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Research article

Farming households' knowledge and perception on Soil degradation in Dera Woreda, Ethiopia

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Abstract

In the highlands of Ethiopia, the problem of soil degradation is rigorous. The study was conducted to investigate farming households' knowledge and perception on soil degradation with special reference to soil erosion and soil fertility loss in Dera Woreda, Ethiopia. Data were collected using field observations, questionnaire survey and focus group discussions. Questionnaire survey was conducted on 90 samples of farming households which are selected from three peasant associations in the Woreda. Focus group discussion was also conducted in each peasant association having a group member of six. The result of the study indicated that soil erosion and soil fertility loss is a problem. To combat soil erosion farmers mainly depend on physical soil conservation measures. However, using of vegetative conservation measures was very much limited. Even the constructed conservation structures are poorly maintained. Again, to maintain the incidence of loss of soil fertility they were using crop rotation and inorganic fertilizers. However, use of compost manure, green manure, soil burning, fallowing, multiple cropping, weed and trash line heap, animal parking and mulching is very low. Thus, as a result of lack of proper management, soil erosion and soil fertility loss were reached to the extent until the land becomes out of cultivation.

Key words: Soil degradation, soil erosion, soil fertility loss

1. Introduction

Ethiopia is one of the most well-endowed countries in Sub-Saharan Africa in terms of natural resources (Gete *et al*., 2006). However, the degradation of soils is one of the crucial issues of environmental damage, not only at the local scale but also at the global scale (Hurni, 2002). In Ethiopia, soil degradation in the form of soil erosion and soil fertility loss is a serious challenge to agricultural productivity and economic growth (Mulugeta, 2004). Recognizing the seriousness of the problem, the Ethiopian government launched a massive soil conservation programme since in the middle of 1970's (Hawando, 1997). However, success to date has been limited (Badege, 2001; Paulos, 2001).

Aligned with the above studies, research conducted in Ethiopian highlands showed that on agricultural lands, degradation of soil is the most deteriorating process and it reached to a state where the land has turned into badlands and agriculture has abandoned even though different efforts has been undertaken (Hurni *et al.,* 2010). The highlands of Ethiopia is characterized by area of steep topography and hence greatest soil erosion occurred in which the measurements of soil loss by running water range from 3.4 to 84.5 tons/ha/ year with a mean of 32.0 tons/ha/year (Berry, 2003). Soil erosion is taking place all over the country but because of the effect of overpopulation on land that is already fragile (steep and mountainous), and mismanagement of the land itself the northern and central highlands are the worst affected (Paulos, 2001). In the study area, part of the northern highland, the problem is very much serious. Therefore, this study is intended to investigate and appraise farming households' knowledge and perception on soil degradation, and the current practices being undertaking to reduce soil degradation.

2. Materials and Methods

2.1 Study area

The study was carried out in Dera Woreda which is located between the coordinates of $11^0$15'N - $11^0$55'N and $37^0$20'E - $37^0$60'E. Its altitude ranges from 1452 to 2749m above sea level and significant difference in altitude can be observed even in a short distance. The Woreda consisting of Dega and Woinadega agro-climatic zones which encompasses 224.586 km^2 (15%) and 1272.654 km^2 (85%) respectively. The average annual rainfall and temperature is 1250 mm and 19 $^{\circ}$C respectively. Agriculture is the major economic activity which is characterized by rain-fed and predominantly subsistence nature. Both crops and livestock productions are equally important at Dega and Woinadega agro-ecological zones of the area. The main soil types are Nitosols, Vertisols, Gleysols, Luvisols and Cambisols. The dominant vegetation type includes: *Eucalyptus* species, *Croton macrostachyus*, *Juniperus procera*, *Cordia africana* and *Ficus vasta*.

2.2 Data collection

To get the required data field observations, questionnaire survey and focus group discussions were employed.

2.3 Determination of sample size

Three peasant associations (PAs) were selected purposefully from the total of twenty nine PAs of the Woreda in which soil degradation is very common and transport accessibility. Then after, 90 samples were selected randomly

whereby questionnaire survey conducted with. The number of samples from each PA was selected in relation to their population number (Table 1). Then, systematic sampling method was applied to select samples. Three groups were formed for focus group discussions having a group member of six (that is one group from one PA). Men and women elders were selected in the local communities to participate in the group discussions. The discussion dwelled on different issues of soil erosion and soil fertility loss.

Table 1*:* Number of selected samples from each PA

Name of PAs	No of HHs	Percentage	No of samples taken
Tana Mitsili	2,636	36.29	33
Gedam Geregera	2,975	40.96	37
Huletu Wogedamai	1,652	22.75	20
Total	7,263	100	90

2.4 Data analysis

Quantitative data collected through questionnaire survey were categorized and tabulated in frequency, percentage and finally interpreted and analyzed by descriptive statistics. The results of focus group discussions were compiled in line with the responses of questionnaire survey.

3. Results and Discussion

3.1 Farming Households' knowledge and perception of soil erosion

The degradation of soils is one of the crucial issues of environmental damage not only at the local scale but also at the global scale (Hurni, 2002). In the Amhara region, the problem is rigorous. For example, soil erosion is a major problem in the region, with the land estimated to be eroding at very rapid rates of 16–50 t/ha per year (Desta *et al.*, 2000). Similarly, the sampled HHs in the study area acknowledged the presence of soil erosion. Again, the majority of sample farming HHs (69%) revealed the increasing of soil erosion. In parallel, a study by Belay (1995) reported that the expansion of agriculture as a result of the ever growing population especially towards the steeper slopes has accelerated soil erosion in Ethiopia.

Table 2: Perception of farming HHs on the rate of soil erosion

Rate of erosion	Frequency	Percentage
Increasing	62	69
Decreasing	28	31
Remain constant	-	-
Total	90	100

Causes of soil erosion

The identified causes of soil erosion in study area were cultivation of steeper slope, intensive cultivation without fallow, lack of soil conservation measures, lack of sense of ownership, deforestation, over grazing, use of crop residues for animal feed and fuel, and heavy rain fall (Table 3). In addition, conversion of forest, shrub and grazing land into cultivated land were also perceived as causes of soil erosion. The situations observed in the study area were similar with the situations in many parts of Amhara region, such as Wag Hemra, North Wello, North and South Gonder, eastern parts of South Wello and northern parts of North Shewa Zones (Desta *et al.,* 2000). In parallel, a study by Hurni (2002) revealed that rapid population growth, cultivation on steep slopes, clearing of vegetation and overgrazing are the main factors that accelerate soil erosion in Ethiopia. In the Ethiopian highlands, the population has grown very fast on the limited land area and every possible piece of land is put into cultivation to produce food which results soil erosion (Hawando, 1997). A study by Tilahun *et al.* (2001) also accounted that declining vegetative cover and increased levels of farming on steep slopes in Ethiopian highlands have eroded and depleted soils in the area, so that soil degradation is now a widespread environmental problem.

Table 3: Causes of soil erosion

Causes of soil erosion	**Frequency (n=90)**	**Percentage**
Cultivation of steeper slope	79	87.8
Intensive cultivation without fallow	83	92.2
Deforestation	68	75.5
Over grazing	56	62.2
Use of crop residues for fuel	45	50
Use of crop residues for animal feed	53	58.9
Lack of soil conservation measures	84	93.3
Heavy rainfall	56	62.2
Lack of sense of ownership	78	86.7

Consequences of soil erosion

The perceived consequences of soil erosion were reduction of land productivity (yield), loss of cultivable land and reduction of farm size, difficulty of land preparation, and change in type of crops grown. The above mentioned consequences in turn lead to poverty and migration (Table 4). Severely degraded land has gone out of production particularly in steep slopes. Numerous rills and gullies are rampant and continue to be formed and enlarged. The natural vegetation has almost been wiped off, and biodiversity in the area is at risk. Thus, with continued soil erosion, the productivity of land becomes too inadequate to support the growing population.

Table 4: Consequences of soil erosion

Consequences	Frequency (n=90)	Percentage
Land productivity (yield) decrease	90	100
Land become out of cultivation	89	98.9
Land preparation becomes difficult	83	92.2
Reduced farm size	81	90
Change in type of crops grown	71	78.9
Poverty	57	63.3
Migration	62	68.9

Measures to prevent soil erosion

Soil conservation measures that are being implementing includes soil and stone bund, cut-off drain, contour plowing and controlling over-grazing (through rotational grazing). In contrary, most of them were not with integrated soil conservation measures (biological and physical measures), check dam and Fanya juu (Table 5). However, the above physical conservation measure which is applied in the study area doesn't contribute for the addition of nutrients removed as compared to vegetative soil conservation measures. Similarly, a study by Tilahun *et al*. (2001) revealed that maximizing vegetation cover on cultivated land is important to prevent erosion and for the addition of nutrients removed. However, so far the effort made to apply integrated watershed management, use of agro-forestry system, application of integrated soil conservation measures, to reduce overgrazing, to construct check dams and terracing is meager. Furthermore, the communities' awareness towards the above activities is found at low level.

Even the constructed physical conservation structures were poorly maintained (Figure 2) and they are also destructed by farmers. The causes identified were shortage of land, its poor quality during construction, inconveniency during ploughing, dispute between the farmers at the junction point of soil conservation structures, the need to use the fertile soil on bunds rather than benefits of soil conservation in the long run and the peoples reluctant to adopt the incoming technologies (Table 6). As a result, soil erosion is very severe in the area. This finding is similar with Getachew (2005) study in Angereb and Gish-Abbay watersheds.

Table 5: Measures being taking to prevent soil erosion

Measures	Frequency (n=90)	Percentage
Soil and stone bund	90	100
Cut-off drain	90	100
Controlling overgrazing	32	35.5
Check dam	5	5.5
Fanya juu	3	3.3
Contour plowing	90	100

Integrated soil conservation measures (biological and physical measures)	7	7.8

Figure 1: The constructed soil conservation structures in the study area

Table 6: Causes for the destruction of constructed soil conservation structures

Causes for the destruction	Frequency (n=90)	Percentage
Shortage of land	75	83.3
poor quality during construction	43	47.8
Inconveniency during ploughing	82	91.1
Dispute between the farmers at the junction point	66	73.3
Need to use the fertile soil on bunds	79	87.8
Reluctant to adopt the incoming technologies	47	52.2

Figure 2: Poorly maintained conservation structures in the study area

3.2 Farming Households' knowledge and perception on soil fertility loss

In the study area, the entire sample HHs explained the incidence of loss of soil fertility on their plot. This finding is similar with Woldeamlak (2003) study which showed that farmers in all the major farming systems experienced a decline in soil fertility.

Causes of soil fertility loss

The causes for the decline of soil fertility includes: long history of cultivation, low inorganic fertilizer application, use of crop residues for fuel and animal feeding, intensive cultivation without fallow, low application of manure, cultivation of steeper slope and lack of soil conservation measures. But, heavy rainfall was poorly mentioned as a cause. The progressive price increment of inorganic fertilizer could explain the low application rates of inorganic fertilizer as maintaining fertility level of the land. Thus, it is critical that other low-cost input sources that can address soil fertility problems should be expanded, given that the higher price of chemical fertilizer and farmer's inability to afford it. But, the use of such organic practices as green manuring, compost and animal parking is relatively limited (Table 7). Similarly, Desta *et al*. (2000) reported that the loss of soil fertility (nutrient depletion) is manifested through using dung and crop residues as household fuels and animal feeds, low use of chemical fertilizers, declining fallow periods, soil and organic matter burning, and soil erosion.

Table 7*:* Causes of soil fertility loss

Causes of soil fertility loss	**Frequency (n=90)**	**Percentage**
Long history of cultivation	90	100
Cultivation of steeper slope	57	63.3
Intensive cultivation without fallow	85	94.4
Low inorganic fertilizer application	87	96.7
Low application of manure	78	86.7
Use of crop residues for fuel	86	95.5
Use of crop residues for animal feeding	86	95.5
Lack of soil conservation measures	54	60
Heavy rainfall	23	25.5

Consequences of soil fertility loss

Most of the respondents declared the consequence of decline of soil fertility as change in type of crops grown, land becomes out of cultivation and reduced farm size, land preparation becomes difficult, poverty and migration (Table 8). To act in response of the consequences of decline of soil fertility, most farmers are taking various measures to improve soil fertility. This could explain the perception that the effect of soil fertility loss decrease in crop yields. Decline of soil fertility is considered as the biophysical root cause of declining per capita food production in sub-

Saharan Africa (Drechsel *et al.,* 2001). There are also convincing results showing that the incidence of some pests and disease is strongly associated with decline in soil fertility (Esilaba, *et al*, 2000 cited in Tilahun, 2003). Similarly, there were the presences of pests and diseases on pepper on the last four years in the study area.

Table 8: Consequence of soil fertility loss

Consequences	Frequency (n=90)	Percentage
Change in type of crops grown	87	96.7
Land become out of cultivation	85	94.4
Land preparation becomes difficult	76	84.4
Reduced farm size	67	74.4
Poverty	56	62.2
Migration	63	70

Farmer's current practice to maintain soil fertility

In order to maintain soil ferity the entire respondents' were using crop rotation and inorganic fertilizers such as DAP and Urea. However, use of compost manure, green manure, soil burning, fallowing, multiple cropping, weed and trash line heap, animal parking and mulching is very low (Table 9). This is an indication that farmers heavily depend on the use of crop rotation and inorganic fertilizer than others. Those farmers who applied fallowing for soil fertility restoration reported a time span of one year for every 5 or 6 years due to scarcity of land for cultivation. In the past crop rotation of two consecutive cereal crops followed by oil crops is the most common in relatively fertile plots. But now a day, crop rotation is practicing by rotating cereal crops. Thus, crop rotation in the study area may not improve soil fertility.

Studies reveal that there is little option left to the subsistence farmer to improve soil fertility through crop rotation although resource rich farmers do practice some rotations and apply manure. In addition, farmers with relatively small farmlands do not adopt soil conservation practices easily since they think it takes away of their croplands. This has an impact on soil fertility management and soil conservation, which will then cause soil degradation as a result of unsustainable intensification of the land (Paulos, 2001).

Table 9: Soil fertility management measures

Measures	Frequency (n=90)	Percentage
Mulching	5	5.5
Fallowing	17	18.9
Crop rotation	90	100
Multiple cropping	43	47.8
Weed and trash line heap	27	30
Compost manure	65	72.2
Green manure	52	57.8

Animal parking	11	12.2
Inorganic fertilizers (DAP and urea)	90	100

4. Conclusions

Soil erosion and loss of soil fertility is a very problematic issue in the study area. To control soil erosion, farmers are being practicing mainly physical soil conservation measures which have less contribution for the addition of nutrients removed as compared to vegetative conservation measures. The constructed conservation measures are not to the standard and at the same time lack proper maintenance for sustainable use of agricultural lands. Furthermore, farmers destroy the constructed conservation structures. Farmers of the study area are also seemed to be resistant to the newly introduced soil and water conservation technologies. On the other hand, repetitive cultivation of the land without appropriate soil fertility management measures resulted decline of soil fertility there by yield reduction and conversion of forest land, shrub land and grass lands into cultivated land which again accelerated soil erosion.

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