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Review on the Realization of National Food Independency through Scaling up Soil & Water Conservation Practices, Ethiopia

Merkineh Mesene Mena
Wolaita Sodo Univerisity; Natural Resource Mgt Dep't.

Lukas Shanka Ashango
Agricultural (Soil and Water Conservation) expert

Abstract
Ethiopia presents the worst example of soil degradation as a result of combined factors such as massive deforestation, lack of sustainable SWC efforts, rapidly growing population pressure, loose land use policies thus lead to the loss of civilization by erosion and flooding, the loss of arable land/fertile soils by erosion, the decline of soil fertility and low infiltration rate of rainwater due to accelerated runoff, which decreases underground water and all resulted in climate change, environmental stress and poverty. The scaling up of SWC practice means increasing soil fertility and land productivity at the end leads to household food independency. Clearly defined and socially accepted land tenure policy encourages farmers to invest on permanent SWC practices. Protected soil ecosystems with its organisms are very important for soil organic matter decomposition and nutrient cycling under natural ecosystem. Thus soil fertility maintained and productivity increases and when fertility increases, soils resistance against erosion increase. Policies and strategies can play a decisive role through SWC practices among which PASDEP is the most popular as it underlines awareness creation at individual land user and community level. Opportunities could be utilized for success of SWC practices such as recognition of the problems by the entire society, progressive new rural development policies, skilled man power, vast experience in SWC practices are notable.
Keywords: food independency, soil degradation, soil & water conservation, scaling up

1. Introduction

Obviously, once Ethiopia was almost covered by the green blanket of natural vegetation, and arable fertile soils. Also it is believed that numerous spring water discharging from mountainous area and these springs join to form several streams and rivers. At a time the country was producing surplus food crops and thus why too many national and international scholars offered Ethiopia the basket of Bread in the Horn of Africa. Eventually this conducive environment of the Ethiopia converted into negative connotation.

Soil degradation collapsed civilization as surely as military conquest. In fact the impact of land and /or soil degradation was severe in then Ethiopia as some informal sources witnesses underlines (Kelley (1983); Bronkensha *et al* (1999)).

If the existing initiation and commitments scaled up un-doubtfully the national food independency strategy shall be realized. The scaling up of soil and water conservation practice means increasing soil fertility and land productivity. It is natural that fertile-land returns maximum yield and it is at this time that national food independency realization gets practical confirmation.

Sustainable use of soil described with the principle of "soil loss tolerance." This would imply that, the maximum depletion must be below the rate of soil and nutrient regeneration. However, forest decline in the south central part of the Ethiopian have been found due to agricultural expansion, massive frequent deforestation and thus soil loss tolerance threshold seems to have been violated and also further explained the horizontal expansion of cash crops towards forest lands, resulted in native tree species degradation (Gessesse (2007); Ludi (2004)). The deforestation process effected by decrease in springs discharging power, reduction in streams volume, wetland shrinkage and especially Wondo Genet catchment which is the major drainage for Lake Hawassa become threatened by the erosion from up land catchment.

Bediru (2006) revealed that agricultural crops expansion and new settlement pushed lowland forest (wood land). As a result Lake Abjata – Shala National park area diminished. Lake Abjata, which is lodged for migratory and endemic birds become threatened. Here, the impact of deforestation and erosion is beyond merely imagination.

Bishaw (2001) indicated extended deforestation in Northern highlands of Ethiopia and the consequences were numerous tragedies.

According to Yosef (2007) at Bale Mountains National Park Area native fauna and flora are threatened due to agricultural crops and new settlement. The long run effect is definitely devastative in mountainous fragile ecosystems. Kaba (2008) found that the scale of deforestation is large. The study by Melaku (2003) indicated

that much of biota is at extinction and further showed the land degradation which is inevitable effect of deforestation.

The major and primary causes for land degradation, soil loss and water resources quality reduction / disappearance (example Lake Alemaya) (in Harar), flooding catastrophes (in Dire Dawa and South Omo)(1999 E.C) and others can be mentioned as: deforestation and conversion of forest land to agricultural land; Inadequate soil and water conservation Practice; though there is re-plantation exist the time gap between current deforestation, that is trees, having with large canopy, and the natural regeneration or growth rate of newly planted trees allows its way, for erosion to take place, thus resulted in degraded landscape; Global climate change (as studied by several natural scientists Gupta (2005) atmospheric temperatures increased);Political instability. Example, in 1991 when the Military Administration fell immediately too many forest resources of the country taken unlawful way; starting from 1991 – 2002/03 there was no land use certificate issuance to rural land users that stabilized the small holders' perception. And at least built awareness and confidence to conserve and develop forest (trees) on their Holdings; and rapidly growing human population.

2. CHALLENGES OF SOIL DEGRADATION

2.1 Consequences of Soil Degradation

In FAO (1983) impressive argumentation was stated as erosion destroyed civilizations. Civilizations began where farming was most productive. When farm productivity declined usually as a result of soil mismanagement, civilization also declined and occasionally vanished entirely.

An extensive research conducted by FAO and Kelly (1983) found that three requisites for thriving civilization. These are fertile soils, a dependable water supply (irrigation) and relatively level land with reasonable rainfall which would not cause erosion. Nevertheless, in Ethiopia very steep slope lands are under cultivation either protected or conserved by biological and structural soil conservation measures or without conservation measures and further stated the worst of all threats is erosion. As the soil has full life and good soils are teeming and showed that the friendship and association of plants and animals, that plant life depend up on soil and after death form humus to sustain the soils viability. The same is true for animals, that the excreta of animals contribute nutrient and improve soil structure.

It is reached to international agreement and scientific acceptance that vegetation (trees) keeps the soil from eroding if undisturbed. However, the influence of human beings over surrounding natural resources in turn influences man. Example; people aggressively make deforestation, soils become eroded, but the mutual combination and existence of trees (forest), soil and water is vital for any crop production. Because of the vanishing of one of the vital factors may result on loss of crops.

Armson (1977) noted the universal significance of water by arguing that soil water is important to man not only because of the amounts which may be utilized directly for his own needs or those of the plants upon which he depends but also indirectly because of the many other biological and chemical processes by which soil sustains life, because, plant for its growth, soil for its viability, all of which require the presence of water and infers that, water is the "life blood" of soil.

If not managed appropriately, water can be one of caustic agent for destruction amongst which soil loss by water erosion is the one. The future to find hunger and misery, despite major technological advances in agricultural production, millions of people in the world today are under nourished or starving. This Paradox stems from a number of causes. Of which the most alarming is the rate at which the productive capacity of the land is being degraded by mismanagement of agricultural and forest resources. In north of the equator, especially Africa 11.6% of the total area is affected by water erosion and 22.4% by wind erosion. In the near east 17.1% of the total area is affected by water erosion (Kelly, 1983).

Table 1: Soil loss from three major land use sytems (Ethiopia)

Type of land use	Topographic features	Annual soil loss
Cultivated Land	Steep slope	>100t/ha
Grazing Land	Flat-undulating	<10t/ha
Forest Land	Undulating	10t/ha

Source: (Hurni and Ludi, 2000)

Pertaining soil loss estimation Morgan (1995) argued that, examining absolute differences between predicted and observed soil loss is important. Ludi (2004) gave measured values and calculated values on the basis of % slope gradient.

Table 2: Comparison between predicted and observed (Ethiopia)

Research Site	Slope Gradient [%]	Calculated Soil Loss (mean)	Measured Soil Loss (Mean)	Remark
Andit Tid	39		212t/ha	
	40	686t/ha		
Anjeni	12		213t/ha	
	10	20t/ha		
Maybar	16		22t/ha	
	16	24t/ha	-	

Source: Ludi (2004)

Table 3: Soil loss under different crop variety

Source of information	**No of plots**	**Crop Type**	**Soil loss**	**Remark**
SCRP 2000b, 41:	7	Wheat	185.1t/ha*a	
	12	Lentil	180t/ha*a	
	10	Barley	141.1t/ha*a	
SCRP 2000c 40:	4	Wheat	192.6t/ha*a	
	6	Teff	178.3t/ha*a	
	5	Barley	111.9t/ha*a	
	3	Horse Beans	115.5t/ha*a	

Source: Ludi (2004)

For Comparison with the USA Experience

Table 4: Soil loss under different crop variety

Land Use	Land Area (1000ha)	Land with water erosion greater than 11mg /ha/ year (%)	Remark
Crop Land			
All	167288	23.5	
Corn	37832	33.6	
Soya Beans	24020	44.3	
Cotton	6713	33.6	
Wheat	28995	12.9	
Potato	53840	10.0	
Range Land	165182	11.0	
Forest Land	-		
Grazed Land	24696	15.0	
Un Grazed Land	124696	2.0	

Brady (1984: pp 544)

2.2 Socio Economic and individual Behaviors in soil degradation and conservation

The study carried out by Teffen *et al,* (1994) confirmed that erosion degrades not only the productivity of the soil but also it degrades the economical value of the land and further he found that the falling price of eroded land from standardized price of f3 to f1 at Motungwa watershed in Kenya.

Kohnke (1959) argued that the place of economics in soil conservation is that, the survival of mankind based on it; explained the irreplaceable nature of soil does not permit us to have a purely economic view point of soil conservation and further noted soil conservation gives an important incentives to the individual farmer to adopt such measures and the farmer has responsibility as steward of the land he will only be able to protect from erosion to raise its productivity if his farming operations pay for itself.

Here, amongst Kohnke's argumentations we can consider two points:

(1) "The irreplaceable nature of soil does not permit us to have a purely economic view point of soil conservation." This is to give heavy emphasis on the practice of soil conservation. Because, soil and water conservation saves the land and/or soil from degradation and conserved land/or soil can repay. But the value of soil conservation is not only the issue of cost benefits relationship, but also it is vital for ecosystem maintenance, stability and sustainability.

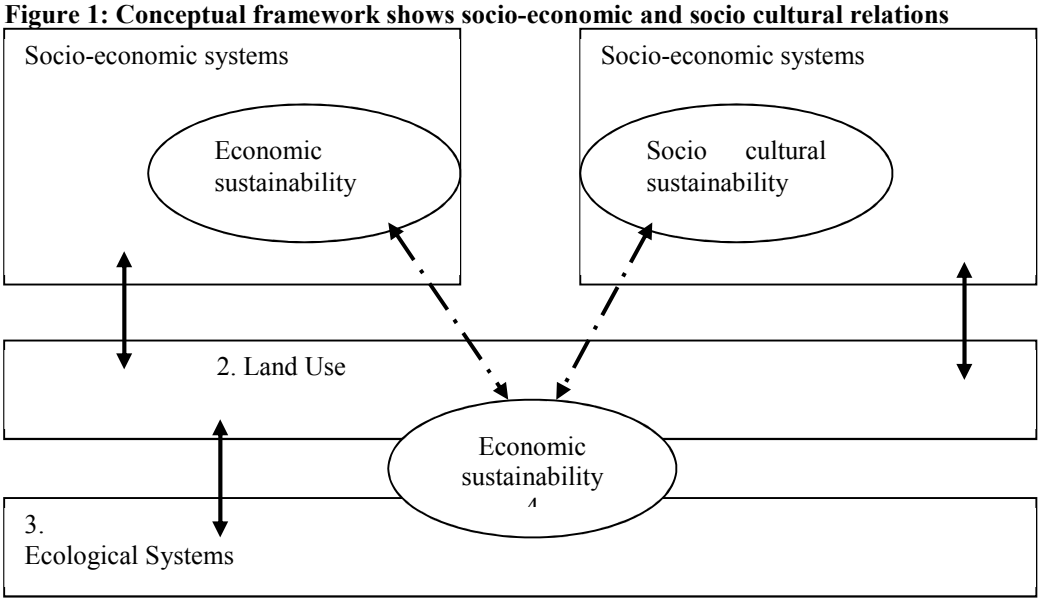
(2) The second point reflects the incentives those individual farmer receives from soil and water conservation practice. Either directly through fair investment on productive soil and maximum harvest and /or transferring productive wealthy land to his young generation. In fact, responsibilities to take care for his individuals possession is another message through the second point.

Moreover, to determine whether soil conservation measures are economically sound or not, limits of time and

area must be established. Practically all soil conservation measures benefit the individual farm as well as the area downstream. Kohnke finalized as a matter of the fact they (soil and water conservation measures) usually benefit the entire community through increased production and purchasing power. The last statement of Kohnke research result is a viable input for the Ethiopian National food independency strategy realization efforts through scaling up soil and water conservation practices.

The generalized conceptual framework of Fig.1 and Fig.2 may help the reader for better understanding.

Figure 1: Conceptual framework shows socio-economic and socio cultural relations



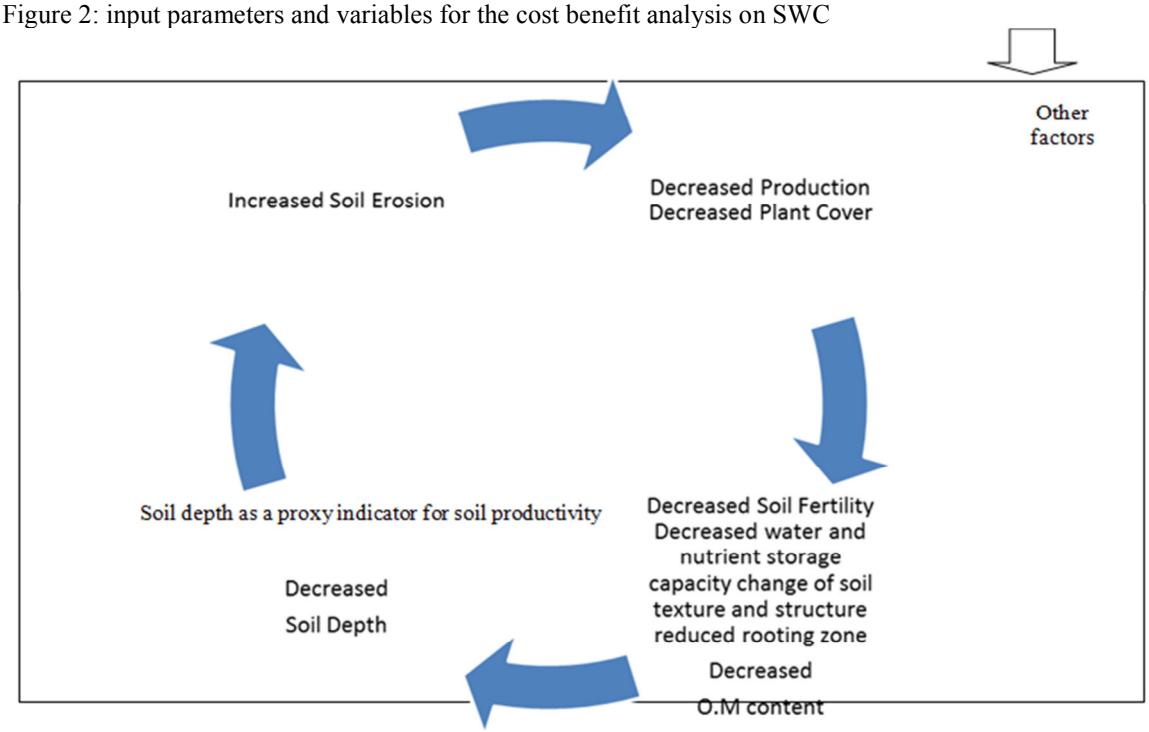
Legend: ←· — · → Focus on "ought": perceptions, valuations, and needs (convergence conflict)

←——→ Focus on "is": relation, systematic interactions and dynamics

(After Wisemann (1998), cited in Ludi, 2004)

As indicated in Figure.1 the sustainability of economic components ensures the existence of socio-economic systems. The existence of socio-economic systems which is reinforced by sustainable economy can gear sustainable ecological systems. Better land use is guarantee for both ecological and socio-economic systems existence. The things should be considered as both can be beneficial in case of heavy lines. In case of dot the relation is loose.

Figure 2: input parameters and variables for the cost benefit analysis on SWC



Source: own compilation, drawings by K. Herweg (cited in Ludi, 2004)

As illustrated in Fig. 2 increased erosion results on loss of soil depth. The decrease (loss) of soil depth by its turn affect soil fertility and in long run disturbed and declined bio-physical and chemical properties of the soil. This will reduce the plant rooting zone. Furthermore, the productivity of the soil will be deteriorated as a result of disabled plant growth.

Finally, higher production cost and minimum yield will call for food insecurity and related complex socio-economic problems. But, scaling up soil and water conservation practice leads to optimist direction. Ludi (2004) found that in most cases, yields are significantly higher just behind the conservation structure than other part of the field and presented this remark: the reduction of soil erosion – could be achieved to some extent, 55% in Maybar, 59% in Andit Tid, and 68% in Anjeni (Table 5 and Table 6).

Level Fanya juu, grass strip, and level bund reduced the annual run off by 81%, 75% and 57% respectively as compared to control plots. The percentage of annual rainfall that become run off was very low on all plots ranging from 0.3mm to 3.0mm. The graded bunds have distinctively higher annual soil loss (5.15tons/ha) whereas, the control plot had an annual soil loss 2.02 tons/ha which is less than half of the annual soil loss of the graded bund and further observed that the three, level soil conservation measures(level Fanya juu, Grass strip, and level bund) distinctively lower annual soil losses compared to those of the other measures) amounting to 0.49, 0.84 and 1.04 tons/ha respectively (Mulugeta ,1988).

Table 6: Estimated annual soil loss from an untreated plots and reductions of soil loss on treated plots

Research Site	Mean Soil Loss	Soil loss reduction based on results from treated plots (%)	Proposed mean soil loss conserved lands
May bar	28t/ha/p.a	55	13t/ha/p.a
Andi Tid	147t/ha/p.a	59	60t/ha/p.a
Anjeni	145t/ha/p.a	68	46t/ha/p.a

Source:Ludi(2004)

Jutzi *et al*,(1988) studied soil types and reported that vertisols are particularly subjected to water erosion. Moreover, the research performed by Ludi (2004) examined mean annual soil depth loss (mm) in comparison from unconserved and conserved lands in parallel with yield change in percent as 1 per soil depth reduction occur in both un conserved and conserved lands (Table 6)

Table 6: SWC practices efficiency over yield in various plots

Research Site	Mean annual soil loss [mm] unconserved land	Mean annual soil loss [mm] conserved land	Yield change [%] per 1cm soil depth reduction	Annual yield change [%] unconserved land	Annual yield change [%], conserved land	Annual yield change, derived from regression analysis of mean yields (%
May bar	2.8	1.3	-0.25	-0.07	-0.04	-1.5
Anidt Tia	14.7	6.0	-0.62	-0.91	-0.37	-2.4
Anjeni	14.5	14.5	-0.16	-0.23	-0.07	-1.6

Note:- Mean soil loss [mm] on un conserved land, yield declines per 1cm soil loss as calculated on the basis the regression functions (yield=f (soil depth, slope gradient), annual yield declines taking into account annual soil loss on un conserved and conserved land; an annual yield change based on regression analysis of mean annual yields. (Source: own compilation, Ludi, (2004 pp:151).Conclusion of the profitability of SWC at the three research sites, according to Ludi, (2004);the profitability of introduced and/or adopted soil and water conservation is pronounced by situation specific. It is clearly dependent up on: slope gradient; soil depth; annual erosion rate; reduction of soil loss rates by considered soil and water conservation technology

When we see in-depth the research results of the above four Authors: Ludi (2004), Teffen et.al,(1994), Mulugeta (1988), and Kohnke(1959) in line with socio economics validity of soil and water conservation practices the research results revealed that conservation practice enables farmers to harvest maximum yield that can make sound profit.

2.2.1 Lack of Awareness on soil degradation

Creation of awareness amongst the rural communities is important for protection and conservation of natural resources to counteract soil erosion and land degradation. This is well implemented by different corners of the world through different methods and approaches. Awareness is literally to mean (according to Webster Dictionary, Fourth *ed*. pp. 160) intelligence, consciousness in social issues. Eyassu (2002) showed that the soil nutrient and organic matter depletion which is by far worse than physical soil loss was not understood by the Kindo Koisha (southern Ethiopia) farmers. However, current awareness awakened them to limit from massive removal of vegetation cover to reduce strong erosion occurrence. Tylor and Lill (1993) showed that for the first decade the conservation work was under taken by local community. Then, with increasing awareness of the

severity of land degradation and the advantages of tackling it massive local initiatives and efforts were made and Machakos District restoration was successfully accomplished by moral and financial complementary of Kenya government and international donors.

In Ethiopia, after 1984/85 drought the study undertaken by ERCS (1986) on upper Mille and Cheleleka catchments found that the creation of awareness amongst the watershed community help the community, the government and the bio physical environment for pre-hand prevention of disasters and awareness creation help farmers to understand about their surroundings.Generally, the significance of awareness creation is commonly reflected by the above authors. The impact of awareness proved to have been brought positive change in the country.

Also, the initiations have been supported and more facilitated by MoFED (2006) on PASDEP. Through PASDEP soil and/or land degradation problems tackling processes started on the basis of deep, wide and strong awareness created to end poverty.

PASDEP (2006), has been involved to scale up awareness with a sense of commitments. PASDEP implementation motorized the range of awareness among the whole Ethiopia society and particularly rural communities. The rural communities seem to reach a maximum awareness level on the basis of free market. Also the performance of awareness building concerning natural resource protection, conservation, fast development and economical utilization is at its infant stage. Because, still deforestation is going a head, land degradation and soil loss is the primary problem of small holders. So, the initiated awareness should scaled up and fully raise the consciousness level of land users.

The scale of awareness should cover conservation of upstream areas through PASDEP. The small holders, who are believed to hold majority of rural land use should thoroughly understand that there is no land productivity and harvest, maximum yield without soil and water conservation. Because it is a land that generates any wealth directly or indirectly. Thus, scaling up soil and water conservation means non other than scaling up land productivity. The scope of PASDEP awareness program included these all.

2.2.2 Relationship between poverty and soil degradation

The study by Madeley and Stolton (1992) indicated that a combination of rapid population growth and lack of sophisticated agricultural practices in the south causing a steadly escalating (back formation) spiral food shortage. Negassi *et al*, (2002) indicated the excessive exploitation of forest and soils caused fertility degradation, that is, physical, biological and chemical degradations of soil.

The Ethiopia Government National strategic plan for 15 years (2006-2009/10) studied by MoFED (2006) on PASDEP, accelerated and sustainable development to end poverty from this country reveals that natural resource conservation based development particularly involving soil and water conservation scaling out practices. The PASDEP implementation programs are broader, participatory, and has better mood for application.

And this is the actual relationship between the poverty and land and/or soil degradation. The aggravating internal, but the most severe influential factor is the occurrence of soil degradation at small holder's crop land due to lack of sufficient awareness concerning erosion hazards and the role of soil and water conservation practice. Provided that, the poverty scale at small holder farmer level deep and wide.

Though the efforts carried out by government showed should be appreciated, the MoFED (2006) issued PASDEP from its infancy age up to now accomplished too many successful achievements except the remaining task is by far greater than the previous accomplishments.

If the ongoing efforts more scaled out concerning soil and water conservation and associated natural resource conservation, conservation based agriculture and in anyone sector according to the PASDEP poverty will be eradicated out from Ethiopia.

Moreover, PASDEP has been involved to scale out soil and water conservation practices at small holders farm level in order to tackle the land degradation and improve productivity. As well different types of farm forestry, agro forestry, wood lot, area closure are some of the PASDEP activities which can generate household income and gradually eradicate poverty.

PASDEP, also at an initiation level to build participatory watershed management and by this it is at its infant to young stage. Particularly the initiation by PASDEP to create household sustainable income generation source is the part that should receive appreciation for its promising efforts and inputs for poverty reduction.

Training is, main poverty alleviation method that capacitating household in sustainable income generation. PASDEP initiation should receive appreciation by this and ought to scaled up the present duties. Because, poverty is a root cause for deforestation; if not the only case. Hence, deforestation paves the way for land and/or soil degradation. It is this land degradation and/or soil loss that depresses the farming society, particularly small holder peasant. When the land lost growing stock (asset) due to deforestation the fertile soil lost due to erosion and hence production cost over whelms yield's price, it is obvious poverty entered to farmer's house.

2.2.3 Land Tenure Security and Its Implication over Sustainable Soil and Water Conservation

The internal need & desire of human beings had been shifted to individual property ownership since the end of

primitive communal society. Moreover, as indicated in Melaku (2003): the need and interest for land privatization was advocated by the enlightment age scholars such as John Lacke (1632–1707) justified the individual's personal property rights as a deserved right and advocated for the application of this view. The Locke's view states that: as soon as man 'mixed' his labour with a "thing" (land) he has all the right to acquire it and furtherly underlines that: man drove his "appropriation" rights from his two postulates that man is entitled and bound to preserve the existence that God has given him; and every man has a property right in his own person. Pollock (1904); Mead (1915) encouraged the Lockean's views of personal land ownership just as natural rights.

However, the Locke's orientation (view) was confronted with Marxian view which opposes the land ownership under private property right (Melaku, 2003).

The contemporary nations, or contemporary writers such as Bromley(1997/98), cited in Melaku(2003) defined property rights as institutional arrangements to govern excess land and other resources. The contemporary writers agreed with Locke's view and accepted the lockean orientation.

FAO (2006) investigated the conditions of property rights and explained that: property rights require institutions or rules to back claims. But these need not be government backed legal institutions and further noted that, entitlements can be defined by cultural norms or customary rights. According to FAO (2006) property rights needs not constitute ownership of a resource but can instead be a bundle of rights, including access to a resource (e.g., the right to enter a farmer's field) or withdrawals of benefits from a particular resource (e.g.; water from a stream of fruit from trees) and added there are also rights to control, exclude and manage a resource, part of a resource or multiple resources (Schlarger and Ostrom, 1992, cited in FAO, 2006). As well based on their spatial characteristics natural resources also embody temporal features that affect production. As in FAO (2006) some economic activities involving natural resources produce returns in a short period and others do so over a long period; property rights that offer security of tenure are important incentives for investing in natural resource management activities fall into this category. Scaling up soil and water conservation requires permanent structures, biological erosion control practices, such as tree planting, repairing of structures, even area closure up to some, minimally 5-7 years, controlled grazing and others.

3. SOIL ECOSYSTEMS AND SOIL EROSION MITIGATION

3.1 Soil Ecosystems and Erosion Mitigation efforts

A study by Forman and Godro (1986) based on soil ecosystems revealed that soil ecosystems include ants, termites, in many tropical soils. Besides these decomposers the soil ecosystems include many more kinds of animals: predators, fungi, bacteria, protozoa, algae and others. Brady and Weil (2002) identified five key roles of soils:

First; soil supports the growth of higher plants, mainly by providing a medium for plant roots and supplying nutrient elements that are essential to the entire plant. Properties of the soil to determine the nature of the vegetation present, and indirectly the number and types of animals (including) people,and vegetation can be supported. Second; soil properties are the principal factors controlling the fate of water in the hydrology systems, water loss, utilization, contamination and purification are all affected by the soil.

Third; the soil function nature's (natural recycling systems). Within the soil, waste products and dead bodies of plants, animals and people are made available for re-use by next generation of life.

Fourth; soils provide habitats a myriad of living organisms, from small mammals and reptiles to tiny insects to microscopic cells of unimaginable numbers and diversity and finally Fifth; a human built ecosystems, soil play an important role as an engine erring medium, Brady and Weil (2000) concluded that, their findings report on soil ecosystem beyond natural processes to cultural significances of the soil as building material and provides the foundation for virtually ever road, air port, and houses we build, concerning cares that are undertaken for sustainability of ecosystems. Ludi (2004) argued that economic development should be in such a way that as to meet the needs of the present generation without competing the ability of future generation.

Bartelmus(1977) agreed with Ludi's(2004) opinion and indicated that, acceptable development is the set of development program that meets the targets of human needs, satisfactions without violating long term natural resource capabilities and standards of environmental quality and social equity. Panda (2006) achieved the welfare of man kind depends on the wise use of our soil and water resources. Another research by Echalm (1978) concluded that governments focus only when large scale disasters strike but they see permissively when deforestation took place. Gupta (2005) found increasing land degradation contributes to temperature rise and become major cause for soil carbon loss and argued that the decrease in soil carbon content may result in slow organic matter recycling.

3.1.1 The contribution of land and/or soil degradation for Global climate change

Peter and Mayers (1992) found that the increase in the greenhouse gases in the atmosphere, thus is a major cause for increased temperature and earth's surface warming (cited in Sigh *et al*, 2004)

So, one can ask what is a linkage between erosion mitigation and Global climate change. It is most obvious that

maintaining soil fertility with organic matter is one of the ultimate goal of SWC and at the same time mitigates erosion and balances the climate system. According to Franz luebbers and Juo (2003) soil organisms play vital role in the maintenance of soil fertility through these processes:

- Accumulation of soil organic matter;
- The mineralization of organic matter which releases nutrients available to higher plants.
- Production of antibiotics from micro-organisms isolated from soils.

Moreover, Franz luebbers and Juo (2003) explained soil fauna as they include (>2 mm in width, such as mice, earth worms, termites, and millipeds), through Meso Fauna (0.2-2mm, such as cottembola, and mites), to microfauna (<0.2mm, such as nematods and protozoa) and Soil flora as they include macro flora (such as the root of higher plants), and micro flora (such as algae, fungi, action mycetes, and bacteria) and the authors furtherly noted the activities of soil fauna and flora that these organisms form a food chain or more accurately a food web and concluded that in natural ecosystems soil fertility is maintained by continuous ground cover and internal nutrient cycling within the ecosystem.

As mentioned above the sustained ground cover enables the functioning of soil ecosystems balanced as organic matter decomposition, mineralization, and nutrient recycling. The ground cover loss exposes the soil for excessive solar radiation; this creates unusual increased temperature of the surface and the subsurface. Due to this phenomenon soil carbon automatically leaves the soil and escape to atmosphere. As a result, soil organic matter decomposing and nutrient recycling banes.

Another negative impact of land degradation may include:

- Clearing green plants and facilitating conditions for destruction of carbon sinks, thus the amount of carbon dioxide that have taken by green plants will scape to atmosphere.
- Increased soil temperature detaches soil aggregation and resulted in soil moisture loss, thus pushes soil carbon towards earth's atmosphere. So, in such a way land degradation contributes to Global climate change.

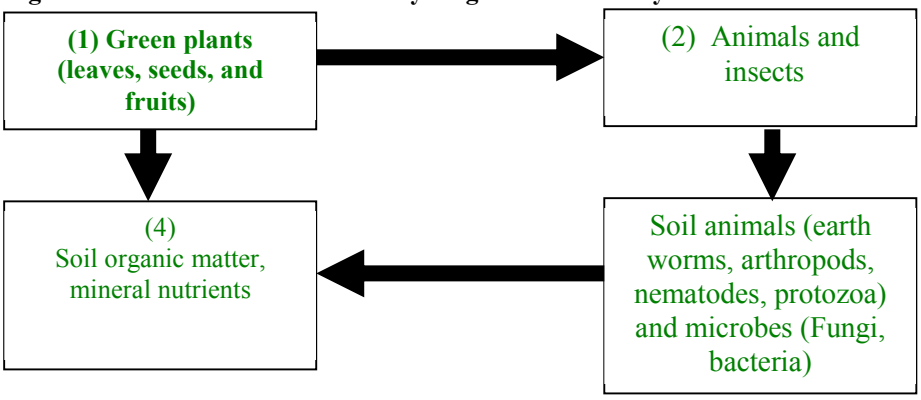
3.1.2 Erosion Mitigation

Provided that the present problems are the product of human interference (man induced) or in some cases natural event and they have to be tackled; the pre requisites for implementation, according to MOFED/PASDEP (2006):

- Geographical location of community based watershed;
- Integrated human, material and logistic inputs;
- Scaling up of the existing soil and water conservation efforts and there by out put levels.
- Applying soil and water conservation based resource management.

According to Franz luebbers and Juo (2003) recommended biological and structural measures since it is vital for replenishing mineral nutrients lost due to run off and leaching .

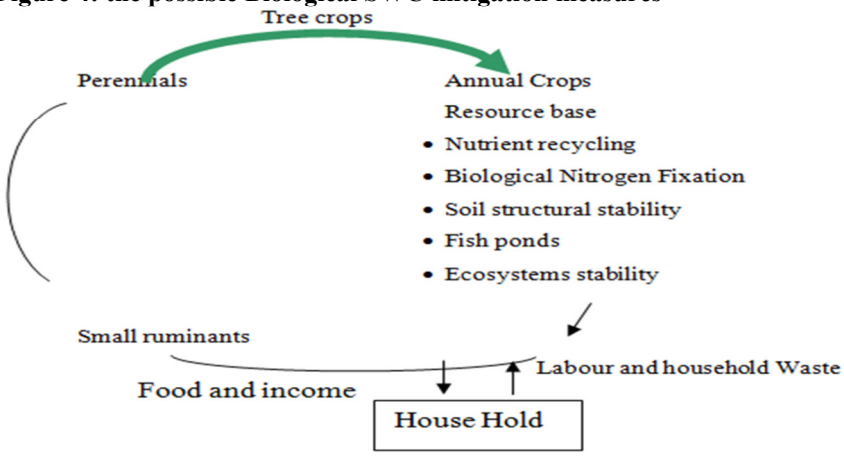
Figure 3: Food chain and nutrient cycling in natural ecosystem



Source: (Franz luebbers and Juo, 2003)

The conceptual framework (Fig 3) above illustrates green plants as a source of food chain (1) and animals and insects as primary consumers (2) soil animals (3) as secondary consumer, and decomposers, and soil organic matter, mineral nutrients (4) as ready made goods to be taken by plants and also plant leaves, seeds, and fruits directly added to (4).

Figure 4: the possible Biological SWC mitigation measures



Source: Franz luebbers and Juo (2003)

Annual crops, perennial crops and small ruminants are the component of these integrated or holistic approach. Having the three major agro forestry practices, the system is efficiently functioning and finally, soil conservation practices enabled a given household to enjoy better life. In case of very severe soil degradation the above elaborated soil conservation measures applied in combination with structural soil engineering measures.

Black (1993) indicated that the most profitable allocation of fertilizer among crops is one of soil structures enhancing option while well structured soil can facilitate water holding, thus improve erosion control efforts.

The study by Swift (1994) revealed that manipulation of the physico-chemical environment: practices such as tillage, irrigation, organic matter application can increase the quality of the soil and hence soil can resist erosion by water.

Campbell *et al*,(2003) found village forestry, local community forests, village wood lots and urban fuel wood plantation, and adopt more efficient fuel wood stoves to conserve forest and there by soil and water resources from being lost by erosion. MoFED (2006) prepared a huge national strategy known on PASDEP, that was aimed to implement resource management based soil and water conservation practices. PASDEP implementation program includes 693,000 ha area enclosure to restore land and /or soil productivity and to cover 10.8 million ha land with such conservation measures. Generally, the findings of different authors from different corners of the world are similar with one another and the Ethiopian PASDEP (2006) in this regard matches to fundamental concepts.

3.2 The role of organizational capacity building to strengthen SWC and land management

Melaku (2009) showed that organizational strength is a tool for implementing newly issued strategies; Mearn and Leach (1988) found that indigenous technical knowledge reflects the diversity of local agro ecological conditions and the importance of this for livelihood strategy geared to manage risks and is important for specific local landscape and livelihood. They further understood that there is limits to local indigenous knowledge and underlined that local indigenous knowledge's is also rarely distributed evenly. Thus why local organization capacity building is necessitated.

Another study by Aderson and Ingran (1993) found that interactive approach used to gain insight in soil, water and land use practices achieved successes. The argumentation of the above authors is to fill the gaps of indigenous technical knowledge by positively intervening the local organization. Warren (1988) reported that the participation and empowering rural communities make the people progressive and self-reliance and concluded natural resource management that does not have a direct impact on income is seldom considered, special remarks that placed is priority for marginalized up land areas, and environmental awareness and natural resource management skills can be improved only if a certain level of organizational capacity is reached and primary needs (income, water supply, education, communication services) are first satisfied to a reasonable extent.

In Ethiopia according to PASDEP, MoFED (2006) local communities especially rural communities are provided with at least 3 Development Agents; i.e one each from natural resource, agronomy and animal husbandry. These skilled technical personals provide extension services for farmers and offer training at FTC (Farmers Training Center) pertaining the benefits of soil and water conservation practically at field in addition to class lesson.

The Ethiopian local institutions are by far more received credit in FDRE in comparison with the past. And by now they are in the position of exercising the cultural and/or traditional values and norms amongst which natural resource conservation and fair utilization is a one. Though, just as Mearns and Leach (1998) stated the

local (cultural) organization and their indigenous knowledge is uneven and yet limitations are not fully avoided. Therefore, routine capacity building and follow up is important for sustainable soil and water conservation practices.

3.3 Policy and Strategies

The ADLI (Agricultural Development Led Industrialization) which had a certainty for PASDEP (plan for accelerated and sustainable development to end poverty, are the major national strategies in Ethiopia amongst which ADLI is the prime guide line through which the country based to promote from the existing agriculture dominated economy to agriculture and industry mutually leading advanced economy.

According to Melaku (2009), ADLI depends on intensification, diversification and increased productions of smallholders' agriculture in addition to large scale (extensive commercial farms) farm investments by private companies.

PASDEP, /MoFED (2006) encompasses over all development sectors based on integrated approaches considering the benefits that come from each sector either by goods or services can improve the whole macro economy and the livelihood of the citizens as a whole.

In Northern Ethiopia, Tigray Regional state by Fistum and Pender (2002) the study performed on land degradation and strategies for sustainable land management confirmed that the policies, strategies and programs of the federal government and the regional at administration hierarchy benefited the people alot. They appreciated the extent of environmental degradation tend to decrease due to conservation based agriculture.

4. OPPORTUNITIES

4.1 Recognition of the problems by Entire society

The opportunities that Ethiopia possesses for the realization of national food independency strategy are too immense. Amongst which the recognition of the problem by the entire society is considerable. For example, the Government of Ethiopia issued different types of relevant strategies, and implementation program, MoFED, PASDEP (2006) Chapter 7.1.8 is a good witness for the recognition of the problem. Because if there were no problems it is not necessary to plan for solution.

4.2 Progressive new Rural Development Policies

The foundation of new rural development policy foundation was laid by Transitional Government of Ethiopia (TGE) since 1991. Melaku (2009) reported that the transitional government of Ethiopia:Promoted economic growth policy through a market based economy; Encourage private sectors to invest in the economy;Government provides selected services for and through decentralized administrative systems; and Agricultural and natural resources management (improvement)

Special strategies such as food security strategy (FSS), PRS (Poverty Reduction Strategy), and ADLI at large Melaku (2009). Amongst the best strategies and attached policies of ADLI the followings are presented: Developing and promoting use of improved agricultural technologies, such as improved seeds, fertilizers and pesticides through agricultural research, extension services, input supply and credit schemes; Expanding small scale irrigation schemes in drought prone areas; Development of livestock resources ;Conservation of natural resources ;Implementation of an enabling land policy; Expansion of marketing services; Enabling private investors to play their proper role; Expanding economic social infrastructures that support development ;and concerning farming activities, ensuring that all activities are centered on farmers decisions.

Also, the Ethiopian food security strategy (FSS) which was issued in 1996 focused on the environmental rehabilitation according ILRI official report and as Melaku concludes the acknowledgement that in food security is a long term undertaking.

4.3 Vast Experience on SWC

The study by Melaku (2009) on natural resources law and policies in Ethiopia ascertained that even the earliest monarchical rulers of the country had placed emphasis for natural resources conservation and environmental protection. The Melaku's study revealed that the earliest traveler such as Nonnus, since 4th C A.D at the region of Axumite Kingdom saw multitudes of elephants pasturing without any human attach: under the royal law of wildlife protection the natural resource protection, conservation and attempts to conduct proper utilization was chrono sequential tasks of the Ethiopian state and government leaders and further exemplified his findings: King David (1365 – 1395) and King Yacob (1597-1603) assigned forest guards for Wof Washa forest protection. The experience of Ethiopia is not only restricted by these efforts only but also stone faced terraces (And anjet, Hullet anjet) at Northern part of Ethiopia and the Konsso people and other southern and any part of the country's stone faced terraces ruminants are good evidences for that Ethiopia has deep experience in soil and water conservation. Also, the country well adopted scientific methodological path of modern soil and water resources conservation (Example: Tigray highlands).

The most impressive wealth that Ethiopia on these days possessed is that the skilled man power starting from junior expertise level up to natural resource and/or forestry scientists together with plenty of labour. In fact, the bundle of problems which will be solved by the integrated efforts of the Ethiopians disregarding anything should be appreciable.

5. SUMMARY AND CONCLUSION

5.1 Summary

Chapter one introduces the occurrence of land/soil degradation in Ethiopia as a result of combined factors such as massive deforestation, lack of sustainable soil and water conservation efforts, rapidly growing population pressure, loose land use policies. Chapter two indicates challenges those arise with soil degradation such as the loss of civilization by erosion and flooding, the loss of arable land/fertile soils by erosion, the decline of soil fertility and low infiltration rate of rainwater due to accelerated runoff, which decreases underground water and it underlines awareness creation at individual land user and at community level. Also indicates the poverty in relation to soil and water conservation practices and noted that the scaling up of soil and water conservation practices leads to household food independency if not poverty is in parallel way.

It concludes with a remark that is clearly defined and socially gained accepted land tenure policy encourages land users to invest permanent soil and water conservation practices. Also encompasses socio-economic aspects and makes analysis over cost benefit of soil and water conservation practices in terms of yield collected. The prime findings stated in this section is conserving 1.0mm of soil depth from erosion is facilitating for yield increment and the reverse is true. This chapter touches the role of individual land/soil user in reference to his meaningful survival coinciding with soil and water conservation practices.

Chapter three reveals soil ecosystems, and addressing mitigating soil erosion. Through its course of presentation the chapter explains five key roles of the soils. This is to motivate the farmers and other soil users for soil and water conservation practices scaling up. Chapter three stated soil ecosystems components such as soil fauna and soil flora. Soil fauna includes: mice, earth worms, termites, millipeds as macro fauna, and collembolan and Mites as Meso fauna while micro fauna includes nematods and protozoa. Soil flora: Macro flora, root of higher plants while micro flora includes algae, fungi, actinomycets and bacteria. The above organisms are very important for soil organic matter decomposition and nutrient cycling under natural ecosystem. Thus soil fertility maintained and soils productivity increase when soil fertility increase soils resistance against erosion increase.

Also, it attempts to show the contributing soil degradation for global climate change. For the implementation facilitation organization capacity building role presented in chapter three.

And concludes with the policies and strategies those can play a decisive role through soil and water conservation practices. Among which PASDEP (plan for accelerated sustainable development to end poverty) is the most popular.Chapter four reveals the opportunities that could utilized for success of soil and water conservation practices such as recognition of the problems by the entire society progressive new rural development policies, skilled man power, vast experience in soil and water conservation practices are notable.

5.2 Conclusion

The scale of soil degradation challenge is from loss in productive soil to loss of lives by drought, famine and starvation. However, the solution for the problems resulted from soil degradation is at hand. The Ethiopian farming societies are rural dwellers and the paper advices an individual household to stand by for scaling up soil and water conservation practices. When these small holders adopt soil and water conservation practices presented in this seminar paper then soil productivity increase. As a result low production cost and higher production characteristics agricultural yield actualized. Then, the success and sustainability of national food independency strategies realized.

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