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Indigenous Knowledge and Practices on Soil and Water Conservation in Ethiopia

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Abstract: Indigenous knowledge in soil and water conservation practices is common in many indigenous peoples of the world. Thus, it is common to see different forms of soil and water conservation practices across the various indigenous societies and peoples of Africa where by Ethiopia is part and parcel. In Ethiopia having the best experience and worldly known knowledge of indigenous soil water conservation is the one in the Konso and Borana people. Many areas of the country's top soil water is under sever condition of erosion however the Ethiopian people have a very deep indigenous soil conservation mechanisms which enable them to save the soil from erosion Soil erosion generally refers to the activity process of detachment transport and loss of the soil and soil materials by water, wind, ice and gravity. Erosion involves both the losses of the soil itself and loss of organic and material nutrients found in the soil. Soil erosion results in the loss of soil organic matter and plant nutrients removal of soil from one part to another usually downhill by the action of water is known as water erosion. For this problem the Ethiopian Peoples use different indigenous techniques. The most important physical and biological indigenous soil water conservation mechanisms:- Terracing, Contour Ploughing, Crop Rotation, Fallowing, Mixed Cropping, Surface Mulching, weed heap, manure, Agro Forestry and Field Boundaries.

Key words: Indigenous knowledge · Soil productivity decline · Soil conservation mechanisms

INTRODUCTION

Indigenous knowledge in soil and water conservation practices is common in many indigenous peoples of the world. Thus, it is common to see different forms of soil conservation practices across the various indigenous societies and peoples of Africa where by Ethiopia is part and parcel. Ethiopia is known that a nation regarded as the roof of Eastern African countries and there by water tower of the region. Hence the many areas of the country's top soil is under sever condition of erosion [1]. Land degradation is a major cause of poverty in rural areas of developing countries. In many areas, farming populations have experienced a decline in real income due to demographic, economic, social and environmental changes. Land degradation is a result of several factors of both physical and socio-economic nature. The immediate consequence of land degradation is reduced crop yield followed by economic decline and social stress. The integrated process of land degradation and increased poverty has been referred to as the "downhill spiral of unsustainability" leading to the "poverty trap". Soil erosion is one facet of land degradation that affects the physical and chemical properties of soils. The physical parameters are primarily organic matter content, structure, texture, bulk density, infiltration rate, rooting depth and water-holding capacity. Changes in chemical parameters are largely a function of changes in physical composition [2].

Soil erosion involves two major processes: (i) detachment of soil particles from the soil surface; and (ii) transport of the resulting sediment [3]. The consequences

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of topsoil erosion on soil productivity depend on the depth and quality of the topsoil relative to the subsoil. In areas where the topsoil is acid and the organic matter content is initially low, surface erosion may, in fact, increase crop yields due to the exposure of more favorable subsoil [2]. The top soil of Ethiopia is undergoing at a faster rate of erosion. The rate of soil loss for Ethiopia varies considerably from place to place. The densely settled areas of Northern Ethiopia are among those with the highest rate of soil loss since the environment is highly degraded as compared to the Southern part of the country. At present, the forest reserves of the country are estimated to be 2.5-3% of the total land and about 100, 000 hectares of forest are lost annually. About 1 billion tons of topsoil also believed to be eroded annually. In line with this, asserts that the average soil erosion is 42 tones/hectare/ year in the crop lands. It is clear that soils with low fertility are unable to allow sufficient crop cover to sustain life. Erosion and low humus content of such soil decrease infiltration and moisture holding capacity of the soil. These all quest for the importance of soil conservation measures. Thus, it is increasingly recognized that adequate conservation of soil resources is a precondition for sustainable rural development strategies particularly in the highlands of Ethiopia. However, most of the projects for soil conservation planned at the center and implemented at the local level show little attention to the question of whether the local population could apply to techniques on their own farm fields. Similar with the above experience at the end of project farmers did not have interest to expand new techniques to the rest farm fields. This is partially attributed to the costly nature and problem of adaptability of the new technology otherwise not contextualize. Furthermore, planners in the field assume that it is the responsibility of the local population for the overall maintenance of the structures built by a project [1].

Traditional conservation measures are well-known in Ethiopia. Various investigators tried to recognize how conservation of natural resources such as water and soil can be done through indigenous knowledge of communities compared to modern ways. In this regard, argues that IK is adapted to local culture and environment, based on experience, habitually established over centuries of use, dynamic and changing. Conceptualizes IK as it has been built upon and pass from one generation to generation and improves within a particular culture or ethnic group and tries to meet continuation of objectives in a specific environmental background [4]. The major causes of soil erosion mentioned by farmers included erosive rains (existence of intensive rain fall), steep slope (topography) and little use of soil conservation practices, damaged conservation structures and tillage, which makes the soil loose and bare. Rainfall leads to significant soil loss mainly at times of seedbed preparation [5].

According to the Ethiopian Highlands Reclamation Study (EHRS) soil erosion is estimated to cost the country 1.9 billion US$ between 1985 and 2010. These call for external interventions based on the local socio-economic and technical potentials if the country is to continue as a nation. Indigenous knowledge refers to the perception that farmers have about their natural and social environment, which they use to adopt, adapt and develop technologies to their local context. The rationale for undertaking certain traditional practices among others is recognition of problems by the local people. Indigenous practices are aimed at arresting the local priority problems. Although they survived the challenges of changing bio- physical and socio-economic environments through a continuous responsive changes and adaptations, indigenous practices are not perfect. There are some who still argue that indigenous practices deserve little emphasis since “they cannot any longer go with the dynamics of the environments”. They further suggest that modernization rather than the ‘backward’ local practices need to be pushed further [6].

Indigenous SWC practices were mechanical (soil bund, stone bund, terrace, micro-basin and tied ridge) and biological SWC practices (grass for structure stabilization and tree plantation). Agro forestry practices (algae check dam, shifting cultivation) consistent with similar practices found in different parts of the country [7]. A physical soil conservation practice is applicable of soil management using knowledge or art with the goal protection of soil resource form exploitation. In addition, among those different applications, different structure applied in different farm lands. However, these conservation applications depend on climate, soil type, vegetation cover and level of economy and also Biological measure for water conservation work by their protective impact on vegetation cover. In a dense vegetation cover the roots and organic matter stabilize the soil aggregate and increases infiltration [8].

The most important indigenous soil conservation mechanisms: Terracing, Contour Ploughing, Crop Rotation, Fallowing, Mixed Cropping, Surface Mulching, Fertilization, Agro Forestry and Field Boundaries [1].

These practices need to be understood particularly for those practices, which are beneficial for their integration in the modern day agriculture [9]. Traditional knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. The focus in the sector of water supply and sanitation is to improve development in a sustainable manner. Since the 1980s, the sustainability of water supply and sanitation has become a special concern of the developing countries and international donors. The main objective of this paper is to review indigenous knowledge and practices on soil and water conservation in Ethiopia.

Literature Review

Indigenous Knowledge and Practices on Soil and Water Conservation in Ethiopia

Soil Erosion and Soil Productivity Decline in Ethiopia: Soil erosion generally refers to the activity process of detachment transport and loss of the soil and soil materials by water, wind, ice and gravity. Erosion involves both the losses of the soil itself and loss of organic and material nutrients found in the soil. Soil erosion results in the loss of soil organic matter and plant nutrients removal of soil from one part to another usually downhill by the action of water is known as water erosion. For such removal to occur it is necessary the soil practical are detached from the land surface and then Tran sported. Soil can be eroded away by wind and water. Soil erosion is the removal of the top soil and particles from the surface which includes removal of including inorganic minerals and organic matter [8].

In process, soil degradation types are consists of physical, chemical and biological soil degradation. The physical degradation process affects soil's mass to volume relationship, air to water relationship, gaseous exchange between soil and the atmosphere and resistance against disruptive forces of air and water. These processes affect the soil's physical, mechanical, rheological (flow) and hydrological properties. Chemical degradation processes refer to adverse changes in soil reaction or pH, reduction in reserves and availability of plant nutrients, the ability to inactivate toxic compounds and reduce excessive buildup of salts in the root zone. Changes in soil biological processes can increase soil degradation and adversely affect the quantity and quality of the SOC pool activity and species diversity of soil biota and increase in relative proportion of soil borne pathogens [10]. Generally land degradation includes all process that diminishes the capacity of land resources to perform essential functions and services in ecosystem [11].

In many parts of Ethiopia, farmers use native soil and water conserving practices as an integral part of their farming systems. Farmers have developed such methods, which have maintained productivity and contributed to long-term sustainability, while introduced measures have often been rejected or just failed to achieve their technical objective. Farmers have their criteria to evaluate the efficiency of soil water conservation measures. Their standards are often based on the natural resources quality (farmers are more likely to preserve those soils that will give the highest return on their investment), gender, the resource level of the household (particularly income levels and labor availability), education, cropping intensity as well as cultural traditions related to age. Of great importance, however, is the need to maintain or increase soil productivity [12] Seed selection and preservation, advancement of traditional farm implements, development of appropriate farming systems and adaptation of effective cropping mechanisms withstanding food insecurities through time. It has well appreciated indigenous technologies that have been devised by the community, using their own indigenous knowledge to cope up harsh time and be able to sustain the livelihoods [10].

Soil and water conservation techniques can be divided in to "ethno-engineering", agro-forestry and agronomic practices. A combination of these practices exists. The term "ethno-engineering" covers indigenous practices such as terracing and development of small drainage systems. The potential of these indigenous soil and water conservation practices have very often been ignored or underestimated, soil conservationists and government staff. The objectives traditional practices give us an understanding of farmers' way of thinking. Agro-forestry is thought to have the potential to improve soil fertility through the maintenance or increase of soil organic matter and biological nitrogen (N2) fixation from nitrogen fixing tree species. There are several techniques of controlling erosion and these are broadly grouped under; agronomic [5].

Indigenous Knowledge Practices on Soil Conservation

Physical Soil Conservation Practices

Drainage Ditches and Furrows: These also known as traditional ditches are one of the widely used soil water

conservation practices. These are micro channels constructed on cultivated farms to drain off excess water and control soil erosion and low-cost measures in which construction is part of the regular plowing activity. However, the plow furrows, the ditches are made broader and deeper in dimension and usually run diagonally across the field [12]. Both structures are constructed mainly by oxen drawn plough, but depending on the runoff expected, which depends on the slope length and gradient, intensity of rainfall and the type of crop planted upstream of the field, re-enforcement by hoeing may be necessary. The cut of drain, which is constructed at the upper most end of the field to divert all the runoff before it enters into the field, should be reinforced by stones, wood, blocks of soils with grass, especially across depressions. To prevent the seed, fertilizers and soil loss due to runoff, semi-parallel drainage furrows are constructed at relatively closer interval depending on the slope. The spacing and gradient of furrows depends on several factors like slope gradient and length and land use or crop type of the upstream area [6] the other structures are micro channels Constructed on cultivated farms to drain off excess water and control soil erosion [13].

Traditional Waterways (Feses) (Daandii Lola): This practices used where the land is steep more water ways has been constructed than gentle slope lands. The structure was widely practiced to reduce soil loss by runoff and to protect soil erosion. Preparing the water ways due to the nature of topography and this ditches differ in terms of gradient, spacing, depth, width and number in a given farm plot. This indigenous soil conservation measures have been made mostly by the individual any house hold members [14].

Soil (Stone) Bund: Is an embankment or ridge built across a slope along the contour? Soil bunds are made of soil or mud. On moderately sloping areas the farmers construct the soil bunds for erosion control. In the common eroded lands especially around the mountainous area, farmers were constructing stone or soil bunds [5, 13, 15]. Stone bund was also practicable soil and water conservation measures. Large stones are plentiful on the land; these may be used to make the bunds. Under water limiting conditions, the stone bunds are efficient measures to improving soil water content through runoff control. Stone bunds contribute to conserving more moisture in the soil for longer, which helps to alleviate water stress during dry spells [16].

Fig. 1: Traditional stone bunds in konso source [17]

Contour Ploughing: Practice of tilling the land along the contours of the slope in order to reduce the runoff on a steep sloping land [13, 15] facilitates rain water percolation [5]. The structure has the capacity to conserve the water resource of the area and prevents the downward flow of water and checks soil loss [14] it is used separately or in combination with other conservation structures such as plantation trees and cut- off drains; carried out using the ox-drawn plough. It is part of the normal farming activity; it needs no extra labor and time for construction. Trees and other non–crop plants such as sisal euphorbia and eucalyptus are planted along the contour sometimes together with other conservation practices. This practices need to in order to reduce runoff and conserve the soil and water round the root of the plants. Indigenous and newly introduced trees and shrubs are planted on over used eroded lands to make the land fully productive again. In common highly degraded lands are closed off to livestock to protect it from grazing and planted with trees for regeneration [13]. In dry areas; contour cultivation can be adjusted to standard ridge and furrow system to make it effective in controlling soil erosion and moisture conservation in dry areas. The most effective way to reduce soil erosion and conserve soil moisture is by minimizing the rate of runoff [18].

Cut Off Drains: Is one of the physical structures constructed by digging the soil deep in order to divert the runoff before reaching the farm land. These measures were commonly constructed at the boundary between plot and grazing lands [14]. The farmer constructed such structures to prevent loss of seeds, fertilizer and soil due to excessive run– off coming from uplands and dispose the excess water for the field most of these structures are accelerating soil erosion [13, 15] and channels used to collect run off from the land above and to divert it safely to a water way or river; thus protecting the land below from excessive erosion [5].

Fig. 2: Traditional cutoff drain Source [19]

Terracing: On steep eroded bare lands stone terraces are most used structures. It is also among the better adopted soil conservation techniques. However, farmers stated different challenges related to the practice and implementation of terracing on their plot. In addition, there are also different types of soil conservation mechanisms construct [5]. And also addition to soil fertility, terracing the low land helps to slow down water runoff and capture sediments [20].

Dry Stone Terraces: These dry-stone terraces, which contour the Konso hills, are striking examples of indigenous soil and moisture conservation techniques. The stones are easily extracted from the basaltic hills of Konso. The terraces, which categorizes into seven types, have different length and height depending on slope of the terrain. The height of the terraces is from 0.5m to 1.5m. The square basin, called kolba, between two terraces has high ridges to retain and conserve rain water. Annual and biennial crops are planted in the basin; whereas perennial plants like coffee are planted at the base of terrace walls [21].

Fig. 3: Konso terraces source [21]

Traditional Check Dams (Kilter): Farmers construct check dams where their farm land affected by large gullies the deepening and expansion of gullies to the nearest crop lands. The check dams were constructed from sticks and small stones to hold back fertile alluvial soil. Then the already eroded soil accumulated in areas where local check dams are constructed. To stabilize the gullies and increase sustainability of dam's farmers used to grow plants like eucalyptus, which give additional advantage for them. Local check dams were constructed by neighboring farmers during the dry season locally known as "bega" after harvesting season [14].

Fanyajuu(up Throw Soil): Terraces, an improved SWC structures, are made by digging a trench and throwing the soil uphill to form an embankment and over time creates sloping bench-like terraces [13]. Natural bench terrace will subsequently form over the next few years. They are usually constructed in the fields sloping above 10%. Even though; it is an important method of soil conservation, its adoption and practice [5].

Field Boundaries: It is also common to see ridge covered with grasses between plots of farm land. The dividing line, boundary and the land before and after the ridge is the property of two different individuals. This structure is important for soil conservation which can reduce the intensity of erosion in the farm fields. But the uses of this structure are not noticed by most farmers. In short, all the above indigenous soil conservation mechanisms, gained through experience by the local community, are the basis for self-sufficiency and self-determination and effective alternatives [1].

Minimum Tillage: Practice in which is reduced soil disturbance. This practice was mostly done at the area where soil compaction is less and the soil is light, such type of soil is found at the low land. This intensive tillage practices reduces infiltration, smoothens the land surface and consequently low surface water storage and leading to high runoff and soil loss. Soil disturbances tend to stimulate soil carbon loss through enhanced decomposition and erosion. Therefore, reducing soil disturbances through minimal tillage systems reduces soil carbon losses. At the soil surface, the impact of raindrops on a bare soil surface can decrease porosity through the formation of surface seals and crusts. These limit the rate of infiltration, leading to increased runoff [18].

Agronomic Conservation Practices: Biologically, agro forestry species that replenish soil fertility have the potential to reverse soil fertility decline, thereby increasing crop yields. Various studies have shown the

potential of agro-forestry as an approach to sustainable agriculture production and soil management, especially in the tropics. Trees used in agro-forestry system can also provide a variety of services such as being a form of saving and investment, protection from wind, employment opportunity, increased amount of water for plant growth, improved seasonal availability of water, protection of soil from erosion and loss of nutrients, restoration of degraded soils and improvement of soil moisture and fertility, maintenance or increase in species and habitat diversity and improved conditions for natural regeneration of most desirable species [22].

Conservation Tillage: Conservation tillage is a tillage practice aimed at creating favorable soil environment for germination, establishment and plant growth. Conservation tillage is designed to avoid the tillage operations that destroy soil structure, which initiate problems of surface sealing and soil compaction. This umbrella term can include reduced tillage, minimum tillage, no-till, direct drill, mulch tillage, stubble-mulch farming, trash farming, strip tillage, plough-plant. Planting through surface mulches is not easy for ox-drawn planters although there may be no problem with hand jab planters tillage includes zero tillage, reduced/minimum tillage, mulch tillage and strip or zero tillage. All conservation tillage operations are aimed at controlling soil degradation and improving soil productivity. Zero tillage is a tillage in which land remains untilled before planting, but planting furrow or hole is opened at planting. Minimum /Reduced tillage is a tillage practice in which the least possible tillage operation is performed to break up hard pans/compacted layers to increase infiltration, water storage capacity of the soil and to minimize resistance to root development Mulch tillage is a tillage operation, which follows the principles of least soil disturbance and maximum crop residue application/maintenance [18].

Fig. 4: Traditional lied in sorghum stalks strip to conserve swc in Derashe southern Ethiopia [17]

Intercropping: Mainly that utilizes legumes is a deliberate measure to maintain soil fertility. Intercropping always involves incorporating a legume, such as bean, along with other crops. The emphasis on legumes is to enhance soil fertility since inorganic fertilizer use has fallen drastically because of the high prices [12] and to protect the soil against erosion [18]. To practice such a system, different crops are intercropped which include maize + bean, maize + potato, maize + cabbage and bean + potato. There are mostly two practical advantages of the intercropping system; for example, mixing legumes with a grain crop especially maize. Firstly, legumes are nitrogen-fixing plants, therefore, by intercropping the two, farmers do not even have to apply fertilizer or reduce the amount since most of them cannot even afford to buy fertilizer. Lastly, legumes are a cover crop, so they suppress the growth of weeds and minimize the difficult task of weeding [12] and reduce erosion by having a crop on the land for a longer period of the year. Also, it served for them to cultivate different crops at one time on a single farm land [1]. The degree of planting mixing crops on the farm land is highly influenced by wealth difference among the farmers [23]. This is it may be the problems occur on the quality of seed and mono types crops during sowing the seed.

Fig. 5: Intercropping Practices source [18]

Leaving Crop Residues: On the field after harvest is another traditional practice used by the farmers in the area. The farmers are implementing this type of measure to improve fertility of the soil and there by protect soil from erosion [13]. Physical land management practices were applied by farmers in both middle altitude and low land. Crop straw, Maize and sorghum stalks are among crop residues used as soil mulch in protecting soil moisture lose during dry season, intercepts rain drops impacts from striking soil surface and contribute in reducing run off. These add organic matter to the soil through decomposition of its litters and improve physical structures of the soil [18].

Covers Crops: Cover crops are basically sown for the controlling of soil erosion. These are the effective tools to control erosion and technique to conserve the environment. The importance of cover crop for controlling soil erosion and helped to improve soil water and reduce evaporation from the soil surface, conserves moisture from the irrigation and rainfall. Increased water retention in soil at water potentials related to field capacity and plant available water by 10%-11% and 21%-22%, respectively. Cover crops are the plants which are grown to improve soil fertility, prevent soil erosion, enrichment and protection of soil and enhance nutrient and water availability and quality of soil. Cover crops provide several benefits to soils used for agriculture production. Cover crops are helpful in increasing and sustaining microbial biodiversity in soils [24]. In order to renew the quality of soil by adding organic matter and most importantly nitrogen using leguminous as a cover crop is the best method [25].

Mulching: Another potential measure to reduce soil/nutrient loss is mulching, that means covering soil surface with crop residues. Through mulching, the hydraulic force of the raindrop on the soil particle will be reduced. Thus, soil detachment is minimized [12]. The benefit of protective covering was widely appreciated, as was the improved infiltration rate afforded by the techniques and reduced evaporation rate. Further stated objective is the addition of nutrients to the soil through the decomposition of the organic matter. However, the density of mulch viewed in many fields was below the level required to be most effective as protective cover since the use of residence as animal food was witnessed in many households of the area [1].

Soil Fertility Amendment Methods: Rural communities have their own indigenous knowledge of classifying, describing and characterizing local soil types in their farmlands based on the soils characteristics and its suitability for growing various types of crops. Farmers identified different soil types based on their colour, stony composition, water holding capacity, the capacity of the soil for long-term productivity of crop yield, drainage & manure requirement of the farmland and topographic location cultivability [20]. According to [6] and [20] traditional soil fertility amendment techniques are d/t those are manuring, fallowing, frequent ploughing, crop rotation and leguminous plants.

Manuring (Dikeeitti Naquu): Refers to the process of kraaling cattle at night and rotate the position of the barn regularly in order to uniformly distribute manure to crop fields. In this case not only manure, but also urine that is with high N content is distributed. Manure is produced from a wide range of organic materials including ashes, plant residues and animal droppings are accumulated and directly added to the plot land. This indigenous practice is mostly practiced by females commonly every day after cleaning their homes [14]. Manuring avoids the major problems of transportation and distribution of manure, which is one of the major constraints of manure use in the other parts of the country. The other advantage associated with this practice is that crop residues and other herbs can easily be incorporated. Hence, in addition to soil fertility improvement, weed is also well controlled [6, 23].

All farmers are applying inorganic fertilizer and farmyard manure to improve soil fertility. This could explain the perception that the effect of soil fertility loss is a decrease in crop yields. It also demonstrated the high concern to achieve better returns. The primary land use systems in the community include homestead farms, where the most important crops such as wheat, teff, barley and vegetables are grown [12]. According to [13] to improving the fertility of the soil many farmers are used manure. Manure consisting of animal dung and urine, is the best form of organic fertilizer. Farmers used manure mainly near the homestead. Because of the high current price of inorganic fertilizer many of poor farmers used manure to replacing different organic fertilizer.

Fig. 6: Manuringapplication source [25]

Table 1: Different Inputs to Maintain Soil Fertility

Types of inputs	Advantage	Disadvantage
Chemical fertilizer	Crop mature earlier makes plants strong good growth of plants enables to produce better yield. Easy to apply	Crop burn if rains is poor Expensive
Manure	Big grains produced improves soil fertility	Crop burn if rains poor Increase weeds Labor intensive production and application
Household waste	Good for reclamation of degraded soil Promotes water retention capacity Easiest and cheapest	Crop burn if rains is poor Small amounts produced
Compost	Good yield result Structure and fertility of soil improved good for vegetables	Crop burn if not well rotted and rain is poor First year effect may be poor

Source [14]

Fallowing: Is a practice of abandoning land for rejuvenation when the nutrients are exhausted? Fallow land is commonly used as a grazing ground for five to seven years depending on land holding of the farmer and the nature of the land to recover. This practice is diminishing and becoming only things of the past [6] the purpose of recovering soil fertility and minimizing soil loss. About 24% of the respondents have applied fallowing as a soil conservation measure and would increase the organic matter content of the soil; improve the soil structure including water holding capacity; recycle and trap nutrients from sub-soil; protect the soil from erosion and eliminate weeds, pests and diseases specific to the cropping system [13]. However due to population pressure, which resulted in reduced land holding and hence limited grazing ground, leaving a land fallow have gradually become difficult [6]. The traditional fallowing periods are practiced less and less as a result of the increasing population pressure and decreasing agricultural productivity is restricted to highly degraded lands which cannot be restored within a short period of time. In most cases only stones are found on these lands [23].

Frequent Ploughing: This technique are use for increase soil fertility and also uses to expose to sun light weed residuals and kill crop pests and diseases [20].

Grass Strip: Grass strip helps to reduce run off and filter out sediments carried by runoff and stabilize fanyajuu and soil bund in farm plot. If grass strips grow, it will effectively build up into terrace and provide cattle fodder. An important type of grass strip method practiced in area is the vetivar grass technology. Unlike any other modern soil conservation methods vetivar grasses are more visible the majorities of the farmers plot [5].

Fig. 7: Grass strip practice on farmland source [18]

Spreading Wastes: Practice of waste spreading on the field for soil fertility maintenance. Literally means waste, consist all kinds of human and livestock residues/leftovers in and around the residence. In the farm household, cleaning grains before grinding is among the daily practices. This leaves weed seeds as a residue to be cleaned away as any waste and distributed to the field. Consequently, the practice is criticized for inducing weed infestation to the field. Therefore it is recommended that pretreatments, like composting be carried out before it is applied to the field [6, 23] this practice undertake mainly in those house hold that have many livestock [5]. The importance is reflected in the very high frequency with which both inorganic and organic fertilizer used to apply [1].

Agro Forestry: Agro forestry is partially used as a means of maintaining soil fertility. Scattered trees on crop land are also found, but the trees are widely spaced and probably have little effect on soil fertility maintenance. Agro forestry could play a potentially valuable role in enhancing soil organic matter and improving land productivity [12]. The best example is *Moringa stenopetala* which has several purposes; used for shade, it has a very high nutrition quality. *Moringa* leaves serve

as their main diet and is used as a medicine for various diseases. *Juniperus procera*, *Euphorbia* spp., *Terminalia browenii*, *Olea africana*, *Ficussori*, *Cordia africana*, *Sterculia africana*, *Acciaaby sinica*. Among these, *Juniperus procera* has a high significance. In fact, the protection of these big trees in the area is also for ritual practices and shading services for some sort of meeting to the local community. Thus, it seems that in addition to trees role for indigenous soil conservation practices in agro forestry form, it has strong attachment the society cultural practices [1].

Fig. 8: Agro-forestry practice source [18]

Crop Rotation: It is one of the indigenous practices to improve soil fertility as well as conserve the soils fertility. It is a system by which nitrogen restoration is attained by alternating different types of crops on the same cultivated land [18, 23] and improves soil moisture [16]. The major cereals, after legumes or oil crops are rotated mainly for soil fertility maintenance, weed and disease control. In the rotation pattern, Viciafaba, field pea, linseed and barely are considered to improve soil fertility while teff and wheat are said to exhaust soil nutrients [6] soil to replenish and restore fertilizing nutrients taken up by the produced crops during the preceding production season [5].

Weed Heaping: Weed heaping is another indigenous soil fertility management practices. Farmer's weeds and plant litter to enrich fertility of their soils. They usually chop the straws of the barley and wheat and disperse over the farm land where it later decomposed and enriched in fertility [23].

Leaf Litter: From their day to day life experience, farmers identified different plant leaves that serve them in enriching the fertility of their soil. For example after harvest, a farmer burns the stem or leafs of maize on their farm land. In addition, they use leaf litter as a mulch to enhance soil. The leftover of straws of wheat and barley after harvest left on the farm land where it decomposed to and later dispersed over the farm land [23].

Table 2: Causes of Soil Erosion and Decline Productivity

T/L	Causes	Percentage
1	Soil erosion	
	• Overgrazing	3.3
	• Over cultivation	9.2
	• Poor agricultural practice	18.3
	• Excess rain	51.7
	• Cultivation of steep slope	17.5
2	Productivity decline	34.8
	• Frequent cultivation	28.3
	• Soil erosion un reliable rainfall	1.7
	• High price of fertilizer	12.0
	• Other	
3	Size of agricultural land decline	
	• Family (population) increase	57%
	• It was sold due to poverty	36.7
	• Land degradation	6.3

Source [13, 26]

Table 3: Indigenous Land Management measures

Physical measures	Stone bund, Dry stone terraces, cut of drain, contour ploughing, soil or stone bund, field boundary, minimum tillage, Traditional check dam, Faynajuu Furrow, Terracing and Traditional waterway	
Vegetative and agronomic measures	Grass strip Planting trees Mixed cropping Area closure Agro forestry	
Soil fertility management Measures	Fallowing Crop rotation Crop residue Weed heap	Animal manure Animal parking

Source [13, 26]

Table 4: Measures taken to enhance the declining fertility of the farm land

T/L	Techniques	Percentage of improvement
1	Crop rotation	26.1
2	Shift to other land	0.5
3	Using manure	18.0
4	Use fertilizer	25.4
5	Change land use type	2.7
6	Fallowing	10.2
7	Others	15.6

Source [13, 26]

CONCLUSION

Ethiopia farmers are various agronomic and physical soil conservation measures have, to some extent, been used traditionally. Down-sloping terraces are most

commonly created by the construction of stone bunds. Farmers also construct check-dams and cut-off drains. In addition farmers use various agronomic conservation practices, including contour ploughing and vegetation strips. The traditional practices are efficient in controlling soil loss in some cases, but should be modified and developed further. Terraces are most commonly constructed of stones since the soils are generally shallow and their stone content is generally high. Measures such as contour ploughing, manuring, crop rotation, cropresidue, cut off drains and ditches, fallowing grass strip, agro forestry, spreading waste as the paramount importance to increase soil fertility, increasing the productive capacity of soil and in arresting soil from erosion then it continue to other Ethiopian regions. The integration of both physical and biological soil water conservation practices are the practices which batter use for amending soil fertility. The cases in Borana and Konso show that the traditional knowledge is largely ignored by the modern approaches. Here, is not arguing that traditions should prevail, but advice better scientific knowledge should emanate from the local experience, especially in terms of resources. The majority of farmers experienced soil erosion, a phenomenon they related to the widespread onsite erosion indicators. They have sufficient knowledge of the water and soil conservation processes and the consequent on-site erosion impacts. Farmers perceived that increased crop yield could be realized, among other husbandry practices, through the implementation of soil water conservation measures. In addition to increased crop yield, soil water conservation measures were perceived to improve soil fertility and soil water retention. Apparently, farmers were knowledgeable about various soil water conservation rules but implemented a few of them such as Ridges, water diversion ditch and contour ploughing were the most popular and used traditional soil water conservation practices.

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