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Review on Effect of Integrated Soil and Water Conservation Measures on Soil Productivity, Soil Quality, Water Quality and Sustanable Soil Management Practice in Ethiopia

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ABSTRACT

Several researchers indicated that severe soil erosion challenges exist in Ethiopia as a result of long-term human related activities and its erosion-prone land forms and climate. Anthropogenic forces that alter the physical landscape and Environmental degradation cause substantial soil erosion with gully formation which have adverse impact on soil fertility, productivity, soil and water quality and, sustainability; therefore necessitating soil and water conservation practices as important aspects of soil and water management planning. In this review we focused principally on the effect of integrated soil and water conservation practices on soil productivity, soil quality, and sustainable soil management and how to mitigate them. The results established by various researchers showed a SWC increase the soil moisture, fertility of soil which maintains soil quality and productivity in Ethiopia by decreasing soil erosion and which cause soil degradation. The increment of soil fertility increases the sustainability of livelihood food security and income. Sustainable agriculture is a balance between social, environmental and economic priorities. The balance secured with production of sufficient amount of food with affordable price and also with keeping the quality of the food. The review revealed the effect of SWC both on-site and off-site effects on land and also on water bodies thereby increased its quality. The objective of the paper is to review on soil and water conservation measures increase soil productivity, soil quality, and sustainable soil management in Ethiopia.

Keywords : Soil and Water, Soil Productivity, Soil Quality, Sustainability, Management

I. INTRODUCTION

Several researcher indicated that (Tanto and Laekemariam, 2019; Laekemariam et al. 2016; Teklu et al. 2018; Adimassu et al. 2017; Wolqa, et al, 2011, Worku Hailu, 2017, ATA, 2013, Abay Ayalew, 2011) construction of soil conservation measures in the degraded highlands and stabilizing with multipurpose plant species and adding organic manure is sustained soil fertility, which increase soil productivity and maintain soil quality.

The cause of taking soil conservation measure is the indication of soil degradation in Ethiopia (Wolqa, et al, 2011, Tanto and Laekemariam, 2019). Soil degradation is the most serious problem and threat to food production, food security, and natural resource conservation in the highlands of Southern Ethiopia. As most of these lands are sloppy, soil loss due to soil erosion is very high removing all the top fertile soils, applied fertilizers, and sown seeds. The World Bank (2005) and IMF (2005) report Farmers are remaining with no or very low harvest when cultivating these vulnerable lands without proper management. The study clearly showed that improving the productivity of highlands, which are prone to soil erosion, without soil conservation is impossible. Estimated soil loss from agricultural fields with different slope positions (left) and different cultivated crops (right) in Debre Mewi in Dirk Jobst Rolker 2008. Dirk Jobst Rolker,2010), Zegeye et al,(2010), indicated soil loss on non-conserved land compared with land soil and water conservation measure taken, the annual soil loosed in non-conserved is 47.6 ton than conserved. In other word the SWC measure prevented 47.6ton of soil loss in 10% slope land of agricultural soil.

several authors has been suggested that the concept of soil quality by (Lal, 1991; Granatstein and Bezdicek, 1992; Sanders, 1992; Karlen et al., 1992; Papendick and Parr, 1992; Parr et al., 1992; Acton and Padbury, 1993) as a tool for assessing long-term sustainability of agricultural practices at local, regional, national, and international levels. This suggestion was reinforced by a recent report from the National Academy of Sciences, National Research Council (1993) recommending that the United States adopt a national policy which seeks to conserve and enhance soil quality as a fundamental first step to environ-mental improvement. Doran and Paikill (1994) suggested that soil quality assessments could be used as a management tool or aid to help farmers select specific management practices and as a measure of sustainability. They also suggested that approaches used to define and assess soil quality should be tailored for specific applications such as sustainable production, environmental quality, and animal or human health. Soil quality may also provide a focal point or vocabulary for communication between scientists and non-scientists, if the concept can be clearly defined.

Several definitions have been proposed in an attempt to define soil quality, but unlike air quality or water quality for which the U.S. has established standards through legislation, the concept remains difficult to define and quantify. Doran and Parkin (1994) stated that a common link among all proposed soil quality definitions was the capacity of soil to "function" effectively at the present time and in the future. They proposed defining soil quality as: The capacity of a soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote animal health.

Acton and Padbury (1993) proposed that the definition of soil quality should be based on two critical soil functions, each representing major expectations placed on soils by farmers and agricultural or other resource managers. These functions are (1) to ensure increase crop production or the capacity to produce crops; and (2) to ensure environmental sustainability or the capacity of soil to serve as an environmental buffer, to accept, hold and release water to plants, streams, and groundwater, and to function as a source or sink for gaseous materials and the capacity to exchange those materials with the above ground atmosphere.

The aim of this paper was to review (1) Knowledge and Adoption of the Soil Conservation Measures in Ethiopia, (2), Soil and water conservation increase productivity and crop production (3). Soil and water conservation measure and livelihood asset in Ethiopia (4), Soil and water conservation maintain soil quality (5) SWC method of Sustainability of productivity management (6) soil and water conservation improve water quality and quantity.

II. Knowledge and Adoption of the Soil Conservation Measures in Ethiopia

The knowledge and adoption of soil and water conservation started in two ways. The first adoption and knowledge is indigenous like Konso, well known for their stone terraces that are believed to have existed for over four hundred years (Tesfaye Beshah, 2003), chench, the terrace was built in one event or at least over a very short period of time. It was most likely established in the late twelfth century or in the first half of the thirteenth century (Assefa and Hans-Rudolf, 2014) and Dawuro Kella (terrace) established in the late fourtith century or in the first half of the fiftieth century (Adimasu and Zelalem (2015), Camplainia et al., (2012) as cited in Haregeweny et al., (2015:3), J.Nyssen,1998:2).soil and water conservation techniques have been practiced for centuries, most likely first implemented during the Aksumite kingdom (400BC to 800AD) in the axum(Aksum) area of Tigray region. Thus, Terracing was developed and "Dagets" are the common traditional techniques of SWC in Tigray(In the intervention of the government in early nineteenth century, soil and water started at different area. In South Wello Amahara region in Maybar watershed the first rural intervention in the area was the 'development through co-operation' campaign known as Zemcha, that was carried out by university and high school students in the early 1970s. in Wolita soil and water conservation started the time of WADU(Wolita Agriculture Development Unit), rural development paradigms of the 1960s, the Ethiopia government initiated a project(WADU, 1981,Tesfaye Beshah, 2003). A targeted intervention took place after the largest famine ever in 1973, commonly known as 'the famine of Wello'. The intervention was carried out in the form of food-for-work and in another side it begins food for work in around 1974 due to famine 1973. Prior to the 1974 revolution, soil degradation did not get policy attention it deserved (Wogayehu, 2003; Demoze, 2014). The famines of 1973 and 1985 provided a momentum for conservation work through large increase in food aid (imported grain and oil). Following these severe famines, the then government launched an ambitious program of soil and water conservation supported by donor and non-governmental organizations. The use of food aid as a payment for labor replaced voluntary labor for conservation campaigns. Supporting this inspiration, Pender, J, and Berhanu, G (2008) stated that soil conservation measures have relied largely on food-for-work programs as an incentive and have been oriented toward labor-intensive activities such as terracing, bund construction and tree planting. With this, Ethiopia became the largest food–for-work program beneficiary in Africa and the second largest country in the world following India. A total of 50 million workdays were devoted to the conservation work between 1982 and 1985 through food-for-work. Between 1976 and 1988, some 800,000 km of soil and stone bunds were constructed on 350,000 ha of cultivated land for terrace formation, and 600,000 ha of steep slopes were closed for regeneration (Wood, 1990).

These conservation structures were introduced with the objectives of conserving, developing and rehabilitating degraded agricultural lands and increasing food security through increased food production/ availability. Soil erosion poses a serious threat to national and household food security and therefore its management is essential for improving food security in seriously affected areas of Ethiopia (Awdenegest and Holden, 2006). Initially, most of the soil conservation works included construction of the stone and earth embankments, which the farmers believed took extra land from their small land holdings and sheltered rodents. Available evidence shows that the adoption of soil and water conservation measures has been very limited. A study by Pender, J, and Berhanu, G (2008) show that the problem of soil erosion is compounded by the fact that some farmers dismantled the conservation structures built in the past through FFW incentives. In fact, until the early 1990s farmers were not allowed to remove the conservation structures once built on their land. This shows that the conservation efforts have also neglected the pronounced regional disparities within the country and have frequently been implemented in a top-down 13 manner, excluding the participation of the local community (Herweg, 1993). It is further clarified that some techniques such as terracing and other land management practices can increase productivity and thus profitable in some area like in low rainfall area, but the same techniques are much less profitable in other areas like in high rainfall areas because they can actually reduce farmers‟‟ yields by reducing the effective area of the plot, causing water-logging, or harbor pests. However, the introduction of economic reform program in 1990s and subsequent liberalization of the economy brought more freedom and hence conservation structures could be removed if the land users so wished. Conservation practices have mainly been undertaken in a form of campaign and quite often farmers have not been involved in the planning process (Herweg, 1993). This shows that soil conservation projects implemented in the country failed to consider local people‟‟s economic, demographic, institutional and technical factors from their very inception. Obviously, the adoption of soil conservation technologies considerably is influenced by different factors. Among other influences, the characteristics of farmers such as age, education, household size, farm size and experience are some major influence for the decision of application of soil conservation. The age of a farmer is an important characteristic of a farmer that affects adoption of soil conservation technology.

Relationship between age and application of soil conservation technologies has been seen from different point of views. Age of the farmers tends to influence negatively the conservation decision in that it decreases participation on environmental protection (Berry, 2003). Yet other studies carried out by Ntege-Nanyeenya et al. (1997) and Nkonya et al. (1998) found no relationship between age and adoption of a technology. According to USAID (2000) exposure to education may enhance the awareness of a new technology and hence increase the capacity of the farmers to apply a given technology. Other case studies in Uganda by Ntege-Nanyeenya et al (1997) indicated that education had a significant effect on farmers‟‟ choice to adopt maize production technologies. Also to Ervin and Ervin (1982) education was found as significantly related to conservation efforts. Education enhances farmers‟‟ willingness to adopt new techniques by improving the management capacity of farmer.

III. Soil and water conservation increase productivity and crop production

Soil degradation directly and indirectly affects agricultural productivity (www.nap.edu,2001). Soil is a critically important resource, the efficient management of which is vital for economic growth and development for the production of food, fiber and other necessities (Troeh et al., 1980, Wolka et al.2013). To accommodate the increasing demand for food, soil fertility is fundamental to the productivity and sustainability of farming Chencho Norbu, and Christopher Floyd, (2001). The low soil fertility in this part of the country is therefore blamed on the bush fires, low residual remaining, and sloppy ploughing with high rain fall which usually occur annually during the rainy season commencing from May to August the all the year (Wolka et al.2013). In the Ethiopian highlands, the agricultural production system cannot maintain a permanent vegetation cover throughout the year under the given ecological, economic and social circumstances (Herweg and Ludi, 1999; Ludi, 2004). This situation renders the soil bare exposing it to both wind and water erosion in the dry and rainy seasons respectively thereby depleting the macro-nutrients such as Nitrogen, Phosphorus and Potassium (NPK) and organic matter from the soil. Initially, farmers used to replenish the soil with its nutrients by practicing shifting cultivation or land rotation. However, with the increase in population which has put pressure on land use, this practice is not being sustained and this therefore calls for other measures to maintain soil fertility for sustainable crop production in the sub-Sahara of Ethiopia Thus, soil conservation measures are a necessary part of the system for combating erosion during critical times of the year and showed certain effect (Kato et al., 2011; Adimassu et al., 2012).

According to Verhulst *et al* (2010) a key factor in soil functioning and is an important factor in the evaluation of the sustainability of crop production systems is Soil structure and it is maintained by soil and water conservation measure that increase soil productivity. Wolka et al, 2013 reported in Bokole watershed southern Ethiopia, in the household survey, interviewed farmers were requested to respond concerning the effects of constructed SWC structures on their cropland, in maintaining or improving soil fertility and thus crop yield. In both the UWS and the LWS, the majority of respondents practice most crop and soil management activities either to improve or to maintain crop yield. The role played by SWC structures in improving crop yield was in the reduction of runoff and soil loss, as perceived by 27.6 and 54.0% in the Upper watershed (UWS) and lower watershed (LWS), respectively. The combination of reduced runoff and soil loss and water retention ability, were perceived to improve crop yield by 72.4 and 46.0% of respondents in the UWS and LWS, respectively. Meshesha et al. (2018) reported Soil and water conservation practices improved soil fertility of their farmland, increased water holding capacity of the soils, reduced runoff and erosion and increased land productivity. The results of focus group discussion also indicated the positive effects Soil and water conservation practices employed in the responsive settlement areas were fences of forage plants, agro-forestry and vegetable, and fruit production in at the garden and communal lands used for grazing which improved forage biomass quantity and increased rates of water percolation.

Figure 1 : Focus group discussion on soil and water conservation and crop yield

Sources: adopted Meshesha et al. (2018), Focus group discussion with farmers in the study area.

According to the Meshesha et al. (2018) results, 10.5, 25and 64.5% of the respondents perceived that the intervention of soil and water conservation practices increased the crop yield very high, high and moderately, respectively in Northwest Ethiopia. Tesfaye (2008) reported that the soil and water conservation measures, fanya-juu and soil bunds are widely acknowledged as being effective measures in protecting soil erosion and as having the potential to improve land productivity.

Figure 2 : land of integrated soil and water conservation measure taken

Sources: Adopted, Treated farm lands with physical and biological methods (Damtie, 2016)

Dirk Jobst Rolker, (2012) reported that comparing non-conserved crop land production in one side and on the other side, crop production on plots with conservation measures and the plot with conservation measure increased the production by 10% in two watersheds in Ethiopia(Table 1 and 2 below)

Table 1. Crop yields in Debre Mewi watershed depending on SWC measure.

Crop	Crop yields (kg*ha^{-1})							
	No SWC		Stone bund		Soil bund		Total	
	n	Average	n	Average	n	Average	n	Average
tef	19	879	3	833	13	1101	35	958
wheat	9	1289	1	1176	3	931	13	1198
barley I	17	1403	-	-	6	983	23	1293
maize	24	1334	3	1667	11	1511	38	1412
finger millet	7	1492	2	1471	2	1176	11	1431
grass pea	19	879	-	-	2	846	21	876

Table2. Crop yields in Anjeni watershed depending on SWC measure.

Crop	Crop yields (kg*ha^{-1})									
	No SWC		Stone bund		Soil bund		*Fanyaa Juu*		Total	
	n	Average	n	Average	n	Average	n	Average	n	Average
tef	5	618	3	735	3	637	30	756	41	729
wheat	4	625	3	719	3	637	23	863	33	801
barley I	5	941	1	980	1	1765	32	924	39	949
maize	7	1919	2	588	2	956	25	1249	36	1326
barley II	1	147	-	-	-	-	6	719	7	637

Source: Adopted from Dirk Jobst Rolker, 2012

Ayalew (2011) reported low yields of crops in Gununo area before construction of soil conservation structures, even with application of fertilizers. According to him, the yield of teff in different farms increased from 300 kg/ha to 800 kg/ha after construction of soil conservation structures and that of haricot 66 beans increased from 180 kg/ha to 400 kg/ha in different farms. Similarly, the yield of wheat was increased from 200 kg/ha to 800 kg/ha. Moreover, maize yield was increased four folds, from 400 kg/ha to 1600 kg/ha and that of potato was increased from <400 kg/ha to 1600 kg/ha

Meshesha et al. (2018), reported his observation Akusti Micro Watershed, Northwest Ethiopia, in four crop type Teff, wheat, maize and potato before soil and water conservation and after conservation indicated in the table below (Table)

Table 3: Crop yield before and after construction of soil conservation measure

Crop	Estimated crop yields before SWCP (kg/ha)	Estimated crop yields after SWCP (kg/ha)
Teff(local seed)	460	6800
Wheat (danifei)	240	3500
Maize	400	12000
Potato	500	16000

Sources: adopted Meshesha et al, 2018

Tanto and Laekemariam, (2019) reported SWC practices have positive impacts on soil fertility and crop productivity of cultivated lands in Southern Ethiopia. According to their report 72.9% more grain yield advantage from integrated SWC practices established for 5 years over non-conserved land. This might be attributed to reduced runoff, retained moisture and enhanced nutrients availability during growth time that is leading to improvement of soil properties and grain yield.

The researchers Alemayehu et al. (2006), Ferede (2018), Teklu et al. (2018) and Adimassu et al. (2014) in Ethiopia also Tugizimana (2015) Nyamasheke District, Rwanda results are indicated, substantial grain yield increment on lands with SWC measures compared to non-conserved land. Similarly, Eshetu et al. (2016) reported up to 87% maize grain yield advantage by using fanya-juu than without treatment.

IV. Soil and water conservation increase livelihood asset

Agricultural Research & Extension Network (AgREN, 2000) made to analysis livelihood asset framework. According to AgREN, there are five different types of assets upon which individuals draw to build their livelihoods. These are: • natural capital – land, water, vegetation, biodiversity, etc. and environmental services; • social capital – social resources (networks, groups, trust, social relations, etc.); • human capital – skills, knowledge, good health and ability to labour; • physical capital – basic infrastructure (transport, shelter, communication, energy); • financial capital – financial resources (savings, access to credit, bank loans, remittances, pensions, etc.). Many studies have looked at the relationship between SWC and a household's access to assets. Anderson and Thampapillai (1990), reported that the same factors are positively associated with soil and water conservation measure.

Gross Soil Loss Rates per Land Cover by Cropland Area was 13% and the soil loss 42tone/ha/yr.(Huni, 1988a: Jan and David,1995;sipcifically Estimated soil loss from agricultural fields with different slope positions (left) and different cultivated crops (right) in Debre Mewi in Dirk Jobst Rolker 2008. Dirk Jobst Rolker,2010), Zegeye et al,(2010), indicated soil loss on non-conserved land compared with land soil and water conservation measure taken, the annual soil loosed in non-conserved is 47.6 ton in 10% slope land of agricultural soil.than conserved. In other word the SWC measure prevented 47.6ton of soil loss Estimated soil loss from agricultural fields with different slope positions (left) and different cultivated crops (right) in Debre Mewi in Dirk Jobst Rolker 2008. Dirk Jobst Rolker,2010), Zegeye et al,(2010), indicated soil loss on non-conserved land compared with land soil and water conservation measure taken, the annual soil loosed in non-conserved is 47.6 ton than conserved. In other word the SWC measure prevented 47.6ton of soil loss in 10% slope land of agricultural soil. Soil and water conservation prevented the loss of soil. It increase the yield of crop production in Ethiopia.

Figure 3: discussion with farmers on livelihood asset relation to soil and water conservation measure

Figure 3 : Adopted Part of focus group discussion in DMW and Sholit watersheds from right to left (Damtie, 2016)

According to Meshesha *et al,* (2018) reported Akusti Micro Watershed, Northwest Ethiopia, the living conditions and purchasing power of the farmers was increased after the implementation of soil and water conservation practices. Before SWCP, the farmers ought to work in off-farm activities to buy clothes and get other services since their harvest was very small. After SWCP however, they could able to maintain seeds and reduce removal of top soil, seeds and fertilizer by erosion that in turn increased their crop harvest and able to buy the necessary materials by selling of the farm out puts.

Nyangena and Köhlin, 2008, in Kenya reported Based on the Environment for Development discussion paper that SWC affects the welfare of adopting farmers through improvements in overall productivity, savings in inputs, and synergies with other inputs, these were framed as hypotheses and subsequently tested.

Sisay Damtie (2017), reported Debre-Mewi Watershed(DMW) and Sholit watershed survey results showed that sample households in DMW had a mean income of 12175.20 ETB where as a mean income of sample house households in Sholit watershed was found to be 11292.29 ETB per year which indicates that households in DMW are better in terms of livelihood condition. From this result we can conclude that to see the effect of SWCP in the two watersheds on people's livelihood condition, it needs longer period of time. Implementing soil and water conservations improves the availability of water, livestock feed resource; reduce conflict, and productivity of cultivated land in DMW watershed is the result of SWCP.

V. Soil and Water Conservation Maintain Soil Quality

Natural Resources Conservation Services National Soil Survey Center (2011), defined Soil quality is the ability of a soil to perform functions that is essential to people and the environment. The quality of soil resources has historically been closely related to soil productivity (Bennett and Chapline, 1928; Lowdermilk, 1953; Hillel, 1991). According to the (USDA) Natural Resource Conservation Service, "Soil quality is have been contain Good soil tilth, Sufficient depth, Sufficient, but not excessive, nutrient supply, Small population of plant pathogens and insect pests, Good soil drainage, Large population of beneficial organisms, Low weed pressure, No chemicals or toxins that may harm the crop, Resilience to degradation and unfavorable conditions.

The Soil Science Society of America's Soil Health Committee defines soil quality as its ability to function within the boundaries of a natural or managed ecosystem, which implies: 1) sustaining the productivity of plants and animals, 2) maintaining or improving air and water quality, (3) maintaining human health and habitat (Karlen et al. 1997; Acevedo et al., 2005), 4) sustaining biological activity, biodiversity and productivity, (5) filtering, buffering, degrading and immobilizing contaminants, 6) storing and recycling nutrients and, 7) supporting socio-economic structures associated with the human habitat (Doran and Parkin, 1996; Karlen et al., 1997; Bautista and Etchevers, 2014).

Johnson and colleagues (1992), in a paper presented at a Symposium on Soil Quality Standards hosted by the Soil Science Society of America in October 1990 suggested that soil quality should be defined in terms of the function soils play in the environment and defined soil function as ''the potential utility of soils in landscapes resulting from the natural combination of soil chemical, physical, and biological attributes".
They recommended that policies to protect soil resources should protect the soil's capacity to serve several functions simultaneously including the production of food, fiber and fuel; nutrient and carbon storage; water filtration, purification, and storage; waste storage and degradation; and the maintenance of ecosystem stability and resiliency.

They recommended that policies to protect soil resources should protect the soil's capacity to serve several functions simultaneously including the production of food, fiber and fuel; nutrient and carbon storage; water filtration, purification, and storage; waste storage and degradation; and the maintenance of ecosystem stability and resiliency.

Soil quality indicators (SQI) are useful tools for assessing the status of soil fertility and its degradation. The concept of quality is functional; includes variables which serve to evaluate the condition of the soil, or soil quality indicators. The SQI are measurement tools that provide information about the properties, processes and characteristics of the soil (Bremer and Ellert, 2004). These SQI are measurable attributes that reveal the response of the productivity or functionality of the soil to the environment, and indicate whether the quality of the soil improves, remains constant or decreases over time (Ghaemi et al., 2014). They give information on the effect of change in the use of the soil and the impact of agricultural practices on its degradation or functioning (Astier et al., 2002). SQI is usually considered to have three main aspects reflecting physical, chemical, and biological soil properties and is important for assessment of land degradation and for identification of sustainable land use practices (Awdenegest Moges *et al,* 2013, Dexter,2004, Singh and Khera,2009].

Physical indicators are related to the arrangement of solid particles and pores. Examples include topsoil depth, bulk density, porosity, aggregate stability, texture, crusting, and compaction. Physical indicators primarily reflect limitations to root growth, seedling emergence, infiltration, or movement of water within the soil profile (USDA Natural Resources Conservation Service, 1996)

The most commonly used chemical indicators to generate SQI are: soil buffer capacity, availability of nutrients for plants and microorganisms, pH, electrical conductivity, total and labile organic carbon, organic matter, Cation exchange capacity, total and mineralized nitrogen, phosphate adsorption capacity and availability of micronutrients (Larson and Pierce, 1991; Doran and Parkin, 1994; NRCS, 1996; Bautista et al. 2004; Bautista et al., 2011; Bautista and Etchevers, 2014).

(USDA Natural Resources Conservation Service, 1996) used Biological: earthworms, microbial biomass C and N, particulate organic matter, potentially mineralizable N, soil enzymes, soil respiration, and total organic carbon => microbial catalytic potential and repository for C and N; soil productivity and N supplying potential; and microbial activity measure

Soil and water conservation practices (SWCP), increase and maintain the SQ by decrease soil erosion and run off in Ethiopia. Several research done in Ethiopia reported in on the effect of SWCP on soil Bio-Physiochemical properties that indicator of SQ indicated conservation measure maintain soil quality.

Physical soil Quality indicators

Soil textural fractions physical properties which SQI varied with soil conservation, while silt, clay, and bulk density differed with soil depths (Awdenegest Moges et al, 2013), According to (Sisay Damtie, 2017) water holding capacity increased due to reducing soil erosion gradually from year to year related to developed conservation structures. Soil structural stability is the ability of aggregates to remain intact when exposed to different stresses (Kay et al. 1988) and measures of aggregate stability are useful as a means of assessing soil structural stability(Verhulst, *et al*,2010). Soil structure or the arrangement or geometry of these soil particles is increased in degraded soil when soil conservation measure taken (FAO 2007; Brady 1996). During SWC redistribution of the soil organic matter takes place. Small changes in soil organic carbon can influence the stability of macro-aggregates. Carter (1992a) found a close linear relationship between organic carbon and MWD. Soil organic matter can increase both soil resistance and resilience to deformation (Kay 1990, Soane 1990), and improve soil macro porosity (Carter et al. 1990). Higher organic matter content in the topsoil reduces slaking and disintegration of aggregates when they are wetted (Blevins et al. 1998)soil that has a good structure provides better living conditions for soil organisms and roots. It has many large and small pore spaces through which air, water, roots, and living organisms can move freely (FAO 2007). SWC helps to protect the removal of fertile top soil in the farm land because rain water percolate down rather than run off as a form of flood. This is because conservation structures break water speed and help to have time to percolate rather than run off. Physical measure Improve soil physical properties Increased aggregate stability, improved soil structure, and surface protection with integrated Biological and agronomic measure provided by crop residues, manure, and cover crops reduce soil erosion losses and increase water-holding capacity and aeration (Delate, *et al,* 2003). Total porosity is normally calculated from measurements of bulk density so the terms bulk density and total porosity can be used interchangeably (Kay and VandenBygaart 2002). The effect of soil and water conservation on soil bulk density is mainly confined to the topsoil (plough layer). Finally SWC maintain soil physical properties increase soil quality.

Soil chemical quality indicators

Soil chemical quality indicators SOC, available K^+, and exchangeable bases varied significantly with land use (Awdenegest Moges *et al,* 2013). R. Zornoza *et al*, 2015 indicated on their review article Soil organic carbon (SOC) has been suggested as the most important single indicator of SQ and agricultural sustainability since it affects most soil properties (Reeves, 1997; Arias et al., 2005). Soil fertility managed by SWCP due to contributes Reduction of soil loss (Shimeles Damene, 2013, Sisay Damtie, 2017) crop productivity is increasing in time since SWCP was started in Ethiopia indicates maintain SQ. the deficiency of key nutrients such as N,P,K,S, Zn, Br, and Cu are the SQI are due to soil erosion from farm land of Ethiopia are increased and maintained due to soil and water conservation practice progressively (Damte,2018, Kebede,2011). ATA, 2013 reported that the Status of soil resources in Ethiopia the indicator of SQ to maintain sustainable management is priorities agenda in Ethiopia. SWCP provide nitrogen (N) and also help recycle nutrients, such as phosphorus (P) and potassium (K), (Delate, et al 2003).

Soil Biological indicators

Visible indicators such as earthworms (Plate 4), biogenic structures, e.g. termite mounds (Plate 5), insects and moulds are comprehensible and useful to farmers and other land managers, who the ultimate stewards are of soil quality (FAO,2003) soil biological activity and the healthy microbial and macro faunal populations that are required for efficient nutrient cycling. These populations include bacteria, fungi, actinomycetes, nematodes, and earthworms. Delta et al, (2003) residues also provide the carbonaceous biomass upon which soil micro fauna (e.g., earthworms and beetles) and microorganisms depend on for survival.

SWC method of Sustainability of productivity management

The condition of our soils ultimately determines human health by serving as a major medium for food and fiber production and a primary interface with the environment, influencing the quality of the air we breathe and water we drink. Thus, there is a clear linkage between soil quality and human and environmental health. As such, the health of our soil resources is a primary indicator of the sustainability of our land management practices (Acton and Gregorich, 1995). Researcher indicated that soil and water conservation a means of sustain the quality of soil due to contributes Reduction of soil loss (Shimeles Damene, 2013, Sisay Damtie, 2017 Reeves, 1997; Arias et al., 2005). It was indicator of increase productivity, crop production and livelihood asset in sustainable way.

Soil and water conservation for sustainable land use

Sustainable land use must be based on a balance among competing technical, social, economic and environmental considerations (Ildefonso Pla Sentís, 2002). The lack of multi objective focus on land use and planning has produced a unilateral approach to resource utilization taken not into account the interdependence of environmental, production and social factors. The consequence has been problems of soil and water degradation, resulting from soil erosion, inappropriate land management practices and conflicting land uses. As a result, not only is the inherent productive base of the land resource affected, but the off-site impacts accrues significant social costs, which in most cases have failed to be acknowledged and quantified (Watkins, 1991). Off-site impacts of soil and land degradation frequently generate more concern than the effects on the land or soil itself, due to their visibility. Planning and implementing land use properly leads to fewer degradation problems, achieving both short-term and long-term benefits (Sheng and Meiman, 1988, Pla, 1994, Ildefonso Pla Sentís, 2002.).

Soil and water conservation is the most important part of land-use planning, and must be inserted into the whole context of land-use planning for land development. Soil and water conservation programs must be seen as the development and application of land use systems that preserve or enhance soil productivity (Virmani and Eswaran, 1991, Brammer, 1991, Ildefonso Pla Sentís, 2002).

SWC Improving water quality

Due to regular and limited rainfall, water is one of the scarce resource while it is years round necessity for people, livestock and plant (vegetation). It is availability influences the nature and extent of human settlement and grazing patterns as well as plant production. The ever increasing demand for water and the high cost of the water development is main constraint to agricultural development (Abebe SA, 2018). Recent study shows well-intended conservation measures reduce soil erosion and better manage and conserve farmland for crop production as well as increased quality of our rivers and lakes which placed under pressure of harmful levels of soluble phosphorus, (Jarvie et al, 2017), soil sink the amount of phosphorus eroded to water. In many places, nonpoint source pollution damage to our water resources comes from soil erosion, excessive fertilizer use, animal waste contamination, and improper use of agricultural chemicals. The soil and water conservation improve the quality of drinking and domestic use water, (Agriculture Cost Share Program (ACSP), 2019). Soil conservation practices very appropriate for controlling surface erosion processes, like bench terraces, increase the water potential in soil and quality of water in downstream (Ildefonso Pla Sentís, 2002).

VI.CONCLUSION

Review was conducted to evaluate the soil and water conservation increase soil productivity, soil quality, and sustainable soil management and sustainable land use in Ethiopia. Knowledge and adoption of conservation structures were introduced with the objectives of conserving, developing and rehabilitating degraded agricultural lands and increasing food security through increased food production/ availability. Implementing soil and water conservations improves the availability of water, livestock feed resource; reduce conflict, and productivity of cultivated land in different watershed is the result of SWCP, indicate it increase livelihood asset. Soil and water conservation practices (SWCP), increase and maintain the SQ by decrease soil erosion and run off in Ethiopia. Several research done in Ethiopia reported in on the effect of SWCP on soil Bio-Physiochemical properties that indicator of SQ indicated conservation measure maintain soil quality. The physical, chemical and biological properties of soil, was three main soil quality indicators. Soil and water conservation is the most important part of land-use planning, and must be inserted into the whole context of land-use planning for land development. Soil and water conservation programs must be seen as the development and application of land use systems that preserve or enhance soil productivity Farmers who perceived SWCP more effective in controlling soil erosion and ensuring sustainability of crop yields adopted modern conservation methods

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