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Desertification in the Land of Plenty (Ethiopia): Causes, Effects and with Recommendations

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Abstract:

Desertification is "the sum of the geological, climatic, biological and human factors which lead to the degradation of the physical, chemical and biological potential of lands in arid and semi-arid zones, and endanger biodiversity and the survival of human communities." (FAO, 1984). Fierce mountains with its steep angles of slopes and with low cover of plants are accelerating land degradation and influencing desertification in the country. Human modification occurs in all ecosystems without exception. Nearly 860,000 km² or 71.5 % dry land of the country is under desertification (TamireHawndo, 2001) The environmental degradation in this country resulted from over fragmentation of farm lands due to fast population growth, over grazing, natural catastrophe such as drought, salinization, removal of biotopes (deforestation), erosion, fires, inappropriate technology, lack of progressive land tenure systems are some of the reasons. All types of pressure that is currently causing stress to the land should be minimized i.e. both human and none human. Regional specialization is more recommended according to regional economic suitability and ecological stability Tackling fast population growth, limiting livestock numbers, creating a nation, that is friendly to their environment and that think and work for its sustainability.

Keywords: deforestation, degradation of soil, desertification, pollution, salinization, overgrazing,

1. Introduction

Ethiopia has a large area of 1.1 million km² with the population of some 94.1 million people (World Bank, 2013) and astronomically located between 3⁰- 15⁰N and 33⁰E – 48⁰E. It borders with the Sudan, and south Sudan in the north and west, Kenya in the south, Somalia in the southeast and Djibouti and Eretria in the east. (World atlas, 2010) (See Figure 1). It is said to be by many authors as country of mountains and rivers where we can find highlands form the largest continuous area of its altitude in the whole continent, with little of its surface falling below 1500 m (4,921 ft.) (Kobar sink), while the summits reach heights of up to 4550 m (14,928 ft) (RasDashin). It is sometimes called the Roof of Africa for its height and large area. (See figure 2)

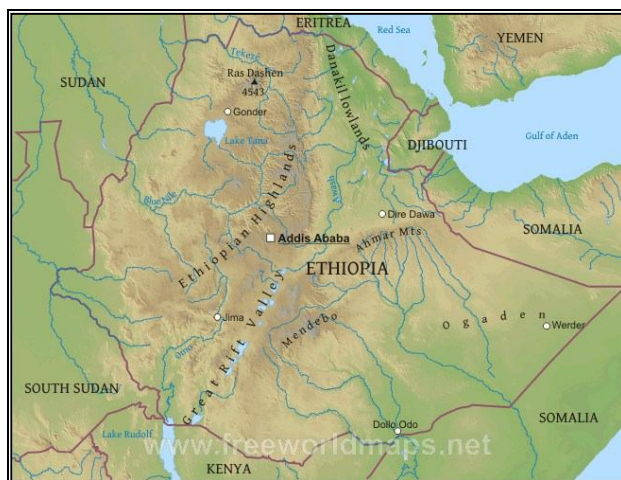


Figure 1: The physical map of Ethiopia



Figure 2: Simien Mountain with height of 4550 m

It's formed by a series of geological faults caused by huge volcanic eruptions centuries 'back that subsequently created what we now call the Ethiopian Highlands and a series of perpendicular cliffs, mountain ridges, rugged valleys and very deep lakes along its entire

rift valley areas. If one can take flight over the highland areas one can see roads as lying snake on the ground. In order to travel along the mountain side one has to make many curves to travel short distance due steepness of the slope in the area.

The highly dissected nature of the landscape has proved a barrier to the development of internal surface communications and has resulted in the long-term isolation of many communities in mountainous area difficult of access. The area is highly affected by erosion caused by man and geological processes. Over the ages, erosion, volcanic eruptions, tectonic movements and subsidence have occurred and continued through millennia to accentuate the unevenness of the surface. (L.Berry, 2003). The high Landers of this country have lived in partnership and equilibrium with nature by creating one of the most harmonious land scape in the continent. Varieties of plants have given different colors to this land from which harvesting is possible more than twice times in a normal year. Even the moderate climate of the highland area of Ethiopia has given moreover possibility of most of European plants to grow without any problem .To day this equilibrium is endanger leaving the area with decline in productivity and consequent increased in migration, especially among the younger and more dynamic people with out any sex discrimination. Currently things are moving in the opposite direction .Thousands of plants had disappeared ,animal species had migrated or threatened .Soils that had been giving abundant harvest to its habitants are now left with shallow depth or with only bed rocks. Ignorance, poverty, and unfair land distribution however, are hampering human environment and advancing desertification in Ethiopia.

Desertification in Ethiopia of course, did not begin with the recent droughts. Archeological records suggest that some areas have been getting progressively drier over 5000 years (FAO 1984). What is new is the coming together of drought with the increasing pressures put on the fragile arid and semiarid land. Large area of rangeland, forest area and cultivated land is under influences of desertification in much shorter times than before. Nearly 860,000 km² or 71.5 % dry land of the country is under desertification (TamireHawndo , 2001) .Fierce mountains with its step angles of slopes and with low cover of plants are accelerating land degradation and influencing desertification in the country. Human modification occurs in all ecosystems without exception .The most profound and accelerating changes now occur in forest, cultivated land, grazing lands and bog ecosystems unorganized reduction. Mountains and valleys that were resistance to all form of control easily giving its soils to the neighbors countries, allow easily removal of its vegetation cover and decline in quality of faunas. About half of the high lands (some 270,000km² is significantly eroded of this 140,000km² are seriously eroded and left relatively shallow soils .20,000km² of agricultural lands are so badly eroded that they are unlikely to sustain cropping in the future.(FAO,1986)

Many studies were given their witness that causes and effects for desertification's in Ethiopia are many in numbers. Some of them explained as follows

1.1. Population Growth

Population is growing fastest in the developing countries. In Sub-Saharan Africa, annual population growth of 2.3 percent has led to ever smaller areas of arable land per capita. Between 1961 and 2009, per capita arable land in Sub-Saharan Africa fell by about 76 square meters a year, the steepest drop in the world (Figure 3 and 4).

The total population of Ethiopia in 1960 was estimated at 11.8 million. It took 60 years for this to double to 23.6 million in 1960. It took only 28 years for the population in 1960 to double to 47.3 million in 1988. The Population grew at an average annual rate of 2.5% between 1965 and 1980 and at 2.9% between 1980 and 1989 and 2.6 between 2009 and 2015. The total population in Ethiopia was last recorded at 91.7 million people in 2012 from 22.2 million in 1960, changing 314 percent during the last 50 years. Population in Ethiopia averaged 48.15 million from 1960 until 2012, reaching an all time high of 91.73 million in 2012 and a record low of 22.15 million in 1960. (World Bank, 2013). The population of Ethiopia represents 1.23percent of the world's total population, which arguably means that one person in every 82 people on the planet is a resident of Ethiopia.

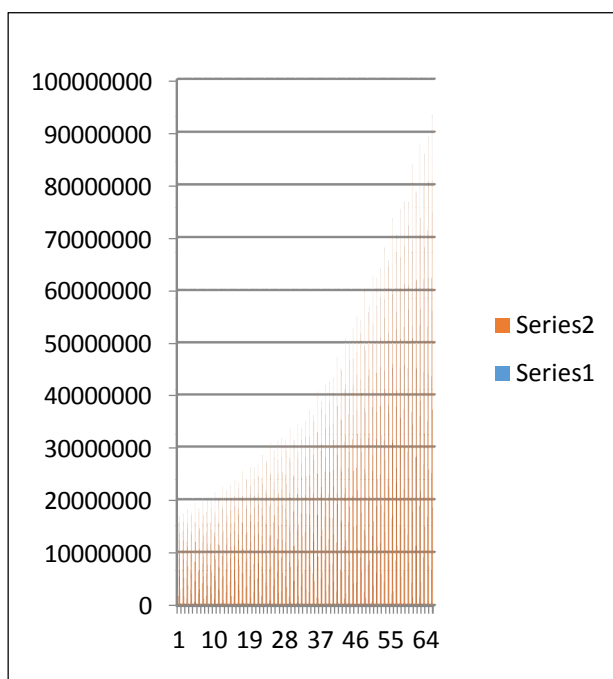


Figure 3: Total Population growth of Ethiopia between 1950 -2014.
Source: Worldometer, 2014.

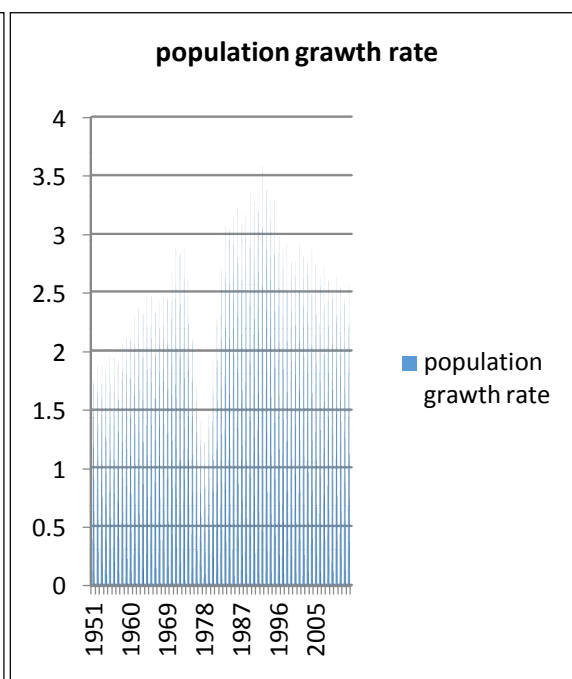


Figure 4: Total Population growth rate of Ethiopia between 1950 -2014.
Source: Worldometer, 2014.

As indicated in figure 3 and 4 the graph the population growth rate of the country was 1.7 % annually in early 1950 and show gradual increase up to 1972 and showed tremendously decline from the year 1972 due to the greatest famine occurrence in Ethiopia up to 1977. Population growth rate again showed tremendous increase after the year 1977. Still the growth rate of the population in Ethiopia is one of the highest in the world. Between 1974 and 1998, human population in creased by 78% with annual growth of 2.5%. (Worldometers, 2014). If one raise question why the population of this country is growing rapidly, reasons may be use of modern medicine relatively to the past, diet change ,traditional belief of people having large family ,less reliable on the growth of their offspring ,then forced to have many , the weakening of the natural factors that reduce number of people(diseases),children's as a work force, religious impacts, considering children as helper during old age, are among reasons mentioned by different researchers. The problem in this country is not the number of the people but sluggish economic development for a long period of time and unskilled man power existing in the country. Still the density of human population in this country per square km² is not as high as the Nile valley, South East Asia and others. (Sissay, 1996),

The area receives more than 90 percent of the total rainfall which makes it favorable for rain fed agriculture and has thus been settled for more than 5000 years (Ethiopia-UNCED National Report, 1992). Large increase in the number of human and livestock population resulted in scarcity of land and expansion of agriculture into traditional grazing areas and marginal lands. The environmental degradation in this country resulted from over fragmentation of farm lands due to fast population growth, less willing to go and work in other places, lack of progressive police insettlement, less protection for new comers in newly opened areas (peripheral areas) by local administrators, insufficient technology, poor impute supply and limited access to credit are some of the reasons. The largest number of the population and two third livestock concentrated on the high lands while the least populated and irrigable lowlands remained untouched by human hands for centuries. More than 90 percent of the land is used for agricultural purposes on a permanent basis and fallowing as a system of farming has completely disappeared indicating that there is serious land shortage (Markos Ezra, 1997). According to this study, in most areas, the average cultivated area per household is slightly more than one half of a hectare. Marginal lands are less able to retain water and are subject to wind and water erosion. Land degradation problem is affecting considerable parts of Ethiopia, especially the highlands, mainly due to water erosion. Soil erosion is the main feature of land resource depletion leading to desertification which leads to reduced agricultural production and shortage of food. Overall, the effect of population pressure and resulting environmental degradation has driven the country into widespread food insecurity, drought and famine for the last four decades.

Over exploitation repeatedly over limited areas of highland areas caused damage to the land and made the area to be degraded seriously that lead to desertification. There is strong relationship between the number of people and live stocks in the area. Here we can find the largest number of livestock than the low land areas .The destruction caused by these livestock is ten times greater than destruction caused by human population as indicated in many ecological researches.

There are frequent encroachments by man that result in widespread destruction of wildlife and their habitats.(Friis and Sebsebe Demissew,2001), further noted that intensive human pressures on the mountains is probably one of the major reasons for the discrepancies between the land situation of the past and present time. In Ethiopia, the increased population ends up needing more land

to cultivate, more trees to cut for fuel wood and other domestic needs. Lack of industrialization and commercial developments mean a high rate of unemployment. This last point means that the majority of people are in rural areas where their life traditional peasants relying heavily on land for livelihood. (Francis F. OJANY)

As a remark we can conclude that fast population growth which absorbs the gains in production or it dashes all hopes for a more comfortable life which causes frustrations that can easily lead to social unrest and even to war. This also brings a constant crisis of wide spread hunger and chronic malnutrition and land degradation. (Mesfin Wolemaria 1977).

1.2. Deforestation

About a century ago, forest cover of Ethiopia was estimated to be about 40% of the country had gone down to less than 4 percent at the present (EVDSA, 1990). However, now a day the estimate is between 2-4 percent. Widespread deforestation in the highlands started around 2500 BC (Ethiopia-UNCED National Report, 1992, The FAO (2007) □ Sucoff, E. (2003) Ee- JRIS, Deforestation for agriculture use is the main factor for the loss in forest cover. Extensive agricultural activities plus demand for firewood due to population increase are the major causes for deforestation. It is to be noted that it is the highland part with better rainfall which had forest cover. The lowland areas had bushes and shrubs covers which are also decreasing fast (conservation Strategy of Ethiopia, 1996, Adrian Wood and Kifle Lemma with Alemaye Konde, 2001)

LANDSAT/TM satellite images from 1986 to 1990 show that Ethiopia's forest cover had since then been reduced to 3.93 %, or 45,055 km² (Ministry of Water Resources, 1997). The figures refer to an annual deforestation rate of 163,600 ha. This means that up to 1999, the size of Ethiopia's natural high forests has been reduced to 2.36 %, respectively 27,059 km². Today, larger forest areas can only be found in very remote and inaccessible areas of south and south west Ethiopia.

The year between 1955- 1979 is known as year of stagnation in the history of forest development in Ethiopia. (See table 1) It was recorded that Ethiopians are losing nearly 60,000 ha of forest.

Year	%	Million ha
1955	15	17.0
1967	7	7.958
1976	4.5	4.5 – 5.67
1979	3.5	3.4 – 4.50
1999	2.36	27,059 km ²

Table 1: changes of forest territory in Ethiopia

Source: Ministry of agriculture (1980)

A detailed analysis of the density classes shows that between 1973 and 1990, the area coverage of closed forest stands had been reduced from 30,243 km² (2.64 % of the country's area) to 2,346 km² 0.2 % of the country's area). The ongoing exploitation could be documented by the fact that within the same time span, the share of severely degraded high forest increased from 0.87 % to 3.08 %.

Lastly forests were lost most often to settlement conversion to agriculture or pasture, exploitations of wood product but there is big gap between the replacement and loss of plant cover in Ethiopia or the rate of deforestation exceed three times than reforestation. Every year Ethiopia is losing 200,000 ha of forest by fire. If you take flight over Ethiopia especially during dry season's night illumination of fire in farm and pastoral areas are common. They have their own reasons to burn forests and grasses. Among reasons to remove old grasses, kill harmful insects and to have new and palatable ones. Of course burning fertilizing ash which is rich in phosphorous and potash through it is likely that enrichment to excessive leaching in year time. Burning is responsible for impoverishment of soil and obliterations of biotopes. If we employed the research result of Mucdonald and Evans (1977) which stated that the clearing and burning of patch forest cause damage of organic matter between 620 – and 1130 ton per hectare and between 110 and 165 kg/hectare of nitrogen to the atmosphere. If we bring 200,000 hectare of forest burning in Ethiopia nearly 124 million - 226 million tons of organic matter and 22 million - 33 million kg of nitrogen can easily escape to the atmosphere from the ground each year. Especially burning of grasses impoverishes the soil; destroy natural vegetation, disappearances of best species. Bio tropic (1985) reviews data from both the tropics and temperate areas to demonstrate the deforestation results in reduction in organic carbon, nitrogen and magnesium while leading to an increase in bulk density of calcium and PH. As result large areas of the country are now exposed to heavy soil erosion. It is estimated that fertile top soil is lost at a rate of 1 billion cubic meters per year (FAO, 1981, Constable, 1985), resulting in a massive environmental degradation and serious threat to sustainable agriculture and forestry. In a forest resource assessment of Ethiopia, Reusing found that within 17 years (1973–1990) high-forest cover decreased from 54,410 to 45,055 km² or from 4.75 to 3.96% of the land area. He calculated a deforestation rate of 1,630 km² per year, which means that deforestation at the same rate would leave about 18,975 of the 45,055 km² in 2006. (FAO, 2007, Sucoff, E., 2003,)

The high level of deforestation and the overall severe environmental deterioration is also fuelling the recurrent drought and famine in the country. As highlighted earlier, deforestation and also de-vegetation has been one of the major factors contributing to land degradation in Ethiopia through exposing the soil for various agents of erosion. Besides, in Ethiopia, the organic content of soils is often low due to the widespread use of dung and crop residues for house hold energy consumption, indicative of the resulting negative impacts on agricultural productivity and production.

Main reasons for changing the structure and function of the original forests in Ethiopia were huge and massive resettlement villagization of 1970's, expansion of mechanize farming and coffee plantation, connection of forest area with urban areas, population growth, socio political changes and political vacuums of 1990's and insecurity of land tenure were among the main reasons. Today,

larger forest areas can only be found in very remote and inaccessible areas of S and SW Ethiopia. At present, the deforestation process has also led to shortage of sawn wood needed as a raw material for the sawmills and wood work manufacturing establishments, and also paper board for paper manufacturing plants in Ethiopia, forcing them to look for imports from such countries as Kenya, Scandinavian countries and Australia. Unchecked deforestation gave opportunity for erosion to remove the top soil. (KebedeGirma, 1988)

1.3. Soil Erosion

The most common form of erosion is the loss of topsoil under the action of water or wind. Water runoff carries the topsoil away; this occurs under most climatic and physical conditions. Displacement of topsoil by wind action is more widespread in arid and semi-arid climates than under more humid conditions. The loss of topsoil reduces fertility because (a) as the soil becomes denser and thinner, it is less penetrable by growing roots and may become too shallow for them; (b) the capacity of the soil to retain water and make it available to plants is reduced; and (c) plant nutrients wash away with soil particles.

A more extreme form of erosion is terrain deformation. Water may cause the formation of rills (i.e. small channels, which can be ploughed over) and gullies (i.e. deeper channels, cut by larger waterflows and difficult or impossible to level by ploughing). It may also cause the destruction of riverbanks, and mass movement (landslides). Wind action may create deflation hollows and dunes. Finally, the covering of the land surface by wind-carried particles (or overblowing) is also recognized as a specific form of degradation.

Erosion risks depend both on natural conditions and on land use patterns. The climate (especially rain intensity), slopes, vegetation cover, and nature of the soil are important. With regard to land use, any human activity which entails the removal of the protective vegetation cover (forest, shrubs, grass etc.) fosters erosion; so do improper measures such as ploughing along slopes.

According to Hawando, T, 1995, the amount of annual soil movement (loss) by erosion is estimated to range from 1,248 – 23,400 million tons per year from 78 million ha of pasture and range lands and cultivated fields throughout Ethiopia

Land use type	Land area million ha	Documented range of annual soil loss, tones/ha/year				
		16	50	100	200	300
		Annual soil movement ,million tones				
Cultivated land	18	288	900	1800	3600	5400
Pasture & Range land	60	960	3000	6000	12000	18000
Total	78	1248	3900	7800	15600	23400

Table 2: Annual soil movement (loss) documented in Ethiopia under cultivated and pasture & rangeland and topographic features (Hawando, T, 1995)

In the dry land areas in Ethiopia 30.9 million ha, consisting of 25 major great groups, are shallower than 50 cm. Further erosion will cause severe damage if rehabilitation measures are not taken in time. Out of the 30.9 million ha, 20.2 occur in areas with xeric soil moisture regime (SMR), 5.2 million ha in aridic soil moisture regime (SMR) and 4.6 million ha in ustic soil moisture regime (SMR) zones (Hawando, T, 1995) – The survey of the soil and water resources of Ethiopia. UNU/Toko. The originally fertile soils of the lowlands in the high and medium altitudes have been intensively cultivated for centuries and are now degraded in some places. (Alemayehu Mengistu, 2004). In Ethiopia as slope increases there was decrease in data of soil production.

Another study carried by FAO (1985) is indicated that the depth of soils is coming shallower than ever before.

Soil depth class	Soil depth (cm)	Area in 1985 [in km ²]	Area in 2010 [in km ²]
A	<150	159420	158580
B	100 -150	63600	58240
C	50 -100	126480	94760
D	25 -50	85940	69180
E	10 -25	76440	56220
F	0 -10	20380	58220
R	Rock	3740	40940

Table: 3 Soil depth class
Source: FAO, 1984

As pointed out in table -3 the depth of soil in Ethiopia varies from <150 cm to 0 -10 cm. Even there are areas with no soil cover. By 2010 nearly 40940 km² area was bare or with no soil cover. Most of these areas are in north Shewa, south Gonder, west Wollo and south Tigray. The reason for being bare was long settlement history, high population density, gambling of political center of the country (Aksum, Lalibela, Gonder, Ankober and Addis Abeba), high geological erosion in the area were some of the causes for land degradation. Nearly 224,560 km² of the area remained with less depth with low water holding capacity, poor soil structure, poor aeration and less fertility. Another study conducted by L. Berry, 2003, indicated that over 14 million hectares of top soil have less than 50 cm depth, 2 million ha beyond reclamation, making it susceptible to drought. In terms of soil nutrient depletion, the equivalent of 30 kg/ha of nitrogen (N) 15 to 20 kg/ha of phosphorus (P) are lost annually through erosion on 71.5 % areas of the country. As designated in the work of

Mulugeta Tesfaye (1988); UNESCO (1986); Tadesse (2001) 50% of the soil of Ethiopia is reduced due to lack of moisture, 3- 5 % is reduced due to heat, 1.5 million tons of grain from the countries annual harvest respectively and half of the rest is highly affected by interference of man. In many places improvement of soil depth depend on soil formation process. This may not true in Ethiopia because soil erosion exceed soil formation process.

According to Hurni (1988) soil loss rates exceed formation rates by a factor 4 to 10 on cultivated land, and of 0.8 to 2.3 on grassland, according to different agro – climatic zones. (Hans Hurni (1988), .Generally loss of soil depth is showing increment from time to time and acting as push factor for the population of the area to resettle in the new opened areas of the country (Mesfin Woldemariam, Alula Punkrest, and others). According to one relevant study in Ethiopia, for instance, " in 1990 alone, reduced soil depth, caused by erosion, resulted in a loss in grain production of 57,000 (at 3.5 mm soil loss) - 128,000 tons (at 8 mm soil depth). It has been estimated that the grain production lost due to land degradation in 1990 would have been sufficient to feed more than four million people." The resultant ecological impacts of land degradation in Ethiopia include loss in the chemical ,physical and/or biological properties of potable water ,lessened volume of surface water depletion of aquifers due to lack of recharge ,and biodiversity loss (Berry,2003)

The movement of these people from more degraded areas to less degraded area of the country is natural and acceptable. But the absence of the ownership of the land since 1974, and other forms of benefit sharing and incentives were responsible for aggressive land degradation in the country. Not working on appropriate technology, not minimizing misunderstanding between the host and new comers and absence appropriate police on the land tenure system remained as main problem for future land utilization and conservation of the land in the country. As the result soils are becoming shallower in depth, infertile with high value of site satisfaction. Reduction of fallow periods in farm areas made trees have less time to mature and bush fires, and cutting for fire wood take an even heavier toll. The development of dams irrigation works has resulted in a marked decline in the contribution of the river to food production negatively affecting grain staples, fish and livestock products (Salem Mardock ,Muneera ,1987) . Absence of Wind breaks in cultivated areas rise the loss of top soils, rougher of seedlings, wilting and beating down of crops by wind or rain they increase levels of moisture in the soil. Many studies have shown that absence of wind breaks reduce the crop yield by 18 to 23 percent. The availability of grazing land were continuously and rapidly shrinking all over the country because of a speedy expansion of cultivated land Feed resources of the livestock was declining review of the relevant literature points to the fact that a number of empirical studies have been undertaken on technology adoption under Ethiopian context. However, nearly all of them have been addressing issues of adoption in relation to improved production

1.4. Drought

Unfortunately, Ethiopia has a history of drought and famine, which were caused by environmental factors but worsened by economic plight, political instability and climate variability. Many writers had indicated famine and drought in Ethiopia were responsible for death of all forms of life. For example the work that was done by Professor Mesfin Wolde Mariam estimated that between 1958 – 1977 nearly 22,111,887 people lost their lives. It is nearly equal to the total number of people lost their lives in the war between Russia Federation and Nazi fascist of Germany during the Second World War. Famine appeared as more curler tool of killing people and environment than big wars of the world. Damaging and wreaking the labor force that can be used for environmental protection and rehabilitation of degraded land

Famine affected areas are inhabited by poorest nations of our planet. When man exercising poverty he is against the environment in which he lives in .He lead his life in collecting woods for sale, work and live in fragile lands (on steep slopes, deep valley areas, top of mountains and swamp areas which were neglected by him for century, burning of cow dung and plant residue for energy .This in return reduce the availability of feed resources to draught animals and soil fertility and forced people to migrate temporary or permanently in and outside of their territory. Now a day famine is making its path from semi arid areas of southeast ,Ogaden ,south of GamuGofaHamer areas, south Bale ,Boren areas, Hamer of south Gamu , Gambela , Denakil depression, the most degraded areas of the north (Tigray,Amhara,northshewa ,Gonder and WolloThis areas are characterized by one of the highest degraded areas of our planet towards areas low affected areas by degradation that is to the high land areas Arssi ,all round rain feed areas of the west , Arssi, Bale and Harerege plateau. Drought captures larger areas in the year 2003(see figure 5) which is equivalent to 77% of the total area of the country. while year 1978 ,1979,1988 and 1992 were years of less drought affected areas(4%) in the territory of Ethiopia(see figure 6). No year with a drought occurrence in Ethiopia .Every year there is threat of drought. Drought is fueling land degradation and transforming area to desertification. From these two figures it is possible to conclude that only few areas remained untouched by this devastating situation of drought.

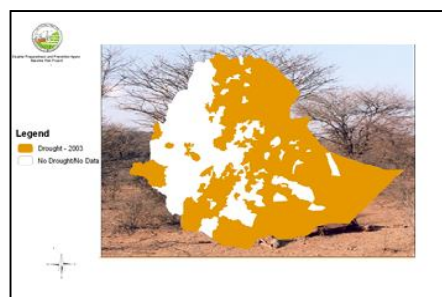


Figure 5: Drought in Ethiopia in 2003.

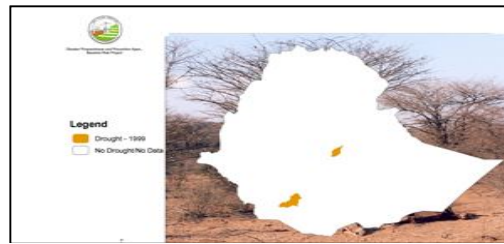


Figure 6: Drought in Ethiopia in 1992
 Source: @DPPAICT/information center2008

Drought is occurring any where in the world without discriminating the poor and rich countries. It cause of high death and huge displacement of people from one ecological area to another in poor countries. Cause anxiety or depression about economic losses and loss of human life at large. What makes Ethiopia different from others droughts affected areas of our planet more and more areas become under the influence drought threat (see figure 7 & 8) and sever creation of ecological refuges in the area. This may be the result of centuries of mismanagement of the territory by it inhabitation and global climate changes. In the year 1978 only 21% of the area was affected by drought while the maximum climax was recorded in 2003 with total percentages of 77%. Shrinkages and expansion of drought affected areas were common and year with no drought is unusual or unexpected.

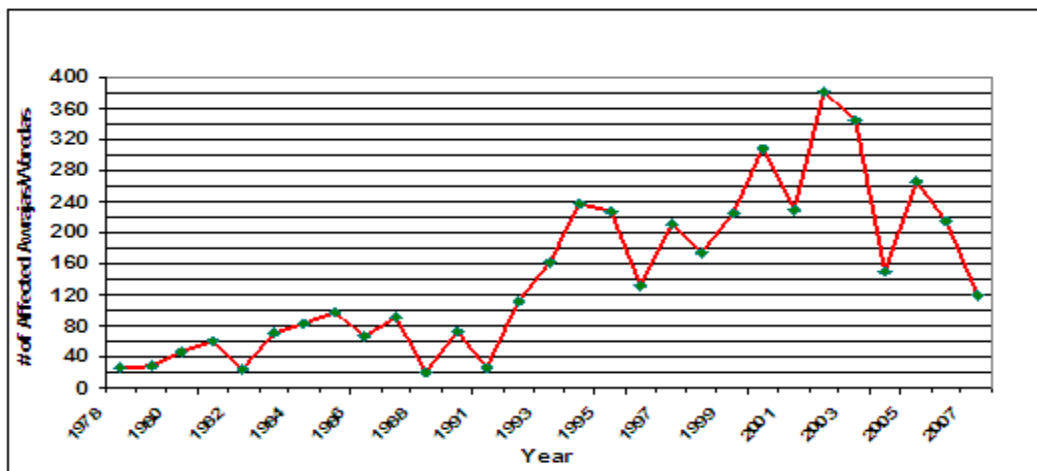


Figure 7: number of drought affected Awragas/woredas at national level 1975 -2007
 Source @DPPAICT/information center2008

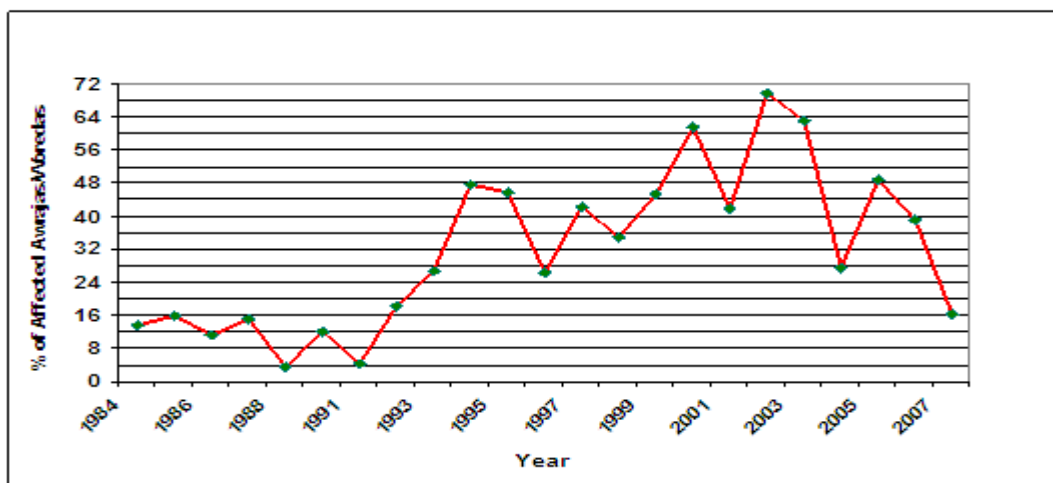


Figure 8: Percentages of drought affected Awragas/woredas at national level during 1975 -2007
 Source @DPPAICT/information center2008

As figure 7 and 8 portrayed both percentages and total areas of the country were easily affected by drought. Now a day there is a tendency of decline not to none. As the conclusion it possible to conclude that drought is responsible for over all collaps of biomass and to displace people from one ecological locality to another.

1.5. Livestock impacts on environment of Ethiopia

As stated on the research work of TemesgenGashaw, AlemeAsresie, MulataHaylom (2014) and others the recent livestock population estimates that the country has about 52.1 million heads of cattle, 24.2 million sheep, 22.6 million goats, 1.1 horses, 0.2 mules, 1.8 donkeys, 2 million camels and 44.9 million poultry. So, this section of the paper aims to give the impact of the livestock's in degrading the environment and enhancing desertification in Ethiopia. Generally the country over a little 5% of grazing land against 21% of live stock population

Balance between feed resources and livestock

Livestock types	Number in Millions	Unit of Conversion of livestock	TLU number in Millions
Cattle	52.1	0.7	36.47
sheep	24.2	0.10	2.42
goat	22.6	0.10	2.26
horses	1.1	0.80	0.88
mules	0.2	0.70	0.14
donkeys	1.8	0.4	0.72
camel	2	1	2
		Total	44,150

Table 4: TLU in Ethiopia

Sources: CSA, 2010, TegeneGashaw, ALEM asresie, 214, TamirieHawanda, 2001, using different sources by the Author. Adugna Tolera, 2001, Ahmed Hassen, Abule Ebro, Mohammed Kurtu and A C Treydte

Ethiopia has about 44.150 million tropical livestock unit (TLU), an on average one TLU requires about 25 liters of water per day (ZinashSileshi, AzageTegegne and GetnetTekleTsadik, 2000). Based on this calculation the total daily water requires for the livestock is estimated at 1,103,750,000 liters. This amount 13,245,000,000 liters per year. It is not an easy task for poor nation like Ethiopia to supply for all of its livestock the above mention amount. Both the highlanders and lowlanders had to travel long distance to get water for their live stocks. Degradation is highly affecting the both the riverine and water well places at the radius of few kilometers. Compaction of soils, devoid of vegetation, pollutions of water and soil, and high social conflicts in the area are common. Soil compaction is a form of physical degradation resulting in densification and distortion of the soil where biological activity, porosity and permeability are reduced, strength is increased and soil structure partly destroyed. Compaction can reduce water infiltration capacity and increase erosion risk by accelerating run-off. The compaction process can be initiated by wheels, tracks, rollers or by the passage of animals.

In arid and semiarid areas even there was no chance to get water for their live stocks at the interval of one day. The problem is acute in nature which has an impact on the health and weights of the livestock. This problem will remain in the future until the balance between the livestock and the required amount of water supply will be achieved. Because between 1974 and 1998, cattle Population increased by 31%, and small ruminant population decreased by 5.6% while the feed resources remained less in amount. Annual growth rate for cattle and small ruminants was 1.1 and -0.2%, respectively. (ZinashSileshi, AzageTegegne and GetnetTekleTsadik, 2000). Cattle population increased by 31%, and small ruminant population decreased by 5.6%.

Decline in the quality of riverine grazing, again as the quinces of the reduction in nutrient rich flood, colonization moving margins of the reservoir, and reduce access to riverine pasture caused by establishment of irrigated perimeters in year round cultivation (Horowis, Badi 1981, FAO 1981). Most of the permanent watering places are overgrazed. (Muneera Salem-Murdock, 1987) The result is debilitation, shortage of milk for calves and poor conservation of feed. The removal of river bank vegetation led to unstable banks and bank erosion quality of water, health of life in the region.

The average productivity or carrying capacity for barren lands is on average about 0.28 livestock units per ha per annums (Furstenbergetal 1984)

Lulc	2013 area km ²	Ha = km ² /0.010000 2013 area (ha)	Conversion factors	Total DM
Forest land	88,000 km ²	8800000	1.2	10560000
Grassland	651,000 km ²	65100000	2	13020000
Wetland	57,800 km ²	5780000	2	11560000
Alpine	6,600 km ²	66000	1.5	99000
Cultivated land aftermath	137,000 km ² is cultivated land	13700000	Average value of crop residues conversion factors (0.8)	10960000
Total				152975000

Table 5: Availability of Dry Materials in the territory of Ethiopia

Source: Synthesized by the author from different sources (FekadeFeyisa, 2007, Ethiopian Livestock Production Professionals Association and others)

As table 5 indicates that the total dry materials that can be available for livestock in the country are equal to 152975000 tones per year. When we look at the grazing areas of this country there are unpleasant pictures that lead to land degradation or desertification. Many studies carried by FAO and others indicated that there is only few places where there is positive correlation between the live stocks and feed resources. These areas are located in Harage, Bale, Sidamo partially and Wollega while the remaining areas are under high deficit of feed resources for their live stocks. This result is also matching with the results that were conducted by FAO 1986 which stated that there is low indices of grazing land to livestock population. Generally speaking the problem of livestock densities is acute in Ethiopia. No area with any cattle. Livestock should be seen as one of the major agent causing the acceleration of land degradation. Expansion of land degradation of land under grazing is not possible. Over grazing is eliminating millions of hectares of grass and loss estimated six times greater than before. Overgrazing is the largest cause of erosion with nothing to hold back surface run off, rain drains quickly before it can soak into the soil to nourish plants or replenish ground water. When the earth is denuded, the micro climate near the ground becomes inhospitable to seed germination. The dry barren surface reflects more of the sun heat, changing the wind patterns, driving away moisture –laden clouds, and leading to further desiccation. Arid lands prone to highly variable rainfall with long periods of drought in which natural vegetation disappears and the land remains highly degraded. Over grazing which caused by large number of live stocks resulted in denudation of grazing land at the rate of 7% and lead to both physical and chemical degradation of soil. (ZinashSileshi, AzageTegegne and GetnetTekleTsadik, 2000)

1.6. Salinization

Chemical deterioration may consist in: (a) the loss of soil nutrients (mainly nitrogen, phosphorus and potassium) or organic matter. In part, nutrients are lost through erosion: "in the humid tropics, many nutrients are leached during the intense rainstorms, especially on unprotected land"; in addition, they can be "depleted by the crops themselves, particularly if the same crops are grown on the same land year after year" (FAO, 1983).

Salinization, or the concentration of salts in the topsoil, which may occur because of: (i) poor management of irrigation schemes high salt content of irrigation water or insufficient attention to drainage can easily lead to rapid salinization of the soils, especially in arid areas where high evaporation rates foster the process; (ii) the intrusion of seawater or saline groundwater in water reserves of good quality; or (iii) human activities which increase evaporation in soils on salt-containing material or with saline groundwater (ISRIC/UNEP, 1991). Salinization has "a deleterious effect on soil productivity and crop yields" (FAO, 1994, BelayhunHailuMamo, ..FAO, 1994); in extreme cases, "damage from salinization is so great that it is technically unfeasible or totally uneconomic to reverse the process" (FAO, 1983)

Primary or natural salinization occurs where soil is rich in soluble salts or there is a shallow saline groundwater table and inadequate rain to remove (leach) soluble salts from the soil. Secondary, usually human-caused, salinization occurs when irrigation is applied without adequate drainage for salts, causing them to stay in the soil when water evaporates. These salts accumulate over time and destroy soil fertility. In a natural state, salt-tolerant plants evolve. When natural flora are removed and irrigated crops introduced, an artificial equilibrium is created that must be maintained or salinization results. Other causes of salinization include waterlogging, improper cropping patterns and rotations, and chemical contamination from heavy use of mineral fertilizer. Because salt inhibits a plant's ability to absorb nutrients, salinization renders soil infertile. Salinized land is less productive and often abandoned. In the worst case, soil becomes so salty that nothing can grow.

Ethiopia reported to possess over 11 million hectares of unproductive naturally salt affected wastelands (Taddele 1993). The natural affected areas are normally found in the arid and semi arid lowlands and in rift valley and other areas that are characterized by higher evapotranspiration rates in relation to precipitation (PGRC 1996)

The rift valley is an extensive grab on, cultured with evidences of recent volcanism in the north and bounded by impressive stepped Horst of the plateau on the west and southeast margins. Since the water in the rift valley is hot and high mineralizes the chance of forming saline and alkalinity is very high. Lake Ziway is the only lake that can be recommended for irrigation while the remaining can be used with caution. However, around the riverbank in Ziway horticultural state farm, one is able to see the solonchack with white salt incrustation on surface (Fisseha 1998). The sugar plantation of Wonji, upper Awash, tendaho cotton plantation of the country are now closing their farm areas because of salinization. In most irrigated areas water is applied liberally with reference to climatic conditions and crop requirement. The influence of geothermal water is also very high.

According to Sissay (1983) salt affected flats have increased from 6% to 16% of the total land areas of Ethiopia in recent year's. About 9% of the population lives in the areas affected by salinity. Tamir (1994) has revealed that 44 million ha (36 % of the country's total land areas) are potentially susceptible to salinity problems. Out of the 44 million ha, 33 million ha have dominantly salinity problems, 8 million ha have combined salinity and alkalinity problems, and 3 million ha have dominantly alkalinity problems. Salinization has "a deleterious effect on soil productivity and crop yields" (FAO, 1994) in extreme cases, "damage from salinization is so great that it is technically unfeasible or totally uneconomic to reverse the process" (FAO, 1983).

The irrigation techniques employed at the present time are imperfect. A large amount of water is used irrationally, leading to salinization of the soil and swap formation. With incorrect irrigation systems, good virgin lands in 10 -15 years may be converted into saline soils and during such period gypsum horizons may form in the area. Liberally irrigated water by the land cultivators are causing salinity over large area.

1.7. Natural factors

High pressure areas and its influence, The climate changes after the ice ages had shown great influences of the region, decrease in humidity's which resulted in gradual reduction of volumes of steams, rivers and others, the weakening of monsoon rain in the north

and central parts of indo – Pakistan, change of position of inter tropical convergence zone within tropics, rising and falling of humidity within monsoon areas, Fast increment of domesticated and wild animals especially elephants were among the natural factors that caused land degradation and desertification in the territory of Ethiopia. Good rain years increasing number of livestock's and cultivated land which has negative consequences in aggravating degradation and causing desertification in the largest area of the country.

2. Results

Man made and natural factors are putting more and more areas under the influence of desertification Best filling lines can be observed in the case of time and area. (Mostafa Kamal Tolba, 1986) In figure 9 it is observable that there is coincide between rainfall decline in the Sudan zones and famine occurrence in Ethiopia .This is a good indication that the influence of Sahara dessert had strong impact in creating rainfall fluctuation in Ethiopia. Years like 1888 (Bettembuorg),1889 (Crouset),1913-1914 , 1905 -6 (F. Rose), 1909 – 1911 (Montando),1900 -1901 (A Epease) ,1907 – 1909 (Georg Escheric), 1974 (Johnatndebibli) were recorded as famine years in Ethiopia(Richard Punkrest,1977) and the same time low rainfall were recorded in Sudan areas (S.E.,Nichoison,1982) which has great impact on the lively hood of Ethiopians.

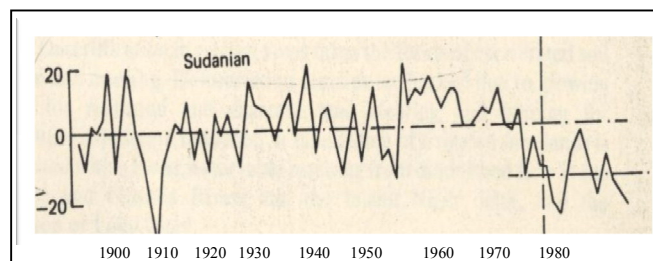


Figure 9: Rainfall fluctuations (1900 -80) for Sudanian zone, and recorded famine years in Ethiopia (S.E., Nichoison, 1982 and Richard Punkrest, 1977)

Decrease in soil depth resisting cover some excessive trampling for growth of crops especially in areas of south Gonder ,Wollo, northern shewa and Tigray. As the result in many areas the equilibrium between water, soil and vegetation is disrupted. Years of draughts and occurrences of famine is narrowing up to one year. No year with any drought .Deforestation exceed afforestation. . Deforestation in Ethiopia is caused by past governmental and institutional changes, insecurity of land tenure, resettlement programs, population pressure, agricultural and infrastructure developments. Farmers suffer from poverty as well as food insecurity and cannot bear the costs of forest conservation. However, this rich cultural and natural heritage is threatened, especially in the form of deforestation. Reforestation did not yield a reasonable return as more attention was given by the government of the campaigns than to the subsequent vita steps of ensuring proper care for the planted tree seedling. Shirking of the forest are high impact in reduction of agricultural production and productivity increased volume of food imports highly affected fauna and flora of the country.

Overgrazing is responsible for physical, biological and chemical deterioration of soil. In appropriate irrigation in the area lead to salinization of the large area in the country .Drought is causing un favorable condition for plant and animal life. Arid, semiarid, and dry humid is under the pressure of high risk of desertification. Densely populated areas become areas of high exploitation of recourses and areas of out migration locally or internationally. Frequent famine and drought occurrence in Ethiopia still remains an open question not only for Ethiopians but of all human being.

Absence of any institution or recognized owner(s) with authority to manage the area as an integrated ecosystem, and how the stocking rate could successfully.Lack of clearly defined and agreed exercise required management practices is responsible for increased desertification in Ethiopia.

3. Recommendations

- Differentiation of lands by their types and aspects for present and future generation use of land .The application of regional specialization is compulsory and highly recommended for ecological stability and economical suitability. Formation of zones of settlement, biological zones, pale topological zone for preserving some unique land escape, and geological zones for keeping soils and peat.
- All types of pressure that is currently causing stress to the land should be minimized i.e. both human and none human.
- Both traditional and modern equipment should pass under examination to check their suitability to the environment and nature.
- Land fragmentation must be tackled by bringing occupational changes. Nearly 30,000, 000 off farm activities should be created.
- Since 1974 there are the land tenure systems that strongly affect agricultural productivity and soil fertility. Both proclamations said that the land belong to all or to the people but practically belong to none .The system was not keeping man on land because of frequent redistribution of land in the previous government and highly diversified agricultural packages not able to put in practice by farmers to conserve their plots from degradation. Unless the question of land ownership unaltered Ethiopia with continue in the state of economic disorder, persistent social disruption, and political upheaval and endless famine .Land tenure and land utilization of the land polices should need revised to the best of the

environment and to the people of Ethiopia.

- Need for alternative energy that can reduce fire wood and dung consumption.
- Provision of strong extension services to farmers for feed resource development and training them in basic principles of collection, storage of harvested feed resources (hay and crop residues) and treatment of crop residue could be very important.
- In order to make livestock provide better value to their owner, much more needs to be done with respect to balancing the nutrient supply with the nutrient need of the livestock population. This may be done by limiting the household herd size preferably replacing the less productive animals with fewer more productive animals especially in medium and high altitude areas, growing productive and nutritious forages in association with food crops.
- Restriction of cultivation on river banks, for a minimum distance of the width of the river beyond each bank
- Enforcement of existing legislation relating to the declaration and management of protective forests :this would necessitate the provision of funds for compensation
- Prohibition of farming on very steep slopes without adequate conservation measures
- Regulation of large mechanized holdings to ensure implementation of suitable conservation measures
- To put high abdication commitment on nation shoulders is compulsory and must if we want to make the use of resources in a more sustainable way
- Drought is occurring anywhere in the world but Ethiopia should adhere from its past mistakes of being lesspreparedness to tackle drought and famine when occurring practically anywhere in the country.
- integrated farming and practices that promote vegetation cover are proposed as sustainable land practices in the country
- Efficient transport network is recommended to transport food and feed resources from more available areas to less available areas
- Much work should done on younger generation to bring attitudinal changes how to combat drought and its consequences
- To impose grazing and water utilization tax to those who engaged on cattle rearing or holding.

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