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Perception of Farmers Toward Physical Soil and Water Conservation Structures in Wyebla Watershed, Northwest Ethiopia

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Abstract: The study was carried out in the Wyebla watershed, Northwestern Ethiopia. Similar to the other highland areas in the country Wyebla watershed is characterized by severe soil erosion and acute water scarcity problems. Hence, the objective of the current research was to assess the perception of farmers towards physical soil and water conservation (SWC) structures and current community mobilization in the study area. A total of 106 households were interviewed and Participatory Rural Appraisal (PRA) techniques were employed to collect data. Data were analyzed using SPSS version 20. Majority of sampled farmers (84.9%) were aware about the problem of soil erosion on their farmland. All interviewed farmers perceived soil erosion as a problem constraint for crop production and that soil erosion can be controlled with proper SWC measures. But there are problems to implement and adopt SWC measures in the Wyebla watershed these are; served as a shelter for pests and rates, difficult to tillage, need much labor, need incentives to implement, difficult to implement and reduce farm size. In addition to the above problems the past trends and ways of farmers' participation on SWC practices are important reasons for the failure of sustainability. However, awareness creation, capacity building and motivating real community participation at planning, implementation and maintenance phases are the critical areas required in depth to insure its sustainability.

Key words: Farmers perception · SWC · Wyebla watershed

INTRODUCTION

Land degradation is one of the major challenges in agricultural production in many parts of the world, especially in developing nations like Ethiopia [1,2]. Land degradation typically occurs because of land management practices or human development that is not sustainable over a period of time [3]. [4] Stated that a 13% yield loss is as a result of severe degradation on 40% of agricultural land and moderate degradation on a further 9% of agricultural land, is equivalent to a decline in water use efficiency of at least 13%. The severity of soil degradation in the Ethiopian highlands is the result of the past and present agricultural activities, mountainous and hilly topography, torrential rainfall, low degree of vegetative cover and unsustainable land resource management in general [3,5].

The problem of soil degradation in Ethiopia is well established fact. The causes and consequences have been substantiated in different regions in the country [6,7]. The average annual rate of soil loss in the country is estimated to be 12 tons/hectare/year and it can be even higher (300 tons/hectare/year) on steep slopes and on places where the vegetation cover is low [8]. Moreover, population growth in the country leads to deforestation and the conversion of pastureland to crops leading to overstocking and further degradation. Crop residues are increasingly used for fuel rather than mulch. Dung is also used as fuel rather than manure. All these factors lead to nutrient loss and increased erosion [9].

In the Wyebla watershed rapid population growth had forced farming families to expand their fields to the forest and grazing lands. As a result, large areas, which were once under forest cover, are exposed to heavy soil erosion and serious threat to sustainable agriculture and human health. Water is essential for human life. But this precious resource is depleted though time as a result of inefficient use of natural resources in the watershed. To overcome these problems huge amount of physical SWC structures were implemented each year. But there is a problem on ensuring of its sustainability. The watershed community is motivated by subsides from NGOs to implement SWC measures. The research gaps were not well studied before on willingness and

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perceptions of farmers on physical SWC measures in the study areas. Therefore, the objectives of this paper are to assess the perception of farmers towards physical SWC structures and current community mobilization in the study area.

MATERIALS AND METHODS

Description of the Study Area: The research area is located in the North Western part of Ethiopia within the highland of Amhara National Regional State (ANRS), in Goncha Siso Enesie at Wyebla watershed. Wyebla watershed is located at 351 km North West of the capital Addis Ababa [10,11].

According to the simplified traditional agro-climatic classification system, which considers only altitude, the study watershed lies within *dega* (temperate) zone. The altitude range of the study watershed is from 2631-2792 masl. Agriculture is the main source of income in the area, where the farming system is characterized by small-scale production of mixed crops and livestock. Crop and livestock production dominate the farmer economy. The major crops grown are cereals (*Teff* (*Eragrostis teff*), Wheat (*Triticum aestivum*), Barley (*Hordium vulgare*), pulses (Bean (*Vicia faba*), Field pea (*Pisum sativum*). The livestock typical herd (flock) composition of cattle, sheep, donkey, as well as chickens and bee colony [12]. Tree growing niches include degraded areas, gullies, farmlands and homesteads. The rarely distributed natural trees that are growing on different niches of the watershed consist of *Acacia abyssinica, Juniperus abyssinica, Rhamnus prinoides and Croton macrostachys*. The dominant exotic tree species in the watershed are *Eucaluptus globules, Acacia saligna, Acacia deccurence* and *Sesbania sesban.* The outputs from trees are wood for fuel, construction, farm improvements, animal fodder, income sources by selling and environmental protection [12].

Sampling Methods and Data Collection: Data for this study were gathered from two sources: primary and secondary sources. The primary data were collected from sample respondents through structured and semi-structured questionnaire. In this research, farmers interview, field observation and measurements, were the major sources of primary data. In order to ensure the reliability and validity of the data collection, triangulation of different methods was conducted during collection of primary data. These methods include observation, focus group discussion; transect walk and other key informants' interview. Secondary sources of information used for this study include published materials such as books, journals, annual reports, plans, official records, census records, project reports, research papers and web pages. The total household heads residing in the area is 460. These household heads stratified based on their residence in to upper, middle and bottom watershed. The number of sample house hold farmers selected for the interview was determined by using the formula [13].

$$n_0 = \frac{z^2 pq}{d^2}$$

$$n = 1 + \frac{n_0}{(n_0 - 1)} \Big/ N$$

Where,

n_0 = is the desired sample size when the population is greater than 10000

n = is number of sample size when population is less than 10000

Z = is 95% confidence limit i.e. 1.96

P = is 0.1 (proportion of the population to be included in the sample i.e. 10%)

Q = is 1-0.1 (i.e., 0.9)

N = is total number of population

d = is margin of error or degree of accuracy desired (0.05).

Based on the above sample size determination formula 106 house hold farmers were selected for interview by using simple random sampling technique at each watershed parts.

Perceptions of Farmers' Towards Physical Soil and Water Conservation Measures: In order to capture the perception of farmers to soil erosion and physical SWC processes formal and informal interview were conducted. In addition, the researcher observed the entire research area and the wider land use and management systems to learn several things by observation. Issues that immerge from observation were used to guide interviews and discussions with selected farmers.

Participatory rural appraisal (PRA) techniques (Focus Group Discussion, Transect Walk, Semi structured interviews (SSI)) were used for data collection.

Closer observations was made along the transect line of the field where measurements were carried out. Data and information about perceptions of farmers in soil erosion processes and SWC technologies were collected using formal interviews with the sampled households.

Data Analysis: Depending on the type of information collected from the field, different data analysis methods were applied. Data collected was organized, analyzed and summarized using Microsoft excel, SPSS Version 20.0 data package using descriptive statistical analysis methods.

RESULTS AND DISCUSSION

Perceptions of Farmers on the Physical SWC Measures and Soil Erosion Problem: Soil erosion is widespread, but there is considerable variation in the degree of erosion from place to place in the study area. The majority of the farmers (84.9%) reported that they perceive soil erosion problem in their farm land. But, the severity of the erosion was varied from place to pace based on different factors mainly slope steepness and soil conservation measures practiced. Based on respondents field interview responses, soil erosion problems were categorized as severe (7.8%), medium (36.7%) and low (55.5%) (Table1). This result was obtained as a result of introduction of physical SWC structures. From all respondents, 8.5% of the farmers rated the extent of the problem as increased and 82.1% of the respondents mentioned that the rate of soil erosion has been decreasing over time after introduction of SWC measures. In contrast to this, [18] found that majority of the surveyed farmers observed an increasing trend in the severity of erosion over the past 8 years (80%). The rest 9.4% didn't observe any change in soil erosion severity over the past 5 years. Moreover, the respondents generally believed that erosion can be controlled (100%). [15] argued that framers believed soil erosion (100%) and soil fertility loss (97%) can be controlled. But according to [2] farmers generally believed that erosion can be controlled (70% of respondents). From the open ended and closed ended questionnaires responses, it can be concluded that farmers have good perception of erosion as a problem that limits soil productivity.

All the interviewed farmers perceived soil erosion as a problem constraining crop Production (Table 1). The problems may be by reduction of farm size, change types of crop grown and soil fertility loss as a result yield reduction was observed. As [16] reported the most important top soil for crop production activity was deteriorating over time due to erosion processes. Hence, they observed frequently how the loss of soil from cultivated fields has been reducing the depth of the topsoil through time and the number of stones in their farmlands has been increasing over time.

In the Wyebla watershed the severity of soil erosion and yield reduction facilitate the introduction of most physical SWC structures. Perception of soil erosion as a hazard to agricultural production and sustainable agriculture is the most important determinant of effort at adoption of conservation measures. Understanding and recognition of soil erosion as a problem in their farm plots and its causes and impacts on crop yields is the first step towards searching for and adoption of remedial 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 [17]. On the other hand, when farmers do not acknowledge soil erosion as a problem, they will not expect benefits from controlling erosion and it is highly likely that they will decide against adopting any conservation technologies. They perceived as constructing physical SWC structures are labor intensive to implement, reduce cultivated land, difficult to plowing.

Factors Affecting Use of the Introduced Physical SWC Technologies: Farmers recognize in Wyebla watershed where degraded and non fertile lands become productive after the introduction of watershed management program. Farmers' introduction of physical SWC practices could possibly be influenced by different problems. In the Wyebla watershed, surveyed household members mentioned some of the factors related to the adoption of newly introduced soil and water conservation structures. Among major threats hindering practices of SWC measures serve as a house for pests and rates, difficult to tillage, need much labor, need incentives to implement, difficult to implement, reduce farm size. Though farmers showed willingness to adopt the newly introduced SWC structures, they are reluctant to practice these measures to their farmlands. From the interviewed farmers, majority reported that some conservation measures like bunds, cut of drain and water ways were difficult to tillage, need much labor, need incentives to implement, difficult to implement and reduce farm size.

To break the problems that affect adoption of newly introduce physical SWC structures efforts have to be done by educating and training farmers towards the newly introduced SWC technologies are very important to

Table 1: Farmers' perceptions of soil erosion hazards and SWC practices in the study area

Perception of farmers on erosion and SWC practices	Number of respondents	Proportion of total respondents (%)
Is there soil erosion problem in your farm land?		
– Yes	90	84.9
– No	16	15.1
If yes to the above question, how it is severity of the problem,		
– Severe	7	7.8
– Medium	33	36.7
– Low	50	55.6
Is there any observed change in soil erosion severity over the past 5 years?		
– Has become more severe	9	8.5
– Has become less severe	87	82.1
– No change	10	9.4
Believing that soil erosion can be controlled?		
– Yes	106	100
– No	0	0
Perception of farmers on erosion and SWC practices	Number of respondents	Proportion of total respondents (%)
1. Land productivity (yield) decline	7	6.6
2. Change in type of crops grown	1	0.9
3. Reduces farm plot size	13	12.3
All	62	58.5
1 and 2	11	10.4
1 and 3	4	3.8
2 and 3	8	7.5
Total	106	100
Which problem is dominant in your farm land		
– Erosion	90	84.9
– Sedimentation	3	2.8
– Free	13	12.26
Do you think physical SWC structures have long term benefits?		
– Yes	106	100
– No	0	0
HH Participation condition in the study areas		
– By interest	49	46.2
– By forces	3	2.8
– All	54	50.9
Do SWC measures increase crop productivity?		
- Yes	106	100
- No	0	0

Table 2: Prioritized indicators of sustainable soil conservation practices

Types of SWC practices in the watershed	Mean	Standard. Deviation.	Coefficient of variance	Priority
Bunds	2.066	2.066	2.066	1
Contour cultivation,	2.481	2.481	2.481	2
Crop rotation	1.861	3.340	2. 2.747	3
Area closure	1.414	1.525	2.849	4
Manuring	1.415	1.525	2.849	5
Improved cut-off drain	2.561	2.367	3.906	6
Check dam	4.925	4.925	4.924	7
Agro forestry	3.467	11.153	7.548	8
Grass strips	2.002	2.326	8.117	9
Composting	2.002	2.326	8.117	10
Fanya juu terraces	5.736	6.472	9.698	11
Water way	7.557	9.453	9.915	12
Intercropping,	7.557	9.453	9.915	13
Crop residue	12.217	8.906	13.226	14
Traditional Cut-off drain	6.558	5.604	15.260	15

facilitate the adoption processes. Soil bunds were reported as the most SWC structures on most farm lands in the study area. However, from field observation, soil bunds were poorly designed, constructed and poorly maintained.

Farmers' Acceptance of SWC Measures: Soil erosion is an insidious and slow process therefore farmers need to perceive its severity and the associated yield loss before they can consider implementing soil and water conservation practices. Understanding farmers' perception of soil erosion and its impact is important in promoting soil and water conservation technologies [18]. Accelerated soil erosion is primarily caused by farmers' land use practices. Likewise, the success of any SWC intervention depends on the extent to which the introduced conservation measures are accepted and adopted by the farming community. In other words, acceptance and farm-level adoption of the newly introduced conservation measures by the farmers is the decisive element for the success of a watershed management intervention [19]. Examination of farmers' acceptance of the introduced conservation structures by level of perception of erosion hazard exposed that no farmer that perceived no erosion problem on his cultivation field did at least retain some of conservation measures [20]. As it can be seen in (Table 1), almost all of the respondents (98%) reported that the technologies were effective in arresting soil erosion. Similarly, all of the respondents believed that the new SWC technologies had the potential to improve land productivity. The farmers who tried to implement some conservation measures in their plots were interviewed how they measure the effectiveness of SWC technologies. Based on farmers' response, the three most important SWC measures which are effective to arrest soil loss are soil bund, contour cultivation and crop rotation (Table 2).

They had already observed a better growth and development of crops particularly along the structures where fertile sediments were trapped. They also evaluated that the amount of sediment trapped by the structure was very high which would be out of the field if that conservation structure were not built. During group discussion, participants who treated their lands by some conservation structures gave witness for the group that the technology they have been using improved their land productivity.

Current Community Mobilization in Physical SWC Works: In the past, developmental agents were the front line implementers of government policy of mass mobilization in which peasants undertook SWC activities under threats of sanction. This is perpetuated by the fact that they may still be expected to contribute up to 45 days per year for community participation without reward. In theory, of integrated watershed management (physical SWC measures) plans were prepared by the community. Under Ethiopia's previous 5 year economic development plan (participatory development training and extension system (PASDEP): 2005–2010), the government invested in a series of land and watershed management activities with the goal of augmenting agricultural production. In the country's recent five-year plan (Growth and Transformation Plan: 2010–2015), the government outlines the need to promote and invest in soil and water conservation activities.

In relative to past experience 2012 year in ANRS community mobilization strategies were effective in mobilizing all active labor forces expected to participate in watershed development activities. The active work forces both men and women participate in physical hard work. The physical works were done by 1:5 work teams [21]. In this year, in chemo *kebele* similar community mobilizing work was done. Each 1:5 work teams had given measured work that implement in a day base. The team is built based on their residence.

In Chemo *kebele* there is gap between participation and realities. In 2013 budget year physical soil and water conservation measures were implemented by mobilizing *kebele* communities in a watershed base plan. As the researcher interviewed with some of the community members, some of them responded that their participation was not by interest. The main reasons to resist participating in communal work were: the work sites far from their home because of this they spent much of their time by journey (2hr); some of the community members need payment for their labor contribution; other rich farmers have no free time even in this time (tailor, mill owners); and some community members also disappointed by output of their work.

As a result of the above factors the community members are not fully interested in communal soil and water conservation work. In respect to payment the previous trend to implement SWC measures in Wyebla watershed was by food–for-work project. This type of payment creates dependency on supporting organizations to construct physical SWC measures without payment. They considered payment as mandatory of the government or NGOs to construct physical SWC measures. Therefore, it creates difficulty to scale up the work to other watershed which does not support by NGOs. The other reason why farmers were reluctant

to participate in mass mobilization work was that, the physical SWC structures were not used by land owner in sustainable manner. In Chemo *kebele* physical SWC measures were done in cultivated lands at least two times in the past 10 years by community participation. Now a day the land is free from conservation measures because of low attention given by land owners. As a result of this, the local community ordered to reconstruct the same structures on the same plot land. This reduces the trust of community on the effectiveness and sustainability of their work. Some community members walk a long distance from the home to the site where SWC done. This affect the working capacity of the community because the tired before they reach to actual work. On the other hand no one present in their home that, keep their live stock and home. Similarly rich farmers don't need to invest their time in community based mass mobilization SWC work; rather they do their own work by paying the sanction (20 birr) set by community.

It is obvious from the foregoing observation that there is a gap in perceptions on SWC between scientists and local population, especially in terms of understanding the approaches of practicing of SWC measures. It is also apparent that most of the previous approaches that dealt with SWC problems were influenced by how those who initiated conservation problems understood/perceived the problems. The failure of most of these programmes is attributed to inadequate involvement of the local population, insensitivity to local needs, too much reliance on technical options and ignorance of local knowledge. More importantly, inadequate attention is paid to social problems such that SWC issues are assumed to be technical problems.

CONCLUSIONS

Based on finding of this study, one could conclude that there were SWC measures implemented before the current mass mobilization work to reduce erosion in Wyebla watershed. Because of better quality structures good result was obtained on gully control than any other SWC measures. However the awareness of farmers in the self help maintenance and practice of soil and water conservation structures like soil bund, water way, cut of drain, fayna juu bund and check dam is still have problems. Farmer perception of erosion severity also explained yield loss perceptions with the same direction of effect, suggesting that farmer perceptions of yield loss depend on their perceptions of soil loss. The most important conservation proactive carried out by farmers as coping strategies to recover the degraded and eroded lands include both of indigenous and introduced SWC measures such as construction of check dams, closuring and fencing of gullies and degraded lands, maturing, crop rotation and using agronomic and other structural measures. But lack of vision, poverty and awareness, carelessness, the majority of farmers did not put the methods in to practice.

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