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Review Paper

An Evaluation of Watershed Management Practice in Ethiopia: A Preliminary Review

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Abstract

Soil erosion and land degradation in the Ethiopian highland is one of the root cause that threatening agricultural development and livelihood of the society. Land degradation in the form of soil erosion and declining fertility is a serious challenge to agricultural productivity and economic growth (Mulugeta, 2004). In the mid-1980s it was estimated that 4% of the highlands (2 million ha) had been so seriously eroded that it could not support cultivation, while another 52% had suffered moderate or serious degradation (Kassie et al., 2009). Average soil loss rates 21 to 42 tones per hectare per year on cultivated lands (Hurni, 1988).Watershed management in Ethiopian highlands is therefore not only related to the improvement and conservation of natural and ecological environment, but also to the sustainable development of Ethiopia's agricultural sector and its economy at large. In Ethiopia, efforts towards this conservation goal were started since 1970s and 1980s (Aklilu, 2006; Wogayehu and Drake, 2001). However, some of the management approaches were successful and other not. Therefore, this paper identifies opportunities to promote and scales up the successful best watershed management practices and identifies challenges to put into practice different management practices which give preparation for watershed managers.

Key word: *Watershed, evaluation, soil erosion, land degradation, soil and water conservation.*

Introduction

Ethiopia is a large country (113million hectares) that is endowed with divers physiographic and climatic condition, with huge water resource potential (about 122 Bm3 annual surface runoff and 2.9 Bm3 groundwater), though it is characterized by uneven spatial and temporal distributions. Between 80-90% of the country's surface water resources are found within four major river basins – Abay (Blue Nile), Tekeze, Baro Akobo and Omo Gibe and Rainfall in the country ranges between 2700 mm per year in the south-western highlands and less than 200 mm in the North and South-East with a further decrease of less than 100 mm per year in the North-East (MoWR, 1999).

Table 1. Major river basin of Ethiopia

River basin	Catchment area in km2	Average runoff in MCM/year	Average rainfall mm/year
Abay(Blue Nile)	199,812	54.8	1000-1800mm
Tekeze	82,350	8.2	600 -1300 mm
Baro-Akobo	75,912	23.6	900- 2400mm
Omo –ghibe	79,000	16.6	400-1900 mm

Source: Integrated River Basin Master Plan Studies, carried out during 1997-2007.

Table 2. Population and Natural resource of Ethiopia

S.No.	Land use	Year	Area in km^2
1	Total area	2014	1,104,300
2	Total population	2014	96,506,03
3	Water surface	2014	104 300
4	Agricultural land	2007	350 770
5	Arable land	2007	140 380
6	Permanent crops	2007	10 390
7	Permanent meadows and pastures	2007	200 000
8	Forest area	2007	127 180
9	**Other land**	**2007**	**522 050**

Source*: www.world stat.info/Asia/Ethiopia/Land, Acc, 27.10.14, 3:20pm*

The economy is primarily based on agricultural production, it accounts for 52% of the GDP (World Bank, 2002), 90% of the total export revenue (IMF, 2002), and employs about 85% of the labour force in the country (CSA, 1999). It is characterized by predominantly subsistent in nature. In recent years, environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, and deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution. A large part of the country is dry, sub-humid, semi-arid, and arid, which is prone to desertification and drought. It has also fragile highland ecosystems that are currently under stress due to population pressure and associated socio economic practices.

The extent of fertile land available for agriculture is decreasing due to land degradation. This is caused by deforestation and inappropriate use and management of the natural resources, (soil, forest resource and water resource). It leads to both non sustainable agricultural production and increased risks of catastrophic flooding, sedimentation, landslides, (Adugnaw B., 2014). The implications of land degradation, soil erosion, and deforestation are extremely important, since the livelihoods of many Ethiopians are entwined with land resources. It reduces the production potential of land, and thus makes it difficult to produce enough to feed the growing population. It also increases farmers' vulnerability to food shortages and becomes a threat to the mere survival of the people. The looming food insecurity in the country is mainly linked to the prevailing degradation problem. Land conservation is therefore badly needed (Sonneveld and Keyzer, 2003).

In Ethiopia land degradation in the form of soil erosion and declining fertility is serious challenge to agricultural productivity and economic growth (Mulugeta, 2004). Several studies have shown that extensive areas of the highlands have high rates of erosion. In the mid-1980s it was estimated that 4% of the highlands (2 million ha) had been so seriously eroded that it could not support cultivation, while another 52% had suffered moderate or serious degradation (Kassie et al., 2009). Average soil loss rates 21 to 42 tones per hectare per year on cultivated lands (Hurni, 1988).

Of this soil loss, an estimated 90% is deposited down slope and the remaining sediment leaving Ethiopia and transported to Egypt. The degradation of agricultural land causes a serious risk to current and potential food production in the highlands of Ethiopia (Hurni, 1988; Azene, 2001; Sonneveld and Keyzer, 2002). Land degradation in Ethiopia is also intensified by soil nutrient depletion, arising from continuous cropping together with removal of crop residues, low external inputs and absence of adequate soil nutrient saving and recycling technologies (Bojo and Cassels, 1995; Sahlemedhin, 1999 as cited in Tesfaye H., 2011).

According to study conducted by FAO in 38 sub-Saharan Africa countries, including Ethiopia showed that Ethiopia is one of the countries with the highest rates of nutrient depletion. The aggregated national scale nutrient loss was 41 kg/ha yr for N, 6 kg/ha yr for P and 26 kg/ha yr for K (Stoorvogel and Smaling, 1990 as cited in Tesfaye H., 2011; Mulugeta L., 2004). To address the land degradation and loss of soils, extensive conservation schemes were launched in Ethiopia, particularly after the famines of the 1970s. Since then, huge areas have been covered with terraces, and millions of trees have been planted (Herweg, 1993; Yeraswork, 2000 as cited in Tesfaye H. 2011). These projects have made use of farmer labor under the 'food-for-work' project funded by the World Food Program. Farmers were provided with grain and edible oil in payment for their participation in the conservation works. Obviously, food aid has helped to fight hunger in famine-stricken areas; however, the success rate has been minimal. This may be recognized to lack of involvement of local people in planning and implementation of the scheme, poor implementation and maintenance of the soil and water conservation structures, limited in span and scope, and lacked the long-term commitments needed to address underlying causes and long-term management issues in a satisfactory way, too much emphasis on natural resources conservation and little attention to human activities and the priorities and needs of people (Paulos Dubale; Achouri M., 2002;Mulugeta, 2004; Woldeamlak, 2003). Eventually, when the supply of food-for-work was discontinued, most of the participating farmers became unwilling to participate in the new conservation projects or maintain those already established. Some farmers even removed the structures from their lands (Yeraswork, 2000; Girma, 2001 as cited in Tesfaye H. 2011).

Since 1980, the government has supported rural land rehabilitation, these aimed to implement natural resource conservation and development programs in Ethiopia through watershed development (MOARD, 2005). The institutional strengthening project was implemented by FAO, and was principally aimed at capacity building of Ministry of Natural Resource's technicians and experts and development agents in the highland regions of the country. The projects used the sub-watershed as the planning unit and sought the views of local technicians and members of the farming community to prepare of land use and capability plans for soil and water conservation. This approach was tested at the pilot stage through FAO technical assistance under ministry of agriculture during 1988-1991(MOARD, 2005; FAO, 2006). This was the first step in the evolution of the participatory planning approach to watershed development.

By late 1990, Watershed development, in Ethiopia has increasingly been managed and developed for poverty alleviation and environmental conservation. Agricultural production particularly rain-fed agriculture production objectives focused to alleviate poverty. As well as for environmental conservation, this also focuses on reducing the degradation of natural resources objectives (FAO, 2006).
Throughout the world and particularly in Ethiopia now Community based Watershed Development Programme has evolved as a comprehensive development concept for sustainable and efficient utilization of natural resources for the benefit of the local community with special attention to the rural poor.

The basic objective under the Community based watershed management programme ought to be that the conservation and development measures be conceived as means and the production systems compatible with the concept of ecological security as ends. Community based Watershed management is, thus, holistic development seeking sustainable livelihood security system for all life forms in the area.

The key to the success of any watershed project and its sustainability depends on people's participation. For achieving the desired participation of people, the roles of community organizations, groups and other stakeholders are crucial. Local people must play an active role starting from project design, moving to implementation and the project maintenance. In this context, a participatory watershed management approach is considered as the ideal for achieving food security and sustainability (Nancy et.al 2001). In spite of substantial progress in watershed management practice in Ethiopia, land degradation and unsustainable natural resource base is still continuing. Sustainable natural resource is essential for conserving water, land and biodiversity, enhancing local livelihoods, improving the economy of highland inhabitants and people living in downstream areas and can only be achieved by an integrated approach through local people's participation. Generally in many part of the country there is an intervention in watershed development project which targets to improve the livelihood of the population. Nevertheless, the achievement is not known. Hence, there is a need to investigate how this project answers the felt need of the community.

Objectives of the review

1. *Evaluate the extent and process of resource degradation,*
2. *Assessing the socio-economic condition, resource, and watershed management practice, and*
3. *Identify major gaps in watershed management strategies and approaches*
4. *Identify the best solution that can lead to sustainable watershed management activity*

Review of Literatures

International perspective

According to Krishna et al 2008 in Nepal, Increasing of population creates more pressure on natural resources in South Asian countries particularly mountain regions resulting in the deterioration of watersheds. To overcome the watershed degradation problems many developing countries have practiced different watershed management approaches from top-down and sectoral to bottom-up, participatory and integrated types. But the study pointed out that both top-down and bottom-up approaches have strengths and weaknesses in implementation of programs. However, the past top-down approach has many limitations for sustainable watershed management, because it ignored needs of local people. In line with this, Empirical evidence by Nancy j. et al 2001 reveals that giving users a role in managing their own watershed resources can lead to project that are more effective and efficient than their top- down predecessors. The study portrays that user participation also has implications for watershed management research. In addition to changing the way technologies and practice are developed and disseminated, participation broadness the research agenda bringing in new topics like horizontal behavior, collective action and conflict resolution.

But there is a great need for further research on these topics as they relate to land and watershed management, beginning with a synthesis and comparative analysis of past experience in areas such as boundaries and scale, transaction cost of facilitation and the development of indicators.

According to the study carried out by Azene and Gathiru in 2006 Experience in south and east Africa has shown that to effectively reach the farmers and to create viable watershed management options, it is important to respect indigenous knowledge and combine it with the formal modern science and technology. According to this study, local traditional institutions should be part and parcel of the process. The study reveals that, there is a lot of under-used indigenous knowledge about climate, soils, biodiversity and other production conditions that confront farmers.

The finding of this research indicates that in the eastern Africa, there have not been sufficient efforts to link watershed management with research -- or to build research into watershed management. The study conclude that, watershed projects have not been used as on-farm sites for research designed and implemented with significant involvement of farmers and extension workers to produce site-specific technological solutions. This leads to problems in adoption and up-scaling of research findings within specific watersheds.

Finally the authors of this study contend that there is also the question of up-scaling technologies and approaches beyond a designated watershed. At the same time, researchers were unable to relate research activities to the real problems facing farmers or to capture the locally developed or modified technologies. Yet there is a need to give technologies appropriate technical and scientific definition and to disseminate them widely.

Another study conducted in Kenya by Isaac in 2009 using survey design indicates that integrated watershed management is fostered by participatory efforts exerted in the critical biophysical, socio-economic conditions and suitable institutional structures that are being established. According to the study, participatory/integrated watershed management has been widely accepted and considered as an effective way of managing watershed resources in Kenya, although implementation of this approach in practice remains a challenge.

These findings also seriously question the optimistic approach in popular and policy-level discussions that treat watershed based development as the new panacea.

Finally, the authors of this study contend that the Watershed management needs to be restructured significantly, if the watershed development approach has to deliver what it promises. Such a restructuring must clearly embrace a normative framework that treats livelihoods, productivity, sustainability, equity and decentralized governance as its central concerns, and must be based on strategies that respond to the varying socio-ecological contexts and experiences with implementation.

Finally Achouri (2005) noted that the reasons why many watershed management programmes in Africa failed to achieve their objectives. First, too much focus on natural resource conservation, second, they designed in little attention to human activities, priorities and needs of people, third, they neglect the beneficiaries' involvement and contribution to planning and implementation of the watershed management interventions and fourthly, they were frequently limited in span and scope, and lacked the long-term commitments needed to address underlying causes and long-term management issues in a satisfactory way.

National perspective

According to Adane Y. 2010 in Terri Watershed in Delanta Woreda, Ethiopia, the natural resource improvements in the watershed are used as opportunity for the watershed community household. As result, households have benefited in terms of ease access to fodder for their livestock, and reduction in soil degradation. Even if the above changes observed economic return became low on which the extent of improvement in crop productivities and production is not in the way of expected.

In the study he pointed out that, the technological (inputs) and technical activities of the watershed have challenged by different factors. As result, the sustainability issue of the watershed has become under question and has exacerbated due to the slow economic return of the natural assets. The dominant livelihood activities of households in the watershed are agricultural and non-farm income generating activities. The existence of the watershed in the area with its enabling opportunities, has contributed to diversify their livelihood portfolio.

In general the study concluded that "integrated" has been conceptualized only in concept context but, lack of practical application in ground and not bringing the anticipated results due to two reasons: First, all the critical assets of households are not made in integrated way. Second, some important activities, which make the watershed integrated, are not done well and even the performed ones are not made simultaneously, rather one follow the other, which is time consuming and as result did not give immediate economic return for the rural poor.

The technical supports for rural poor except food-for-Work, and poor social and institutional activities of the intervention result in the sustainability of the watershed to be in question. According to Woldeamlak (2001; 2003) in East Gojjam Zone, the extent of farmers' participation in soil and water conservation activities revealed that majority of the farmers participated in the soil and water conservation activities against their will. According to this study majority of the farmers considered soil and water conservation activities that were underway in their communities to be a mandatory development work in which the village administration and development agents of the area forced them to participate. The study conclude that, the most important factor discouraging them from participating freely was the perceived ineffectiveness of soil and water conservation structures under construction.

According to Aklilu (2006), in Beressa watershed pointed out that, the majority of farmers believe that erosion halted, and they used a range of practices for erosion control and fertility improvement though most farmers have developed negative attitudes towards externally recommended measures. This study pointed out that, participation and consideration of farmers' conservation knowledge and practices identified as a key to the success of conservation practices in the study watershed. Finally the study verifies that development of employment opportunities outside farming could help to reduce the pressure on land and emerging landlessness. Security of land tenure encourages farmers to invest in long-term conservation activities. Furthermore, efficient market and credit services are needed to support smallholder production and resource conservation. These enabling conditions would help to enhance better farming and sustainable land use in the watershed area and other areas of the Ethiopian highlands with comparable situations.

Another study conducted by Binyam and Desale, 2014, severe soil erosion and low crop productivity mainly caused by low soil fertility and absence of efficient and sustainable soil fertility management practices are the major constraints contributing to food shortages in the highlands of Ethiopia. To tackle this problem, various physical and biological soil and water conservations practices had been widely implemented in the highlands, by the Ethiopian government in collaboration with the local community and charitable organizations. Accordingly, reports have shown that some soil and water conservation practices have resulted in positive effects on soil fertility, moisture conservation and agricultural productivity, while there was soil and water conservation systems have not. However, the integrated application of mechanical, biological and soil management practices have been vital for the rehabilitation of degraded lands since they reduce flood risks, nutrient losses, sediment losses and increase grain yields.

Finally this review has shown that integrated watershed management practices are the only possible solution for rehabilitation of degraded lands. Therefore, an integrated use of physical, biological and agronomic soil and water conservation measures through public investments with site suitability and their long-term agro-ecological and economic consequences should be considered.

Analysis

1970 -1990 watershed management activates

Despite the growing concern over the management of watershed in view of environmental and economic implication, there is confusion as why watershed should be considered conservation and development planning units. Watershed development and management project receive low priority because of unattractive direct benefit. Inconsistency is found in the basic framework of the program. The early started soil and water conservation activates were failed without achieving the desired objective.

Due to;

- ✓ *Low level of community participation.*
- ✓ *Wrongly applied techniques.*
- ✓ *In appropriate technological preference.*
- ✓ *In sufficient research support.*
- ✓ *Low technical capabilities field technical.*

It became apparent that the "top down" planning approach to development that focused on technical and physical works alone would not lead to the desired environmental, social and economical objectives.

After 1990 watershed management activities

Following the failure of early started soil and water conservation activities, the approach has changed to people based approach; it was the turning point to shift from top down to people based approach .It was then realized that watershed development needed to be more participatory, taking into account community and household concerns. This approach changed the whole picture of soil and water conservation in the country where quality, sustainability, livelihood and environmental impacts of measures were highly valued than fulfilling quotas.

In comparison to previous land rehabilitation initiatives strong emphasis was placed on household income-generating activities and innovative approaches towards conversion of degraded landscapes to productive lands. To achieve the desired objectives,

- ✓ *Should involve farmers and consider their interests, because the key to the success of any watershed project and its sustainability depends on people's participation.*
- ✓ *Local people must play an active role in project design, implementation and maintenance.*
- ✓ *In this context, a participatory watershed management approach is considered as the ideal for achieving food security and sustainability*
- ✓ *Farmers need to be convinced that there are short-term benefits to be obtained from the change*
- ✓ *The integrated and bottom up watershed management approach should concentrate on both the community and the individual farmer level and sufficiently take into consideration biological and production aspects.*
- ✓ *Although with the help of the experience gained at all levels from peasants to experts, set of measures were gradually refined, it eventually became quite clear that there exists an urgent need for applied research to assist the activities and experiences*

Technological gap

Even though, different studies have been made on watershed management practice, the focus of many studies has so far been more on pinpointing;

- ➢ *Watershed management problem and effect (Mintesnot,2007)*
- ➢ *Mainstreaming gender in watershed management(UNDP 2006)*
- ➢ *Site specific conservation planning and investigation of watershed management practice due to divers environmental condition (Woldeamlak, 2003),*
- ➢ *No studies have given more emphasis on economic return of watershed management practice for who have farm land and landless community,*
- ➢ *This section points out key opportunities to help improve the quality of interventions, up-scale successful practices and long term commitment of watershed management practice.*

Conclusion

As per various studies, the problem of watershed degradation could not be solved without addressing the socio-economic problems of the area. This situation can be overcome, only through 'incomes generating mechanisms' to the poor and landless for preserving and conserving the watershed. This can be implemented through economic linkages in terms of employment, education, and basic facilities and amenities of the watershed inhabitant.

Many people especially in developing countries mainly depend on natural resources for their survival. To reduce such pressure on natural resource, People should be empowered so that they can rely on alternative income generation activities apart from the complete dependence on natural resources. Demand based technologies; people's participation, effective conservation, education and sense of ownership are the key elements essential for the sustainable management of natural resources. Demand based technology addresses both the production and conservation objectives of the resource poor in the context of conservation and socio-economic environments. Simple and low cost technologies are more acceptable for farmers rather than expensive and labor intensive conservation techniques. Farmers need technologies which they can easily understand and implement on their farms with minimum cost.

Improved interaction between farmers and extension workers facilitates knowledge transfer and thus raises the level of farmers' awareness of problems and benefits of conservation. Farmer's participation in monitoring and evaluation empowers the farmers, develops a sense of ownership of the conservation activities, and further promotes trust among the stakeholders.

It is strictly essential to think about conservation technologies which will get endorsed by farmers if meaningful results are to be achieved. Farmers' endorsement will be obtained if they are genuinely involved in all stages of problem identification, finding of alternative solutions, implementation and evaluation of effectiveness and efficiency of the solutions.

Different discussion have been made about factors that influenced farmers' willful participation in the conservation works, in addition to effectiveness of the technologies, included farmers' awareness and perception of soil erosion and degradation hazards, labour availability, and feeling of insecurity on plots held. Results show that the farmers are generally aware of soil erosion as a problem damaging to their plots of land; labour shortage is not a major problem of households to their farming operation, including soil and water conservation, and tenure insecurity does not appear to be a primary constraint for the farmers to apply soil and water conservation measures. That is, these factors cannot provide explanation to the disinterest shown by most of the farmers to participate in the soil and water conservation activities.

Therefore, the important factors that need immediate consideration for soil and water conservation endeavours in the study watershed or the Region at large are: soil and water conservation structures have to be carefully designed and constructed taking into account the realities on the ground; and participation of the farmers has to come out of their conviction through a demonstrated effectiveness and efficiency of the technologies.

Lessons from past experiences have shown that watershed management programmes must be comprehensive and involve all stakeholders. Project failures are due in large part to the application of top-down approaches and rigid principles that are not adapted to local conditions.

The excessive emphasis on short-term visions for watershed management programmes is also a cause of failure. The absence of water rights and land property rights has been identified as a major constraint to the successful application of programmes for upstream–downstream linkages. There is also a need to link biophysical and socio-economic considerations in planning for watershed management programmes (FAO, 2005). According to Achouri, 2002. Generally watershed management is increasingly seen as an appropriate vehicle not only for environmental conservation but also for the improvement of living conditions of rural communities. In this regard, there is a need for long-term commitment through the participation of all stakeholders at all level.

Recommendations

Community based watershed management practice have found to change crop pattern, increase the responsibility of an individual over natural resource conservation, crop diversification, increase in agricultural production, increase sustainable natural resource conservation, it has also an increase employment opportunity for rural poor, especially for the landless population because it help to enhance the off farm activity for the landless watershed residents. Therefore, alternative farming system together with agricultural crops, livestock, beekeeping and tourism component with comparable profit should be evolved demonstrated to the watershed residents.

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