

Major constraints in Sustaining Soil Conservation System—An Ethiopian Experience

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Abstract

Soil is a vital resource which provides momentous ecosystem service. It is the principal resource surrounded by lithosphere, hydrosphere, biosphere and atmosphere. It can play crucial role to interlink these four spheres in addition to being medium for plant growth. But, soil degradation is one of the major challenges in Ethiopia hindering the productivity of land. Soil and water conservation which is the combination of appropriate land use and management practices that promote the productive and sustainable use of soils was considered as an option. Soil resource conservation attempt was just four decades old in Ethiopia. Several soil and water conservation work has been carried out every year through some campaigns that involved different communities. However, the sustainability of these practices has been threatened by different factors, such as institutional factors, attitudinal factors, economic factors, biophysical factors and demographic factors. Thus, under long run condition, any decision and policies regarding soil conservation must consider all these factors. The detail regarding the major constraints existing in soil and water conservation system in Ethiopia is described in this article.

Keywords: Soil ecosystem, soil degradation, management practices, sustainability, water conservation.

Introduction

Soil is a multifunction natural resource and provides unrepresented service to human being and other creatures (Nigussie *et al.*, 2017; Bünemann *et al.*, 2018). It is a central resource for almost all human beings. However, irrational and unwise interference of human being to obtain economic benefit from soil is leading to rapid degradation of world soils. Its ability to grow crops and delivering expected ecosystem services is being jeopardized and unbalanced. Soil resource dilapidation is being aggravated from time to time and threatens food security of the current generation in a worldwide level (Adugna *et al.*, 2017). Among the sub-Saharan countries, Ethiopia encountered high-level of soil erosion. All most all the rural Ethiopians live is entirely dependent on the agriculture sector. The urban communities also support their live through commodities and services translocate from subsidize agriculture in the rural areas. Urban agriculture is constrained by several factors and industrialization is not supporting many people as expected. This time land share of each people is quite small and not more than one a hectare on an average, which can tolerate any future degradation of soils (Zegeye, 2009).

In Ethiopia, soil conservation work was started since the beginning of 1970s. Since then, several soil conservation measures were carried using different approaches. Recently, mass mobilized community movement is started via productive safety net program in some part of the country. In this approach all land owners must do soil conservation structure for sixty days. A significant portion of the country's territory is covered by terraces and bunds. Thus, in Ethiopia, emphasis has been given on soil conservation practices to safeguard sustainability of agriculture sector and environmental quality. The focus was on the highland areas of the country where the problem is crucial and food deficit is prevalent. The conservation works were mainly undertaken through Food-for-Work (FFW) program benefits (Birhanu and Meseret., 2013; Biratu and Asmamaw, 2016). In this approach, huge hectare of land was covered by physical soil conservation measures. Since incentives in terms of grains are started at that time, people were willing to do conservation measures on crop land as well as on mountains. However, the sustainability of these conservation structures were an issue (Birhanu and Meseret, 2013).

Several factors can be mentioned as a cause for failure of these conservation structures. As peculiar reason development agents and implementing agencies ignored socio economic characteristics of the society and biophysical feature of the environment. Planning should be effective in considering extremely diversified socio- economic conditions of the people. An approach which works effectively one area may not work well somewhere else. Moreover, sustainability of soil and water conservation work is constrained by farmer's outlook towards land degradation and technology adoption. Perception of the people is primarily halted all conservation work maintenance habit and aggravate soil erosion (Birhanu and Meseret, 2013). In Ethiopia, land resource degradation due to poor farming system is the main environmental problem which needs attention and immediate solution. Institutional factor emerging from poor or weak organization like land tenure insecurity, weak extension contact, absence of trainings and awareness campaign, unavailability of technologies are main barriers for negative outlooks of the people. There are any planning effort towards soil conservation could be comprehensive enough in considering all these heterogeneous socio-economic characteristics and farmers' perception. Thus, careful identification of hindrances will help to stakeholders, policy makers and agricultural extension workers for caring out appropriate soil and water conservation. Considering the importance, the present study is an attempt to collate information on prevailing factors that affects the sustainability of soil resource conservation measures and practices in Ethiopia.

The concept of soil conservation

Soil Conservation is defined in different ways by different scholars. It can be defined as the combination of appropriate land use and management practices that promote the productive and sustainable use of soils, thereby minimizing erosion and other forms of land degradation (Ekpenyong and Ekpenyong, 2012). Therefore, soil and water conservation is necessary for Sustaining the fertility and productivity status of soils. Thus, considering the significance of the sustainability of soil conservational works, efforts have been made to collate the available literatures from the journals, books, proceedings, newspapers etc. on the aspect of the major constraints in sustaining soil conservation system under various situations.

Soil conservation in Ethiopia

The aim of soil and water conservation is preventing or reducing the effects of soil erosion in one way maintaining the soil quality, in other (Esser and Haile, 2002). The Ethiopian government first recognized the severity of the soil degradation problem following the 1973-74 famines in

northern Ethiopia. The 1973-74 droughts also drew attention of external donors to land degradation problem; and then, conservation become a priority in Ethiopia. After the early 1970s, national efforts to conserve land with appropriate interventions largely relied on mobilization of farm households and FFW projects to conserve degraded lands through the construction of soil bunds, stone terraces and afforestation activities. SWC practices followed in Ethiopia can be divided into mechanical and biological practices. Mechanical practices control soil erosion, whereas biological practices prevent erosion by intercepting raindrops and thus not allowing the erosion process to start. The major benefits of erosion control are conserving water and retaining of soil nutrients and organic matter, as well as maintaining soil depth and soil structure (Ekpenyong and Ekpenyong, 2012).

Principal causes for unsustainable SWC measures

Attitudinal factors: In Ethiopia, farmers perceive SWC techniques differently (Adimassu *et al.*, 2013). Local people in the low land areas have low perceptions of SWC problems (Adimassu *et al.*, 2013). Therefore, severe gully formation, low absorption capacity of soil, formation of termite mounds, low ground water recharge capacity, less vegetation cover, disappearance of grasses, emergence of invasive weeds and decline in crop yields are some of the important indicators for low perception of SWC problems in the low land agro- ecology of the region. Most of the interventions of soil and water conservation practices have either not fully or partially considered the involvement of farmers. Failure to participate community at all stages brought less ownership sense to soil and water conservation structures constructed in the area that imposed negative impacts to its sustainability (Adugna *et al.*, 2015). Farmers' perception to soil erosion is one factor affecting sustainability of soil and water conservation practices (Nigussie *et al.*, 2017). Land owners outlook towards soil degradation problem has appositive and key influence on adoption and continued use of soil and water conservation measures and technologies than a person who feel nothing about degradation status of his land. The inference is that a farmer who feels and recognizes soil erosion or any other soil degradation type in his farm is more willing to do and adopt soil conservation measures. If all other governing factors kept constant, farmers who feel his land is prone to degradation is more likely to adopt and sustainably maintain soil conservation works (Adugna *et al.*, 2015). The farmers and land owners sustainable utilization of soil conservation work is affected by the interest and effectiveness of introduced technologies and approach. An incentive in the form of cash, kind or both was given to the farmers participating in public work through food-for-work schemes (FFW) (Esser and Haile, 2002).

Moreover, the recently launched productive safety net program has supported food insecure rural families to receive cash or kind payment. All people participating in mass mobilized soil resource conservation will receive promising incentive in terms of cash or kind. The most common means used to promote and compensate people is offer of wheat, corn and oil for food and equipment like shovel. In all incentive approach, sustainability questions arise when incentives stopped, beneficiary farmers dismantled and/or abolished the constructed soil conservation works from communal and even from private land (Nyssen *et al.*, 2010).

Bio-physical factor: The physical soil and water conservation structures have been poorly or partially supported with biological stabilizers like fodder trees, multi-purpose trees, and live bund stabilizers (Bewket and Sterk, 2003). In most of the areas, soil and water conservation practices have been done either with food-for-aid schemes or government campaign through different programs. Similarly in some areas farmers tried to use soil and water conservation practices on their farmland. In spite of the effort to construct different physical soil conservation structures both on communal and private farm land, in most cases it was not supported with biological soil and water conservation measures (Gashaw *et al.*, 2014). The second reason is just absence of integrating indigenous SWC. Farmers have typical agronomic soil and water conservation practices to conserve the soil, moisture and to enrich soil fertility. Some of the known agronomic practices are crop rotation, contour ploughing, mulching, manuring, strip cropping, agro-forestry practices and life tree planting. The failure to integrate these rich practices to exotic soil and water conservation is one of the main constraints exist in Ethiopia. Unaware and untrained land owners and farmers try to destruct and remove conservation structures from their land. Sometimes they consider conservation works as barriers for farming and wish to get additional land from destruction of constructed physical conservation structure. Most vulnerable soil conservation structure for destruction includes stone and soil based terrace due to host to animals like rat.

The soil fertility level of the farm land has negative effect on sustainable utilization of soil conservation structure. A land owner growing crops and keeping animals on fertile land is not voluntary and fully motivated to continually use soil conservation work and other management practice. Despite this, some farmers may invest much more on soil conservation of fertile land to obtain maximum yield (Birhanu and Meseret, 2013). Landscape of slope has a detrimental effect in recognizing soil erosion and degradation. Farmers who has farmland with steep slope position is more likely to recognize the occurrence of soil

degradation as well as soil erosion problem and apply management and conservation measures than farmers who owned land in flat area. Farmer's willingness to adopt conservation measures in sloppy area perhaps due to effectiveness of measures and technologies induced (Hammad, 2006; Joshi *et al.*, 2017). The distance of farm land from residential area of farm land will negatively affect continued use of soil and water conservation work. The inference is that land owners who have land far from his homestead has lower probability to sustainably adopt conservation work. This will lead to conclusion that farmers give high conservation attention to nearby farm land than distant plots. Therefore the greater the distance between farm land and farmer the lower the attention will be given to sustainable soil conservation work (Birhanu and Meseret, 2013).

Farm land size has a negative influence of adoption and courage to sustainably use conservation work. Land owners with large territory have less probability to sustainably use soil conservation work. Therefore, there is negative association between land holding size and sustainable adoption of conservation work. This might be due expensiveness and labor demanding nature of soil and water conservation works. According to prior study, farmers having greater than one ha and far lands are not interested on continual use of SWC structures. In contrary, farmer's having low fertility and moderate slope highly involved in conservations (Birhanu and Meseret, 2013).

Demographic factors: High population density forced majority of farmers to depend on intensive farming for their subsistence which is a prime cause for less or no attention towards long term soil and water conservation investment. A positive correlation between family size and adoption of water conservation practices and assumed that this was related to the increased manpower in a large family (Bewket and Sterk, 2003; Joshi *et al.*, 2017). In contrast, family size has a significant negative effect on adoption of water conservation practices; they assumed that the increase in family size decreased the probability of adopting soil and water conservation of soil conservation and were more inclined to adopt SWC measures. Hence, people are forced to incline towards their immediate livelihood need rather than investing on SWC that posed a win-win negative impact on soil and climate (Birhanu and Meseret, 2013).

Institutional factors: Inefficient extension system, weak link between research and extension are root causes of unwise utilization and management of the natural resources. In addition, the development agents have been assigned to support and advice farmers in all agricultural activities including SWC.

However, the adoptions of natural resource management technologies are low and even the adopted ones are not sustainable (Adugna *et al.*, 2015). Unstable institutional frame works and weak link between research and extension have found to be root causes of soil degradation and are major policy constraints discourage farmers from making any sort of investment in the land to use it in a more suitable way. Land owners with frequent visit of farmer training center and demonstration sites are more voluntary to maintain soil conservation works because it give chance to learn technical skills and principles of natural resource management (Antonio, 2016). Less training on natural resource management and poor SWC design are another barrier. There is less or no subsequent training on natural resource management, specifically on soil and water conservation measures (Birhanu and Meseret, 2013). Moreover there is no formal and informal type of training given to farmers to raise their awareness and perception level of natural resource management. Similarly the capacity building targeting natural resource management is rare, rather more attention has be given to crop and animal production (Tadele *et al.*, 2017). Formal education centers are vital to give detailed and comprehensives technical skill for trainers and extension workers regarding land management principles. It is believed to create room for integrating native resource conservation approach and knowledge with scientific evidences and knowledge. Therefore access of farmer's education center is vital to attain sustainable utilization of resource conservation technologies.

Prerequisite analysis of farmer's attitude towards SWC practices before planning and implementing is very essential for sustainable management. In Ethiopia, However analysis of farmer's attitude before planning and implementing of conservation effort received little or no attention. It influences sustainable implementing program. Planning and implementing SWC measures through top down approach without the agreement and willingness land owners, farmer's idea, experience affect continuous use of SWC practices. Follow down top approach and include farmers in any decision making process is significant to aware long term beneficial practices. Land tenure securities are a vital issue to provide incentives to invest on land management and boost agricultural productivity (Waiganjo and Ngugi, 2001; Bugri, 2008; Kabubo and Mariara, 2010; Kahsay, 2011; Biratu and Asmamaw, 2016). It can state rules and regulation regarding land resource (Soule *et al.*, 2000; Waiganjo and Ngugi, 2001; Rulers, 2008; Kahsay, 2011). Land owners responsibility and obligation with respective right can be clearly elaborated. In adequate access to land and unclear restriction from use of land are major obstacles for land management and open room for poverty. Secured land right can facilitate soil and water conservation work due to

several reasons. Just to give some example; if people are guaranteed for their land right in future, they will be more voluntary to invest on land management (Kabubo and Mariara, 2010). Secondly, people will add conservation work on their land just to add value of their land on the market.

Other factors: Weak or less adoption of soil and water conservation techniques, cultivating marginal, hilly and mountainous land, improper use of agronomic practices, clearing of forest and bushy areas expose the top fertile soil to erosion and depletion of its nutrients in the country has imposed its negative impacts on sustained soil and water conservation practices (Beyene, 2011). However, in most cases, farmers are reluctant in maintaining the structures; particularly those constructed in communal lands are fully destroyed, cultivated and opened to free grazing (Tadele *et al.*, 2017). The engagement of farmers in off farm activities is one factor that affects sustainability of soil and water conservation works negatively. Land owners who engaged in non-farm income producing activating are likely to put less effort on land conservation than person having land based livelihood. In addition, most of the noon farm income activities are under way in a season when conservation work is going to be done. Thus, off farm and non-farm activities are competing for labor force with land conservation activities. The courage and commitments of land owners to conserve and continually use soil resource conservation work is lower as farmers engaged in off farm activities (Birhanu and Meseret, 2013).

Conclusion

Sustainability of SWC in Ethiopia has been affected by attitudinal factors, such as farmer's perception on SWC and soil erosion. Bio-physical factors, such as lack of integrating bio-physical SWC measures, absence of integrating local SWC techniques, farm size, soil fertility, slope, and farm land distance from habitat areas have tremendous effect on sustainable adoption of soil conservation work. Besides, sustainability of conservational works also depends on the demographic and institutional factors. Poor extension system, improper training, lack of peoples' awareness, land insecurity etc. are found to be important factors hindering the sustainability of soil and water conservational works in Ethiopia. Less involvement of farmers in off farm activities as well as misuse of available scare resources are also major factors responsible for ineffectiveness of the conservational. It is quit necessary to recognize that sustainable utilization of SWC structures are entirely dependent on their easy feature, compatibility with ecology and cost-effective. Improving farmer's attitude and perception regarding natural resource conservation as a whole and soil resource conservation in particular found to be principal.

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