

Review

The causes, consequences and remedies of deforestation in Ethiopia

Alemayehu Oljirra*

Department of Agricultural Economics and Agribusiness Management, Jimma University College of Agriculture and Veterinary Medicine, Ethiopia

*alemayehu2016@gmail.com

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Abstract: Forests are one of the most valuable ecosystems in the world, containing over 60% of the world's biodiversity. This ecosystem has multiple social economic values, apart from its intrinsic value. Forest provides a sustainable environment. Deforestation leads to the disappearance of sustainable development. Deforestation takes place due to multiple of reasons like logging, population growth, urbanization, grazing, construction of dams and reservoirs, habitat fragmentation, slash and burn method of farming, wildfire, global warming, hydroelectric projects. Agriculture is considered to be the backbone of Ethiopian economy and almost 85% of the societies in Ethiopia engage in agriculture. The agricultural sector in Ethiopia in particular and in Africa, in general, is highly affected by deforestation directly and indirectly. Therefore, this paper focuses not only on the causes and consequences of deforestation but also seeks for better alternatives to tackle deforestation in Ethiopia.

Keywords: *agriculture, climate change, deforestation, degradation, forest*

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Introduction

Among developing countries, especially in Africa, Ethiopia is exceptionally rich in history, as well as cultural and biological diversity. It is home to one of the earliest ancestors of the human species, around 80 languages are spoken by various ethnic groups, and it is home to two globally important biodiversity hotspots. However, this rich cultural and natural heritage is threatened, especially in the form of deforestation. Ethiopia has the second largest population in Africa and has been hit by famine many times due to rain shortages and depletion of natural resources. Deforestation may have further lowered the already meagre rainfall. Growing populations are increasing deforestation which is leading the country to famine. As the population continues to grow, the needs of the people increase. The country has lost 98% of its forested regions in the last 50 years (Argaw, 2005).

Forests in Ethiopia play a big role in protecting erosion as tree roots protect against washouts. Trees also help to keep water in the soil

and reduce global warming by uptake of carbon dioxide. Because there are not enough trees, the Blue Nile is carrying all the soil and nutrients in the water to the neighbouring countries of Sudan and Egypt. Historically, forests have been very important for the livelihoods of the people of Ethiopia. The Ethiopian people used trees for lumber for construction, and to fuel their cooking fires. They also made traditional medicines from trees and other forest plants. Forests were also important in Ethiopian religious beliefs; the people believed in holy spirits in the forest that they treat in the same way as human beings. Mitchell Page states that over 6603 plant species live in Ethiopia, of which approximately one fifth are not native to other countries (Bekele and Draike, 2003).

At the beginning of the twentieth century, around 420,000 square kilometres (35% of Ethiopia's land) was covered by trees but recent research indicates that forest cover is now less than 14.2% due to population growth (MoARD, 2009). Despite the growing need for forested lands, lack of education among locals has led to a continuing

decline of forested areas Forest degradation due to fuelwood consumption as well as formal and informal logging Agriculture in Ethiopia is the foundation of the country's economy, accounting for half of the gross domestic product (GDP), 83.9% of exports, and 80% of total employment (CSA, 2006)

Ethiopia's agriculture is plagued by periodic drought; soil degradation caused by overgrazing, deforestation, high population density citation needed high levels of taxation and poor infrastructure making it difficult and expensive to get goods to market. Yet agriculture is the country's most promising resource. A potential exists for self-sufficiency in grains and export development in livestock, grains, vegetables, and fruits. As many as 4.6 million people need food assistance annually (World Food Program, 2005). Over 85% of the Ethiopian population depends on agriculture (CSA, 2006).

The objectives of this paper are; to review causes of deforestation, to review the consequences of deforestation and to review the remedies of deforestation in Ethiopia. Deforestation has serious far-reaching consequences including natural habitat exhaustion, desertification, altering the natural hydrological cycle, water run-off and aridity of specific areas that pose serious problems to practicing profitable agriculture. Therefore, this paper focuses not only on the causes and consequences of deforestation but also seeks for better alternatives to tackle deforestation in Ethiopia.

Forest Resources of Ethiopia

Natural forests

High forests, either coniferous or broad-leaved, were the climax vegetation of 35-40% of Ethiopia before human settlement took place. With the inclusion of savanna woodlands, some 66% of the country was originally covered with forest or woodlands (Brittenbach, 1961, Wood, 1990, Kuru 1990, Yirdaw, 1996). Over the last 3000 years, there has been progressive deforestation, which has accelerated tremendously during the last century. Rapid population growth (3% per year), extensive forest clearing for cultivation, over-grazing, movement of political centres, and exploitation of forests for fuelwood and construction materials without replanting has reduced the forest area of the country to 16% in the 1950s and to 3.1% by 1982 (UNEP, 1983). Further estimates of the distribution of forest and woodland areas made on the basis of information from LANDSAT imagery (1979) revealed that 2.8% of the land surface is

under forest and woodland (Kuru, 1990; MOA, 1991).

The Impact of Deforestation on Agriculture in Ethiopia

Deforestation is clearing or removal of a forest or stand of trees where the land is thereafter converted to non-forest use. Examples of deforestation include conversion of forestland to farms, ranches, or urban use. Tropical rainforests are where the most concentrated deforestation occurs. Almost 30% of Ethiopia is covered by forests, excluding water mass (Karkee, 2004). In temperate climates, natural regeneration of forest stands often will not occur in the absence of disturbance, whether natural or anthropogenic Furthermore, biodiversity after regeneration harvest often mimics that found after natural disturbance, including biodiversity loss after naturally occurring rainforest destruction (Bishaw, 2009).

Deforestation occurs for many reasons: trees are cut down to be used or sold as fuel (sometimes in the form of charcoal) or timber, while cleared land is used as pasture for livestock, plantations of commodities and settlements. The removal of trees without sufficient reforestation has resulted in damage to habitat, biodiversity loss and aridity. It has adverse impacts on biosequestration of atmospheric carbon dioxide. Deforestation has also been used in war to deprive the enemy of cover for its forces and also vital resources. Deforested regions typically incur significant adverse soil erosion and frequently degrade into a wasteland (Culas, 2006).

Disregard of ascribed value, lax forest management and deficient environmental laws are some of the factors that allow deforestation to occur on a large scale. In many countries, deforestation, both naturally occurring and human-induced, is an ongoing issue. Deforestation causes extinction, changes to climatic conditions, desertification, and displacement of populations as observed by current conditions and in the past through the fossil record (Culas, 2006).

Deforestation is clearing the Earth's forests on a large scale worldwide and resulting in many land damages. One of the causes of deforestation is to clear land for pasture or crops. According to Ethiopian environmentalist, 5% of deforestation is due to cattle ranching, 19% due to over-heavy logging, 22% due to the growing sector of palm oil plantations, and 54% due to slash-and-burn farming (Bishaw, 2009). Deforestation causes the loss of habitat for millions of species and is also a driver of climate change. Trees act as carbon, in

which they absorb carbon dioxide, an unwanted greenhouse gas, out of the atmosphere. By removing trees, carbon dioxide is released into the atmosphere, and there is now less trees to absorb the increasing amount of carbon dioxide in the air (Bekele, 2001). In this way, deforestation exacerbates climate change. When trees are removed from forests, the soils tend to dry out because there is no longer shade, and there are not enough trees to assist in the water cycle by returning water vapour back to the environment. With no trees, landscapes that were once trees can potentially become barren deserts. The removal of

trees also causes extreme fluctuations in temperature.

According to (FAO, 2000), "the role of population dynamics in a local setting may vary from decisive to negligible," and that deforestation can result from "a combination of population pressure and stagnating economic, social and technological conditions." Income generated from the above sources is used to cover other household expenses, government and social obligations such as clothing, school fees for children, payments of fertilizers and others. The variation is statistically significant ($P < 0.004$) (Table 1).

Table 1. Households income sources and dependency on forest resources

Sources of income	Farmers' Association			Overall mean	P-value
	Mille	Meche	Kanchama		
Crop	10(18)	5(9)	7.25(13)	22(40)	***
Crop-livestock	25.8(46)	22(40)	23.8(43)	71.6(28)	
Sale of wood and charcoal	0.61(1)	2.5(4.5)	3.3(6)	6.8(12)	
Selling of FP	Own farm	12.6(21)	5.4(9)	27(45)	**
	Community forest	23.4(39)	30.6(51)	75(135)	

FP=forest product. Source: Enbakom et al. (2017)

Causes of Deforestation

Direct causes: Burning tree, Expanding cultivate land, Wood extraction/ logging and Infrastructure development (Ehui and Hertel, 1989)

Indirect/underlying causes: Economic factors, Political factors, Technological factor Cultural factors and Demographic factors (Kaimowitz, 2003). According to Kaimowitz (2003), more than 50 percent of the tree cover has disappeared due to human activity. This removal of forest or trees from land and converting it for no forest use is called deforestation. One of the most worrying factors today is the massive destruction of the rainforest of the world is affecting the biodiversity adversely, as well as being one of the major contributory factors to the ongoing Holocene mass extinction.

Deforestation causes include many factors. The destruction of the forests is occurring due to various reasons, one of the main reasons being the short-term economic benefits. Corruption at the government institutions, wealth and power due to harvesting of the riches of the forest, population growth and urbanization are some of the common causes.

Urban Construction

The cutting down of trees for lumber that is used for building materials, furniture, and paper products have a major impact on forest life. Forests

are cleared to accommodate expanding urban areas. This results in a loss of forest area and massive deforestation (Hakapaino, 2005).

Table 2. Extent of Ethiopia's high forests by region

Regions	Total (ha)	% of total
Oromia	2547632	62.5
SNNPR	775393	19
Gambella	535948	13.2
Amhara	92744	2.3
Tigray	9332	0.2
Benishangul Gumuz	68495	1.7
Afar	39197	1.0
Somali	4257	0.10
Others (Harari, diredawa)	216	0.0
Total	4073214	100

Source: (CSA, 2006)

Used for Fuel

Trees are cut down in developing countries to be used as firewood or turned into charcoal, which is used for cooking and heating purposes.

Illegal Logging

Many government agencies are fighting illegal logging to protect the forests. However, any type of

logging legal or illegal leads to deforestation. Trees are cut down indiscriminately by logging companies, to fulfil the demands of the wood market, (Hakapaino. 2005). Ethiopia losses about 141,000 hectares of natural forests each year due to firewood collection, conversion of farmland, overgrazing and use of wood for building material. Ethiopia faces a difficult future because the agricultural sector which forms the backbone of the economy is totally dependent on forest resources.

Consequence of Deforestation

There are a number of adverse effects, which include environmental and economic. Some of these effects are discussed below.

Disruption of the Water Cycle

Trees contribute in a large way in maintaining the water cycle. They draw up water via their roots, which are then released into the atmosphere. A large part of the water that circulates in the ecosystem of rainforests, for instance, remains inside the plants. When these trees are cut down it results in the climate getting drier in that area. The groundwater tables are affected and soon get depleted. The trees help in the prevention of running off of water and help the soil absorb the flowing water. When there are no trees, water just runs off, leaving no chance for the groundwater tables to absorb more water. Thus, ultimately leading to a reduction in water resources (Yasuka and Levins, 2007).

Loss of Biodiversity

The unique biodiversity of various geographical areas is being lost on a scale that is quite unprecedented. Even though tropical rainforest makes up just 6 percent of the surface area of the Earth, about 80-90 percent of the entire species of the world exist here. Due to the massive felling of trees, about 50 to 100 species of animals are being lost each day. The outcome of which is the extinction of animals and plants on a massive scale. The effects on animals are very heartbreaking. They not only lose their habitat and protective cover, but they are also pushed to extinction. Many beautiful creatures, both plants and animals have vanished from the face of the earth (Karkee, 2004)

Flooding and Drought

One of the vital functions of forests is to absorb and store great amounts of water quickly when there are heavy rains. When forests are cut down, this regulation of the flow of water is disrupted, which leads to alternating periods of flood and then drought in the affected area. Thus, leading to the

disruption of human settlements and loss of life in thousands (Hakapaino. 2005)

Climate Change

It is well-known that global warming is being caused largely due to emissions of greenhouse gases like carbon dioxide into the atmosphere (NAPA, 2007). However, what is not known quite as well is that deforestation has a direct association with carbon dioxide emissions into the atmosphere. Trees act as a major storage depot for carbon since they absorb carbon dioxide from the atmosphere, which is then used to produce carbohydrates, fats, and proteins that makeup trees. When deforestation occurs, many of the trees are burnt or they are allowed to rot, which results in releasing the carbon that is stored in them as carbon dioxide. This, in turn, leads to greater concentrations of carbon dioxide in the atmosphere. People dependent on the forests for their survival lose their livelihood (Sunderlin et al., 2005).

Deforestation is caused by the growing demand for forest products and the conversion of forest to agriculture as the human population continues to expand. In 1980 cropland and pastureland occupied 6-7% of the global land surface; by 2000 cropland and pastureland occupied 35-39% of the global land surface. It is estimated that the world is currently losing over 9 million hectares per year which is an area the size of Ethiopia. Deforestation not only affects the climate by increasing the atmospheric level of carbon dioxide but also affects the environment by inhibiting water recycling, triggering severe flooding, aquifer depletion, soil degradation and the extinction of plant and animal species (Robalino and Pfaff, 2012).

Agriculture is the source of income of many families in developing countries as precipitation patterns are being affected greatly by climate change, it can lead to floods as well as drought conditions. These both conditions have negative effects of climate change on poor people as their crops are destroyed in both situations. This is also a great loss to our economy as combating poverty is a major issue for our economy.

Heavy Soil Erosion

The roots of the trees hold the soil firmly keeping it intact. With large scale, deforestation soil erosion and landslides have become a normal phenomenon. During heavy rains and typhoons, soil is washed away to lower regions. This increases the risk for landslides which can cause seriously threaten the safety of the people and damage their properties (Brehane and Mekonen, 2009).

Soil erosion and the effects of soil erosion on crop productivity have become emotional issues and have attracted the attention of agriculturists, environmentalists, and the public in general. In spite of heavy investments in research and development, the global rates of accelerated erosion are now presumably higher than ever before. However, the data from available records obtained by diverse methods are incomparable, unreliable, confusing, and often vary by several orders of magnitude. Reports of erosion-caused alterations in crop productivity and soil properties are also contradictory and subjective. In addition to the lack of standardized methodology in evaluating soil erosion and its effects on crops, controversial interpretations are attributed to differences in soil profile characteristics, nutrient status, crops grown, and prevailing climatic conditions. Although erosion is generally associated with yield reductions, there are examples of where soil erosion has had no effect or has had a positive effect on crop production. Accelerated erosion affects productivity both directly and indirectly. Directly, the erosion-induced reduction in crop yields is attributed to loss of rooting depth, degradation of soil structure, decrease in plant-available water reserves, reduction in organic matter, and nutrient imbalance (Argaw, 2005).

Desertification

Deforestation is one of the causes behind the conversion of many fertile tracts of land to deserts. This phenomenon is known as desertification. When mountain forest faces desertion, watersheds are degraded and this leads to the loss of sustained water supplies for lowland communities. Desertification occurs when the tree and plant cover that binds the soil is removed. It occurs when trees and bushes are stripped away for fuelwood and timber, or to clear land for cultivation. It occurs when animals eat away grasses and erode topsoil with their hooves. It occurs when intensive farming depletes the nutrients in the soil. (Bishaw, 2009). Wind and water erosion aggravate the damage, carrying away topsoil and leaving behind a highly infertile mix of dust and sand. It is the combination of these factors that transforms degraded land into a desert (Hakapaino, 2005).

Desertification is one of the central problems that pose very real and severe challenges to the sustainable development of the dry land's ecosystem. Rainfall variability both in time and space, coupled with the inherent ecological fragility of the drylands, weakens the resilience of the ecosystem and its ability to return to its original condition. If an area becomes a desert, then it's almost impossible to grow substantial crops there

without special technologies. This can cost a lot of money to try and do, so many farmers will have to sell their land and leave the desert areas. Without farms in these areas, the food that those farms produce will become much scarcer, and the people who live in those local areas will be a lot more likely to try and deal with hunger problems. Animals will also go hungry, which will cause even more of a food shortage.

Drought

Drought is defined as an extended period of time where rainfall is deficient. Drought occurs when sufficient water needed to sustain an area is not available, causing economic impacts on agriculture, society, and ecosystems (Bekele and Draike, 2003). It is most often caused by lack of rainfall over a long time period but can also be affected by unusually high temperatures and dry spells, particularly during summer months.

The impact of drought on agriculture, land use and degradation and water resource management is especially visible in semi-arid and sub-humid areas. In many semi-arid and sub-humid areas, the occurrence of drought has been a phenomenon observed periodically for hundreds or thousands of years. Basically, the local plant, animal and human life had adapted itself to the occurrence of drought. In a "balanced" system, the exploitation of micro-climatic opportunities maintains or even enhances their existence.

Time of droughts can have significant environmental, agricultural, health, economic and social consequences. The effect varies according to vulnerability. For example, subsistence farmers are more likely to migrate during drought because they do not have alternative food sources. Areas with populations that depend on water sources as a major food source are more vulnerable to famine. Drought can also reduce water quality because lower water flows reduce dilution of pollutants and increase contamination of remaining water sources. Common consequences of drought include:

- Diminished crop growth or yield productions and carrying capacity for livestock
- Dust bowls, themselves a sign of erosion, which further erodes the landscape
- Dust storms, when drought hits an area suffering from desertification and erosion
- Famine due to lack of water for irrigation
- Habitat damage, affecting both terrestrial and aquatic wildlife
- Hunger, drought provides too little water to support food crops.

Remedies for Deforestation

The run for profitability on the grounds of deforestation is leading the world towards devastation and desolation. There is a need to keep a check on such activities before it is too late to act. Here are a few solutions that can help save our planet from the harmful effects of deforestation.

Improved Methods of Farming

Land is needed to grow crops and rear cattle for which trees on it need to be cleared. To prevent this, farmers need to be introduced to new methods of farming. This can prevent the indiscriminate cutting down of trees.

Cyclic Agriculture

In cyclic agriculture, the land is used for cultivation till the soil loses its fertility, after which it is abandoned. Natural vegetation makes the soil fertile again in a few years. The time span in which the land remains barren can be utilized for cattle grazing and this can help in preserving forests as more trees don't have to be cut for creating lands for farming (Bekele, 2001)

Crop Rotation

In this type of farming, the same plot of land is utilized to grow seasonal crops, one after the other. This prevents cutting down of trees to get new land for cultivation. Crop rotation also increases the productivity of soil (Ehui and Hertel, 1989).

Use of High-Yield Variety Seeds

This is a farming technique which uses highly productive seeds that are often drought and insect resistant. These seeds produce more while utilizing a smaller area of land. With the use of these seeds, the need to cut trees is lesser and a higher production is achieved from the same piece of land (Ehui and Hertel, 1989).

Hydroponics

It is a special farming technique of growing plants in water (without soil) containing dissolved nutrients. These techniques, if followed in the right manner, can definitely help prevent deforestation. Farmers should also be made aware of the harmful effects of cutting trees and of intensive farming, which leads to erosion and infertility (Ehui and Hertel, 1989).

International Programs

Several programs have been drafted to limit and control the rate of trees being cut in recent years. Reducing Emissions from Deforestation and Forest Degradation (REDD) is a program initiated to provide monetary assistance to developing countries facing the problem of deforestation. The money is utilized to roll back or limit deforestation and stop practices that are harmful to the environment (Yasuoka and Levins, 2007). Another initiative taken by Forest Stewardship Council (FSC), a non-profit organization aims at minimizing the impact of commercial logging on forests around Ethiopia.

Table 3. Forest Conservation Efforts in the farmer's association

Activities	Farmers Association			
	Mille	Meche	Kanchama	Overall mean
Tree planting		5(3)	2.4(4)	7.2(12)
Care of nursery		2.4(4)	8.4(14)	16.11(29)
No training		30.6(51)	24.6(41)	76.7(138)
Using fuel saving stoves	Yes	1.8(3)	2.4(4)	61.11(11)
	No	34.2(57)	33.6(56)	93.9(169)
Awareness of forest law	Yes	29.4(49)	27(45)	78.3(141)
	No	6.6(11)	9(15)	21.7(39)

Source: Enbakom et al. (2017)

It provides certifications to timber logs and products that have originated from sustainable forests. It ensures the spread of green cover. This should also help in making up for the loss of trees in the past and promote a healthier environment.

It was established that the selected household heads had low training opportunities in Mille (30.6%), Meche (27.6%) and Kanchama (24.6%).

Nevertheless, some of the respondents had taken some training on tree planting (7.2%) and care of nursery (16 %). This finding was also in conformity with the result at the national level of Ethiopia (NCS, 2012). Respondents perception towards the laws and rules of forest resources indicated that the majority of the households in the study areas knows about the effects of

deforestation and conservation practices through experience and from different sources of Knowledge ($P < 0.675$).

Conclusion and Recommendations

Conclusion

Deforestation is one of the major causes of a disturbed water cycle, global warming, and soil erosion. If not controlled, the imbalance is likely to threaten life on Earth. It highly affects agricultural productivity in Ethiopia. The factors cause that deforestation are burning forest, cutting tree, urbanization, increase population density and etc. Deforestation affects the water cycle. Trees absorb groundwater and release the same into the atmosphere during transpiration. With the loss of medium for this release, the climate automatically changes to a drier one and reduction in not only the atmospheric moisture but also the water table. Deforestation reduces soil quality and results in soil erosion and flooding. The land's capacity to hold groundwater shrinks with the depleting forest cover. Deforested areas witness surface runoff and increased sub-surface flow.

The absence of trees leads to increase salinity in the soil cover and thus, affects the agricultural activity that is carried on in such regions. Tree roots not only bind fertile soil but also the underlying bedrock. Deforestation results in an increased risk of landslides that not only claims the alluvial soil but also threatens the lives of people inhabiting the cleared region.

Forests support biodiversity and foster conservation of medicinal products like honey, resin and herbs. Deforestation destroys genetic variations and results in a permanent loss of various rare plant, animal and insect species.

Recommendation

In rural areas, the government and NGOs realized that if the deforestation continues the overall condition of the country will worsen. Because of that, the government has begun teaching the people about the benefits of forests and encouraging the people to plant more trees and to protect what they have by providing them alternative home and agricultural materials. If any person cuts a tree, he or she needs to plant one to replace it. The current government and people are working hard together to make their country a better place. Prohibiting the Ethiopian population to cut trees, especially rural populations, will actually hurt daily life since meeting daily needs becomes more difficult. The government is trying to provide the Ethiopian people with fuel and electrical machinery so the

demand for forest resources is not as high. Additionally, the government is providing flat land with no pre-existing forests to promote agriculture so that deforestation is not necessary for modern agriculture.

There are governmental and nonprofit groups working with the government to protect the land. Organizations such as Farm Africa are working with the federal government and local governments to create a good system of forest management. The government is also working to relocate people who live in dry regions to places where they can find fertile land for farming so that they would be able to support themselves without any assistance from the government. With the fund provided by E.C grant (around 2.3 million Euros) people were trained to protect the land from erosion and taught to use water for irrigation, which improved quality of life and the environment. Locals have now come to the realization that trees need legal recognition, and must be protected for future generations. One of the methods used to protect trees is to designate certain areas where trees may be chopped down and used and other areas where trees are protected by law.

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