). Larger parcel size may create a positive incentive for small-scale farmers to invest in SWC technologies (Tesfaye et al., 2014b; Teshome et al., 2016). This is presumably true in subsistence agriculture because farmers assume that SWC technologies compete for space on small plots, which reduces productivity in the short run, thereby increasing farmer reluctance to apply countermeasures (Tesfaye et al., 2014).

Conclusion and policy implication

Farmers in the study area were generally aware of and perceived soil erosion as a serious problem and its effect on agricultural land productivity. The possibility of perceiving its impact on agricultural land productivity from slight to severe was primarily determined by institutional and demographic factors as well as weakly by biophysical factors. The socio-institutional and demographic determinants of the effects of land degradation and soil erosion risks on agricultural productivity decline point to policy implications for public inclusive SLM practices and capacity building programs, as well as bringing back and indigenous land management practices to research and learning platforms for sustainable and desirable societal betterment.

The finding of this study is the need to increase

farmers' perception of soil erosion problem through the provision of knowledge on demonstration of gains and risk reduction characteristics of soil conservation practices. This is important because, the extent to which farmers understand and feel the need for controlling soil erosion affects adoption of soil conservation measures positively. Therefore, this is important to design soil conservation practices, which couple modern scientific knowledge with indigenous technical knowledge to facilitate their dissemination and ensure their sustainability.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCE

Achamyeleh K (2015). Integration of Acacia decurrens (J.C. Wendl.) Willd. into the farming system, its effects on soil fertility and comparative economic advantages in Northwestern Ethiopia. MSc Thesis, Bahir Dar University: Bahir Dar, Ethiopia 140.

Aklilu A (2006). *Caring for the Land Best Practices in Soil and Water Conservation in Beressa Watershed, Highlands of Ethiopia*. Trop. Resour. Manage. P.76.

Alemayehu M, Amede T, Böhme M, Peters K (2013). Collective management on communal grazing lands: its impact on vegetation attributes and soil erosion in the upper Blue Nile basin, northwestern Ethiopia. Livest.Sci. 157:271–279.

Amsalu A, de Graaff J (2007). Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecol. Econo.* 6:294-302.

Asrat P, Belay K, Hamito D (2004). Determinants of farmers' willingness to pay for soil conservation practices in the southeastern highlands of Ethiopia. Land Degradation Dev. 15:423-438.

Assefa D (2009). Assessment of Upland Erosion Processes and Farmer's Perception of Land Conservation in Debre-Mewi Watershed, Near Lake Tana, Ethiopia. A Thesis Presented to the Faculty of Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Masters of Professional Studies.104p.

Assefa E, Hans-Rudolf B (2016). Farmers' perception of land degradation and traditional knowledge in southern Ethiopia - Resilience and stability. Land Degrad. Dev. 27(6):1552-1561.

Bekele S, Okello J, Ratna VR (2009). Adoption and Adaptation of Natural Resource Management Innovations in Smallholder Agriculture: Reflections on Key Lessons and Best Practices. Environ. Dev. Sustain. 11:601-619.

Bekele W, Drake L (2003). Soil and water conservation decision

behavior of subsistence farmers in the Eastern Highlands of Ethiopia: a case study of the Hunde-Lafto area. Ecol. Econ. 46:437-451.

Bewket W, Sterk G (2002). Farmers' participation in soil and water conservation activities in the Chemoga watershed, Blue Nile basin, Ethiopia. Land Degrad. Dev. 13:189-200.

Bewket W, Sterk G (2003). Assessment of soil erosion in cultivated fields using a survey methodology for rills in the Chemoga watershed, Ethiopia. Agric. Ecosyst. Environ. 97:81-93.

Bewket W, Teferi E (2009). Assessment of soil erosion hazard and prioritization for treatment at the watershed level: case study in the Chemoga watershed, Blue Nile Basin, Ethiopia. Land Degradation Dev. 20:609–622.

Ervin CA, Ervin DE (1982). Factors Affecting the use of Soil Conservation Practices: Hypothesis, Evidences, and Policy Implications. Land Econ. 38(3):277-292.

FAO (2011). Sustainable Land Management in Practice Guidelines and Best Practices for Sub-Saharan Africa. Rome, 2011.

FAO (2006). Preparation of a Global Report on the State of Land and Water Resources, SoLAW. Land and Water Development Division, FAO, Rome, 2006. In-progress Draft Report – Version 01.

FAO (2010). Investment Centre Database of Projects. Rome, Food and Agriculture Organization of the United Nations.

Gebremedhin B (1998). The Economics of Soil Conservation Investments in the Tigray Region of Ethiopia. Unpublished PhD Dissertation, Michigan State University, Department of Agricultural Economics, East Lansing, USA.

Haregeweyn N, Tsunekawa A, Nyssen J, Poesen J, Tsubo M, Meshesha DT, Schütt B, Adgo E, Tegegne F (2015). Soil erosion and conservation in Ethiopia: a review. Prog. Phys. Geogr. 39:750–774.

Million T, Belay K (2007). Factors influencing adoption of soil conservation measures in southern Ethiopia: The Case of Gununo Area. *J. Agric. Rural Dev. Trop. Subtrop.* 105(1):49-62.

Pender J, Berhanu G (2004). Impacts of policies and technologies in dryland agriculture: evidence from northern Ethiopia. In: S.C. Rao (Ed.), *Challenges and Strategies for Dryland Agriculture*, American Society of Agronomy and Crop Science Society of America, CSSA Special Publication 32, Madison, WI.

Pender J, Gebremedhin B (2006). Land management, crop production and household income in the highlands of Tigray, northern Ethiopia. In: Pender J, Place F, Ehui S (eds.), *Strategies for Sustainable Land Management in the East African Highlands*. IFPRI, Washington, D.C. In press.

Seid H (2009). Determinants of Physical Soil and Water Conservation Practices: The Case of Bati District, Oromyia Zone, Amhara Reion, Ethiopia. M.Sc. Thesis Presented to the School of Graduates of Alemaya University, Alemaya. 162p.

Tegene B (1992). Farmers' perceptions of erosion hazards and attitudes towards soil conservation in Gunono, Wolayita, southern Ethiopia. Ethiopian J. Dev. Res. 14:31-58.

Tesfa A, Mekuriaw S (2014). The Effect of Land Degradation on Farm Size Dynamics and Crop-Livestock Farming System in Ethiopia: A Review. Open J. Soil Sci. 4:1.

Tesfaye A, Deneke TT, Selassie YG (2014). Determinants of maintenance decision of introduced soil and water conservation practices in Fagita Lekoma District, North West Highlands of Ethiopia. Ethiopian J. Appl. Sci. Technol. 5:1-17.

Tesfaye A, Negatu W, Brouwer R, Zaag P (2014b). Understanding soil conservation decision of farmers in the Gedeb watershed, Ethiopia. Land Degradation Dev. 25:71–79.

Teferaa B, Sterk G (2010). Land management, erosion problems and soil and water conservation in Fincha'a watershed, western Ethiopia.

Teshome A, de Graaff J, Ritsema C, Kassie M (2016). Farmers' perceptions about the influence of land quality, land fragmentation and tenure systems on sustainable land management in the north western Ethiopian highlands. Land Degradation Dev. 27:884-898.

Wagayehu B, Drake L (2003). Soil and water conservation decision behavior of subsistence farmers in the Eastern Highlands of Ethiopia: a case study of the Hunde-Lafto area. Ecol. Econ. 46 (3):437-451.

Woodfine A (2009). The Potential of Sustainable Land Management Practices for Climate Change Mitigation and Adaptation in Sub-Saharan Africa. Rome, Food and Agriculture Organization of the United Nations.

World Bank (WB) (2012). Managing land in a changing climate: an operational perspective for Sub- Saharan Africa. Draft version Report No.: 54134-AFR. WB, Washington D.C.

Full Length Research Paper

Pre-scaling up of urea treated rice straw and supplements on fattening performance of oxen along the Rib-river, South Gondar Ethiopia

Molla Haile*, Lijalem Abebaw, Asresu Yitayew, Tewoderos Bimerew, Zelalem Asmare and Wondemeneh Mekonen

Amhara Agricultural Research Institute, Andasa Livestock Research Center, Ethiopia.

The main objective of the study was to create a wider demand and assess the farmer's perception on ox fattening technique by using locally available rice straw and concentrate supplementation. A total of 55 oxen with similar age and body condition were selected for the study from 44 volunteer participant farmers. Urea treated rice straw used as a basal diet and 3 kg concentrate as a supplement per ox per day were used as the experimental animals. The feeding experiment was done for 105 days including 15 days acclimatization period. The analytical result showed that the average weight of the fattened oxen changed from 313.4 to 407.2 kg. The partial budget analysis result also showed that ox fattening by using the above method of feeding and management was profitable with average net benefit of 1654 ETB. The sensitivity analysis result showed that if the price of output becomes constant and the price of the inputs rise by 20%, the fattening by using the above method has a positive return. Farmers report on the fattening technology during field day is very appreciable and they are willing to continue with the same method of fattening. Based on the result, fattening sector generates an alternative income for small holder farmer's livelihood diversification.

Key words: Cattle fattening, rice straw, concentrate, pre-scaling up.

INTRODUCTION

Ethiopia has the largest cattle population in Africa with an estimated population of 52.1 million heads of animals (CSA, 2014/15). As total livestock sector development brings 8.2% of the country's GDP during GTPI (Ethiopian growth and transformation plan, 2015) with their large number and diversity of products, cattle contribute more to the national economy than any other livestock species.

They provide about 45% of all domestic meat consumption with small surplus which generates export income mainly from the sale of live animals. However, the earning from export of live animals and processed meat is very small as compared to the potential of the country.

The potential beef production in Amhara region of Ethiopia is characterized by the use of the indigenous

*Corresponding author. E-mail: molla.haile2005@gmail.com. Tel: +251918011428.

cattle breed in mixed smallholder system and low quality and quantity feed availability. The farming system in Libokemkem and Fogera districts is mixed crop livestock system. Farmers in this district cultivate crops and rear livestock for various purposes. The major crop cultivated in the area was rice. In 2010, Ethiopia cultivated about 222,000 ha of rice in 565,000 farmers land (Savitri, 2012). According to the study, as cited by Afework and Lema (2015), Fogera districts is one of the main producers of rice which contributes 58% of the region and 28% of the national production of rice. The major share of livestock feed at fogera district is obtained from crop residues which account for about 58% of share (Getachew et al., 2015). Rice straw is used mainly as a source of livestock feed at all seasons (Simegnew et al., 2014).

Straw can provide some carbohydrate but it is very deficient in other nutrients mainly protein. Also, because of the high lignin content, digestibility is poor. One of the most successful procedures to improve digestibility of crude plant material is through treatment with ammonia/urea. This weakens the hard cell walls, allowing better penetration by rumen microorganisms to produce more effective fermentation and liberation of nutrients.

Therefore, measures should be taken to improve these huge animal feed resources in the district. To do so, treating the straw with urea were one of the most appropriate and friendly method recommended by Adebabay et al. (2013). Participatory technology evaluation and demonstration was done to incorporate farmer's contribution and to create demand on it, finally in that area participant famers show a demand to continue on the fattening technology (Simegnew et al., 2014). Scaling up is one way of technology diffusion at a larger scale. Consequently, this scaling up activity was conducted to meet the following objectives.

1. To create a wider demand and disseminate fattening technology
2. To assess the farmers perception on the demonstrated technology
3. To create linkage with possible actors in fattening sector

MATERIALS AND METHODS

Location and study area description

The study was conducted in two kebeles (AbewanaKokit and ShinaTsion) in the Borders of Fogera and LiboKemkem districts along Rib River which is the mandate area of the research funding project, Ethio Nile irrigation and Drainage project. Fogera district is one of the districts of the Amhara Regional State and found in South Gondar Zone. It is situated at 110° 58´ N latitude and 370° 41´ E longitude. Woreta, the capital of the district is found 625 km from Addis Ababa and 55 km from the Regional capital, Bahir Dar. The district is bordered by LiboKemkem district in the North, DeraWoreda in the South, Lake Tana in the West and Farta district in the East. Two selected rural study kebeles are 10 km from Woreta town.

Farmer's selection

Discussions were undertaken in both districts and kebeles with agricultural experts for selection of participant farmers. From the two districts, a total of 44 farmers: one female and 43 male were selected purposively by using the following criteria that is voluntariness and experience on fattening practice, able to purchase ox and able to share cost with the research center that is used for concentrate feed purchasing. Farmers research extension group (FREG) is a method or a tool used by research organization, and then FREG was organized to increase the linkage between researchers, farmers and extension staffs.

Extension methods used to disseminate a technology

To disseminate and diffuse the fattening technology at larger scale, farmers research extension group (FREG) was used as group extension methods. Participatory practical and theoretical training by using leaflet, printed photograph, power point presentation and on job training was given to the selected farmers and extension workers. The content of the training were on improved fattening practice which is focused mainly on improved feeding and management system, oxen selection for fattening, health management and record keeping. Field day was organized at the farmers field and all possible actors (Regional and district Agriculture officers, Regional and local Administration staffs, Farmers Cooperative Union, Trade and Industry expansion Office, Researchers, Hotels and Persons who are working in the fattening sector etc..) were invited to conduct a result demonstration and create linkage for further scaling of the technology. Joint field visit and experience sharing with farmers, extension workers and researchers was done to hold method demonstration especially on urea treatment, animals feeding methods. Urea treatment fattening technology manual was prepared in Amharic version and distributed to the agricultural extension structure.

The recommended fattening technique and procedures

A total of 55 oxen were used for fattening. The experimental animals were examined for their health status and treatments were done for internal (shestomiasis disease) and external parasites (ticks and mites) using broad spectrum anthelmintics before commencement of feeding trial. For each ox, 3 kg concentrate were given as supplementation per day with basal supplementation of urea treated rice straw; water was provided *ad libitum*. The feeding trail was undertaken for 105 days including 15 days of acclimatization period.

Urea treatment was done by farmer's participation with the assistance of DAs and assistance researchers of ALRC; which makes the participant farmers familiar with the methodology of urea treatment. A rice treatment was done with the ration of 80 L water, 5 kg urea and 100 kg air dried rice straw. Concentrate feed were prepared and distributed to the participant farmers with the formulation of 58% maize grain, 40% Nouge seed cake and 2% salt, purchased from Merkeb union animal feed preparation factory.

Data collection and analysis

Body weight changes from initial to final, input cost used for ox fattening (ox purchasing and feed, medicament and labor) cost incurred and benefit gained from fattened ox sell were collected. The perception of farmers towards the demonstrated fattening system was collected by using semi-structured questioner after the end of fattening period during the field day. The collected data was coded and entered into the computer by using Excel and SPSS

Table 1. Household characteristics of the participant farmers.

Variables	Attributes	Percent (%)
Sex	Female	96.7
	Male	3.3
Marital status	Married	93.3
	Single	6.7
Education status	Illiterate	56.7
	1-4 grade	13.3
	5-8 grade	26.7
	College and university	3.3

(version 16). Simple descriptive statistics were employed to analyze the collected data. Likert scale analysis also used to measure the farmer's perception. Partial budget and sensitivity analysis were conducted to compute the variable cost of fattening, income from selling of fattened animals and cost benefit ratio. Sensitivity analysis was also calculated by considering the price of input increases and the price of output is constant.

RESULTS AND DISCUSSION

House hold characteristics

As indicated in Table 1, the sex of the participant households were 96.7 and 3.3% male and female, respectively, the number of female farmer was small because the female headed farmers in the selected villages are small. The marital statuses of the participants were 93.3 and 6.7% married and single, respectively. The educational status of the participant was 56.7% illiterate, 13.3% from grade 1 to 4th, 26.7% from grade 5th to 8th and the remaining 3.3% participants has college and university level. The educational status of a majority of participant's was illiterate (56.7%), this shows that the demonstrated fattening techniques can be simply done by farmer's indigenous knowledge without having formal education.

Household asset

On average, one participant farmer owned 2.23 oxen, 1.28 cows, 0.85 heifer, 0.97 bulls, 0.3 calves and 0.61 small ruminants. The average land holding for an individual participants were 1.1 hectare, with maximum of 2.5 and a minimum of 0.25 ha (Table 2). On the other hand, farmers had an alternative to produce their crop through renting land from peoples that do not have oxen or human resource to cultivate their land. The average ranted land amount of land by individual participant was 0.47 ha.

Table 2. Average cattle holding.

Cattle type holding	TLU
Ox	2.23
Cow	1.28
Heifer	0.85
Bull	0.97
Calf	0.3
Small ruminant	0.61

TLU = Total livestock unit.

Table 3. Body weight gain of the fattened ox.

Parameter	Average in kg
Initial body weight in kg	313.4
Final body weight in kg	407.2
Body weight gain in kg	93.84
Body weight gain in %	29.94

Kg= kilo gram.

Body weight change

The average weight of the fattened oxen changes from 313.4 to 407.2 kg with a final body weight gain of 93.84 kg at the end of experiment by feeding treated rice straw as a basal diet and supplementing of 3 kg formulated concentrate (Table 3). The result obtained was in line with the report of Simegnew et al. (2014). They reported that it is possible for fatten ox to feed on treated rice straw with supplementation of 3 kg concentrate which leads to average body weight gain of 88.96 kg after 90 days of feeding.

Partial budget analysis

As indicated in Table 4, ox fattening by feeding on treated rice straw with supplementing of concentrate for 90 days is profitable (average net benefit of 1654 ETB). The sensitivity analysis result showed that if the price of output become constant and the price of the inputs rose by 20% and the fattening had a positive return. Similarly, a report of Simegnew et al. (2014) on the same feeding type work done reported that ox fattening for 90 days gives average net benefit of 1519 ETB.

Marketing of fattened oxen

The average distance on foot for the nearest livestock market was 2.02 and 2.32 h for ''Woreta'' and ''Yifag'' town livestock markets, respectively. All fatteners (100%)

Table 4. Cost benefit analysis.

Variables	Partial budget analysis (ETB)	Sensitivity analysis (ETB)
Fattened oxen selling price	9698	9698
A. Total Benefit	9698	9698
Price of oxen purchase	5696	6867.66
Concentrate	1653	1993.02
Plastic	360	434.05
Medicament	12	14.46
Labor for urea treatment	200	241.14
Urea	123	148.30
B. Total Cost	8044	9698.65
Net benefit (A-B)	1654	-0.65
Benefit/Cost ratio (A/B)	1.20	0.99

ETB= Ethiopian birr.

Table 5. Marketing information on oxen fattening.

Parameter		N	Frequency
Where is the livestock market for you	"Woreta" and "yifag "	30	100
How did you sold your fattened ox	Directly at a market	30	100
For what type of buyer did you sold your fattened oxen	Individual consumer	5	16.7
	Traders and/exporters	25	83.3
Did you got livestock market information formally	Yes	11	39.3
	No	17	60.7
Is there any livestock fattening cooperative around your village	Yes	0	0
	No	30	100
What are the market problems do you faced	The selling price of the fattened ox was not attractive	11	64.7
	No alternative buyer	6	35.3

N= sample.

sold their fattened oxen directly at a market. A majority of participants (83.3%) and 16.7% also sold for individual consumers and traders, respectively. Most of the participant farmers (60.7%) did not have formal livestock market information for their decision but the remaining 39.3% participants got informal market information from their relatives and friends. There is no fattening cooperative around the study area (Tables 5 and 6).

Perception of farmers

During the field day, most of the participant and nonparticipant farmers demanded to continue with the demonstrated way of fattening experience. As indicated in Table 7, Likert scales result showed that oxen fattening sector were highly profitable, profitable and not profitable which accounts for 90, 6.7 and 3.3%, respectively. Treated rice straw were highly palatable, palatable and not palatable (86.7, 10 and 3.3%, respectively) for their oxen.

Also, rice straw can be easily treated by 60% farmers and it can also be done at home by 40% of farmers. 100% farmers strongly agreed that concentrate feed was palatable and use full for ox fattening and 56.7% of farmers responded that by taking the formula and raw materials, they can prepare the concentrate feed at home. 80% of respondent farmers strongly agreed that fattening activity can be managed by women easily at home, also, the remaining 20% farmers agreed next to the above. Among the farmers, 36.7% of agreed that there is no market problem for fattened ox but 43.3% disagreed and believed that if the fattening activity is not linked with the hotels and restaurants, there is high market problem especially after holidays.

CONCLUSION AND RECOMMENDATION

According to the Likert scales analysis result, the fattening technique was accepted by the farmers and the extension linkage was created with the responsible

Table 6. Average livestock market distance in hour from participant's residence.

Parameter	N	Min	Max	Mean	SD
How far woreta livestock market from your residence in hour	30	1.00	3.00	2.02	0.63
How far yifag livestock market from your residence in hour	29	1.50	3.00	2.32	0.44

N = total sample, Min = minimum, Max = maximum SD = standard deviation.

Table 7. Farmer's perception of the demonstrated technology.

Questions/variables		Strongly agree	Agree	Neither	Disagree	Strongly disagree
The ox fattening sector was profitable	N	27	2			1
	%	90	6.7			3.3
The treated rice straw was useful and most palatable by oxen	N	26	3			1
	%	86.7	10			3.3
Treating of rice straw was easy to me	N	18	12			
	%	60	40			
The concentrate was useful and most palatable by oxen	N	30				
	%	100				
The concentrate can be prepared at my home by using the formulation	N	8	17	2	3	
	%	26.7	56.7	6.7	10	
An ox fattened by feeding concentrate and treated rice straw was preferable by the consumers than the traditional one	N	21	9			
	%	70	30			
There is no market problem on the fattened oxen at my nearest livestock market	N	3	11	1	13	2
	%	10	36.7	3.3	43.3	6.7
Fattening activity can be managed by women easily at home	N	24	5			1
	%	80	16.7			3.3
In my house hold, there is no labor shortage in participating in oxen fattening	N	16	9	1	4	
	%	53.3	30	3.3	13.3	

N= total sample.

actors. Therefore, the fattening technology linked is to be disseminated at larger scale in the areas that has an abundant potential to produce rice. Partial and sensitivity analysis result shows that fattening sector generates an alternative income for small holder farmer's livelihood diversification. Therefore, fattening technology shall be highly promoted especially at the areas which has ample source of rice straw and crop residues.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

REFERENCES

Adebabay K, Addisu B, Tewodros B, Asresu Y, Yihalem D, Yeshiwas F, Getinet Z (2013). Comparative evaluation of the fattening performance of fogera and adet old oxen at andassa livestock reseach center, Ethiopia. Int. J. Pharm. Med. Biol. Sci. 2(4).
Afework H, Lema Z (2015). Determinants of improved Rice varaties Adoption in fogera District of Ethiopia http://www.starjournal.org/
Central Statistical Agency (CSA) (2014/15). Report on Livestock Resources of Amhara Region.
Getachew M, Tsehay R, Zelalem L, Gerba L, Duncan AJ, Yeshambel M (2015). Assessment of livestock production systems, the potential of feed availability, farming system and livestock production problems in Fogera District, Amhara Region, Ethiopia.
Simegnew T, Habtemariam A, Wondemeneh M, Molla H (2014). Participatory Evaluation and Demonstration of urea treated rice straw and Concentrate supplements on the fattening performance of oxen along the Rib-River, South Gondar, Amhara Region, Ethiopia. Proceeding of the 9th Annual Amhara Regional Agricultural Research Institute Conference on Completed Socio economics and Agricultural extension Directorate Completed Activity.
Savitri M (2012). Rice Today January-March. Int. Rice Res. Instit. 11(1).
The Second Growth and Transformation Plan (GTP II) (2015/16-2019/20), National Planning Commission September 2015.

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