

Impacts of Human-induced Deforestation, Forest Degradation and Fragmentation on Food Security

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Abstract: Forest is an extensive area composing of dense and tall species of trees and other biota in symbiotic relationships. Forests exist in all regions of the world capable of sustaining tree growth at altitudes up to the tree line, where the environment is not challenged with frequent inundation that can impede forest establishment. Forests across the world vary in structure and composition from one geographical location to the other, it performs environmental functions including biodiversity conservation, climate moderations, soil management and carbon sequestration; it also perform socio-cultural and economic functions as it includes food security, source of employment, income and revenue generation, provision of raw materials for industries and place of religious worship among others. In spite of the various beneficial functions of forests, it is been threaten with deforestation, forest degradation and fragmentation. While deforestation is simply the conversion of forest areas to non-forest areas, forest degradation is the reduction in the density or structure of forest and forest fragmentation is the conversion of a continuous forest area into patches of forest separated by non-forest lands. Deforestation is a menace in many part of the world, highest in countries of Africa, then Latin America and part of Asia. Worldwide, Brazil has the highest annual net loss of forest areas but Nigeria has the highest deforestation rate of its primary forest and Comoros has the highest rate of annual reduction of forests of all sorts. The agents that bring about deforestation include slash-and-burn farmers, commercial farmers, cattle ranchers, livestock herders, loggers, commercial tree planters, firewood collectors, mining and petroleum industrialists and land settlement planners while the main causes of human-induced deforestation include logging, agriculture croplands and pasture expansion, urbanization, fuel wood collection, mining and resource extraction, hunting and, slash and burn practices. Food security is the accessibility of people to adequate quantity and safe food that enhance healthy living at all times. Deforestation directly impact on food security through the loss of biodiversity that are source of food to man and indirectly through its effect on soil degradation and alteration of the weather elements which in turn reduce agricultural productivity. Approaches to combat deforestation include environmental education and literacy, agroforestry practice, increasing of protected area, development of alternatives, development of policy and enforcement strategies, and furthermore, reforestation, afforestation and avoided deforestation.

[OLAGUNJU, Temidayo Ebenezer. **Impacts of Human-induced Deforestation, Forest Degradation and Fragmentation on Food Security.** *N Y Sci J* 2015;8(1):4-16]. (ISSN: 1554-0200). <http://www.sciencepub.net/newyork>. 2

Keywords: forest, human-induced, deforestation, forest degradation, forest fragmentation, food security

Introduction

Forests are vast areas of land predominantly defined by densely-tall woody and non-woody vegetations as well as other communities of flora and fauna in symbiotic relationships. Forest is an intricate system made up of plants and trees that protect biodiversity, providing home to terrestrial biodiversity and improving the quality of life forms on earth (Popoola, 2014). Onyeanusu and Otegbeye (2012) defined forests as large areas of land covered with trees and brush that grow thick but forest according to the Food and Agriculture Organization (FAO) Forest Resources Assessment (2002) is an area where trees cover ten percent or more of the land. Forest was originally used to mean a vast expanse of land covered by trees usually associated with game hunting. Forest has been variously used to define any tall densely packed area of vegetation, even underwater vegetation

such as kelp forests, or non-vegetation such as fungi and bacteria but a typical forest is composed of the overstory (canopy or upper tree layer) and the understory which includes shrub layer, herb layer, and moss layer, and also soil microbes.

Forests are found in all regions capable of sustaining tree growth at altitudes up to the tree line, except where natural fire frequency or other disturbances is too high or where the environment has been impaired by anthropogenic activities. Forests are naturally endowed with numerous resources that are valuable to mankind (FAO, 2003). Forest functions depend on the daily needs of livelihood of people living close to it. For instance, rural populations depend most fundamentally on forests in terms of subsistence, health, income and culture (Van *et al.*, 1997; Adebisi, 2008). The forest is a source of resources that are of environmental, economic, socio-

cultural and aesthetic benefit. It provides food, income, ecological resources, social and cultural features, as well as physical facilities like power and building materials. Other functions of the forest are prevention of erosion, as well as the provision of essential habitat for wildlife to survive. In addition to conserving biological and cultural diversity, it is now widely recognised that many protected areas also have important social and economic functions. These include protecting watersheds, soil and coastlines, providing natural products for use on a sustainable basis, and supporting tourism and recreation (Lee *et al.*, 2003).

Types of Forest

Forests vary considerably in composition, structure and geographic distribution. It can be classified into different types based on the following criteria:

- a. Based on spontaneity: natural and artificial forest
- b. Based on indications of human activity: primary/frontier and secondary forest
- c. Based on leaf longevity: evergreen and deciduous forest
- d. Based on leaf broadness: broadleaf tree, coniferous trees or mixed forest
- e. Based on geographic zone: temperate forest, sub-tropical and tropical moist forest, sub-tropical and tropical dry forest
- f. Based on physiognomy: old growth and second growth
- g. Based on dominant species

Functions of the forest

Forest are important to sustainability of the earth and hence the existence of man. Broadly, functions of the forest can be categorized as follows:

a. Environmental function

- Biodiversity protection and conservation
- Moderation of weather elements e.g. rainfall, temperature etc.

- Carbon sequestration
- Soil management

b. Socio-cultural function and economic function

- Food security
- Provision of medicinal products
- Source of fuel wood
- Source of employment and income
- Source of raw materials for industries
- Source of national revenue and exchange income earnings
- Provision of religious and cultural sites
- Aesthetic and sporting

Concept Of Deforestation, Forest Degradation And Fragmentation

Deforestation

Deforestation is basically the conversion of forested areas to non-forested land for several purposes basically agricultural, industrial and urbanization. Deforestation is a process whereby trees are felled for several purposes but without replanting to replace the ones felled (Aina and Salau, 1992). It is the large scale removal of forests resulting to non-forest areas for urbanization, agriculture and for some other reasons without corresponding re-afforestation of the area (Fiset, 2011). According to FAO (2005), deforestation is the conversion of forest to another land use or the long term-term reduction of tree canopy cover below the 10% threshold. On a broad sense, deforestation can apart from conversion of forest areas to non-forest ones, include reduction of forest quality in terms of its density, structure of the trees, the ecological and other essential services supplied, biota biomass and species diversity as well as the genetic diversity of the composing biota. Deforestation is a major problem in many parts of the world, and the idea underlying the phenomenon can be a diminution of vegetal covers from thick forest to light forest, from heavy or light forest to open area under development. It can also be from heavy or light forest to savannah or grassland and or from savannah to open or isolated land (Okorie, 2012).

In spite of the multi-various usefulness of the forest resources, rapid population growth and changes in land uses have put the forest resources under pressure. For instance, majority of logging operations in tropical countries are considered unsuitable and damaging. The widespread failure of forest governance – characterized by illegal logging, associated illegal trade, and corruption-directly undermines sustainable economic growth, equitable development, and environmental conservation. It puts at risk poor and forest-dependent populations, which rely on timber and non-timber forest products; undermines responsible forest enterprises by distorting timber and reducing profitability; and results in a loss of government revenue that could be invested in sustainable forest management or general economic development (World Bank, 2006).

Forest degradation

Forest degradation is a process leading to a temporary or permanent deterioration in the density or structure of vegetation cover or its species composition (FAO, 2007). It results from disturbances that cause changes in the forest attributes that leads to a reduced productive capacity of the forest. For the purpose of having a harmonized set of forest and forest change definitions, that also is measurable with conventional techniques, forest degradation is assumed to be indicated by the reduction of canopy cover and/or stocking of the forest through logging,

fire, wind felling or other events, provided that the canopy cover stays above 10%. In a more general sense, forest degradation is the long-term reduction of the overall potential supply of benefits from the forest, which includes wood, biodiversity and any other product or service.

Forest fragmentation

Forest fragmentation is any process that converts once a continuous forest area into fragments or patches of forest separated by non-forest lands. Fragmentation is a complex phenomenon resulting from dynamic interactions between the natural landscape and society's ever-increasing demands on the land, creating a mosaic of natural and human-modified environments (FAO, 2007). Forest fragmentation is basically the conversion of large areas of contiguous native forest to other types of vegetation and /or land use leaving remnant patches of forest that varies in size and isolation.

Global status of deforestation

Forest predate man and they have evolved over millions of years and have been profoundly shaped by swings and variations between climates and other natural forces (Popoola, 2014). Climate conditions have continued to influence the world's forests, while anthropogenic factors have also played key roles in shaping what became of world's forest. Deforestation is a global phenomenon with the highest rate in developing nations. In some countries, deforestation is on the decline but the worldwide deforestation figures confirm the continue trend in net forest decline. In pre-industrial times, forest covered about 15.6% of the earth's surface (approximately 50% of the total land area), but at present, the total world forest has been estimated to cover just about 9.4% of the earth surface (approximately a third of the total land area or approximately 30% of the total land area) (Sheram, 1993; FAO, 2005; UNEP, 2005). FAO (2005) reported that the worldwide forest area is around 4 billion hectares corresponding to 0.62 hectares per capita, but it is declining by 13 million hectares a year- "an alarming rate". The overall net loss in the period 2000-2005 was about 7.3 million hectares forest area per year (or 0.18% of forest cover which equals 2.2 times the size of Belgium) versus a net loss of 8.9 million hectares (or 0.22% of forest cover) per year in the period from 1990 to 2000 (European commission, Directorate-General for Environment, Food and Agriculture Organization, 2003).

Table 1 and 2 show the summary of deforestation between 1990 and 21010, while table 1 shows the change in forest area by region and subregion, table 2 shows countries with largest annual net loss of forest

area. These tables show there was considerable increase in deforestation in many countries and subregions while few reduce the trend. The increasing trend during 1990-2010 was almost entirely confined to tropical regions especially Africa. Deforestation is prominent in tropical regions of Africa Latin America and part of Asia as shown in table 1, 2 and 3. Deforestation occurred at the rate of 9.2 million hectares per annum from 1980-1990, 16 million hectares per annum from 1990-2000 and decreased to 13 million hectares per annum from 2000-2010. The net change in forest area during the last decade was estimated at -5.2 million hectares per year, the loss area was however lesser than that reported during 1990-2000 which was 8.3 million hectares per year equivalent to a loss of 0.20 per cent of the remaining forest area each year. The current annual net loss is 37 per cent lower than that in the 1990s and equals a loss of 0.13 per cent of the remaining forest area each year during this period. By contrast many countries like Nigeria have very high losses per year and they are in risk of virtually losing all their forest within the next few decades if the current rate is unabated. South America with about four million hectares per year suffered the largest net loss of forests during the last decade followed by Africa with 3.4 million hectares annually and the least, Oceania. The net loss in Oceania has been accrued to the 2000AD Australia severe drought and forest fires (Chakravarty *et al.*, 2011).

As shown in Table 2, Brazil and Indonesia has the annual net loss of forest area between 1990 and 2000 with Nigeria having the highest percentage forest loss rate. Brazil and Indonesia accounted for almost 40 percent of the total net forest loss worldwide within that decade while the net loss increased in Australia placing it second to Brazil between 2000 and 2010. Chakravarty *et al.* (2011) reported that Comoros (-9.3%), Togo (-5.1%), Nigeria (-3.7%), Mauritania (-2.7%) and Uganda (-2.6%) were the five countries of the world with the highest percentage rate of forest loss, all in Africa.

Deforestation is highly prominent in the Africa, Latin America and some parts of Asia. Table 3 indicates that Africa is currently mostly challenged with deforestation as against its position between 1880 and 1990. Asia was the continent with the highest deforestation rate of 65% between 1880 and 1990, followed by Latin America and then Africa with just 6% forest cover loss rate. But by 1990s, Africa deforestation rate has grown to 51% making it the continent with the highest deforestation rate.

Table 1: Annual change in forest area by region and subregion, 1990-2010

Region/subregions	1990-2000		2000-2010	
	1000 ha/year	%	1 000 ha/year	%
Eastern and Southern Africa	-1841	-0.62	-1839	-0.66
Northern Africa	-590	-0.72	-41	-0.05
Western and Central Africa	-1637	-0.46	-1535	-0.46
Total Africa	-4067	-0.56	-3414	-0.49
East Asia	1762	0.81	2781	1.16
South and Southeast Asia	-2428	-0.77	-677	-0.23
Western and Central Asia	72	0.17	131	0.31
Total Asia	-595	-0.10	2235	0.39
Russian Federation (RF)	32	n.s.	-18	n.s.
Europe excluding RF	845	0.46	694	0.36
Total Europe	877	0.09	676	0.07
Caribbean	53	0.87	50	0.75
Central America	-374	-1.56	-248	-1.19
North America	32	n.s.	188	0.03
Total North and Central America	-289	-0.04	-10	0.00
Total Oceania	-41	-0.02	-700	-0.36
Total South America	-4213	-0.45	-3997	-0.45
World	-8327	-0.20	-5211	-0.13

Source: FAO, 2010a

Table 2: Countries with largest annual net loss of forest area, 1990-2010

Country	Annual change 1990-2000		country	Annual change 2000-2010	
	1000 ha/year	%		1 000 ha/year	%
Brazil	-2890	-0.51	Brazil	-2642	-0.49
Indonesia	-1914	-1.75	Australia	-562	-0.37
Sudan	-589	-0.80	Indonesia	-498	-0.51
Myanmar	-435	-1.17	Nigeria	-410	-3.67
Nigeria	-410	-2.68	Tanzania	-403	-1.13
Tanzania	-403	-1.02	Zimbabwe	-327	-1.88
Mexico	-354	-0.52	The Congo	-311	-0.20
Zimbabwe	-327	-1.58	Myanmar	-310	-0.93
Congo	-311	-0.20	Bolivia	-290	-0.49
Argentina	-293	-0.88	Venezuela	-288	-0.60
Total	-7926	-0.71	Total	-6040	-0.53

Source: FAO, 2010a

Table 3: Change in forest cover in Africa, Asia and Latin America between 1880 and 2000

country	Losses in forest cover			
	1880-1990		1990-2000	
	10 ⁶ km ²	%	1000 ha	%
Africa	0.81	6	5264	51
Asia	1.83	65	454	4
Latin America	0.80	29	4588	45
Total	2.81	100	10306	100

Ramankutty and Foley (1999); FAO Global Forest Assessment (2000)

Africa

Africa accounted for a net loss of 4.0 million hectares per year (equivalent to 0.3% of the entire African forest cover) and an average annual negative

change rate of -0.62% from 2000 to 2005. Table 4 below presents the five African countries with the largest annual net negative change rate and the largest net loss in forest area for the period from 2000 to 2005.

Between 2000 and 2005, Burundi has the highest annual deforestation rate in Africa and second largest in the world (Chakravarty *et al.*, 2011) while Sudan has

the highest net loss with Nigeria the least among the five countries (although Nigeria has the highest deforestation rate of primary forest in the world).

Table 4: Countries in the Africa with highest deforestation rate and highest net annual forest area change Deforestation rate 2000-2005 Annual net loss 2000-2005

country	Annual change rate in % (1000ha/year)	Country	Annual change in 1000 ha/year (in % negative change)
Burundi	-5.2% (-9)	Sudan	-589 (-0.8%)
Togo	-4.5% (-20)	Zambia	-445 (-1.0%)
Mauritania	-3.4% (-10)	Tanzania	-412 (-1.4%)
Nigeria	-3.3% (-410)	Nigeria	-410 (-3.3%)
Benin	-2.5% (-65)	DR Congo	-319 (-0.2%)

Source: FAO, 2006

Latin America

Latin America accounted for the largest loss of forest losing 4.3 million hectares per annum (equivalent to 0.5% of the entire Latin American and Caribbean forest cover) and an average annual deforestation rate of approximately -0.5% from 2000-2005. Table 5 below presents the five Latin American countries with the largest annual deforestation rate and the largest net loss in forest area for the period from

2000 to 2005. Brazil, where 60% of Amazon rainforests are located (Chakravarty *et al.*, 2011), accounted by far for the largest annual net losses (but with just -0.6% deforestation rate), followed by Venezuela, Bolivia, Mexico and Ecuador but Honduras, El Salvador, Ecuador, Guatemala and Nicaragua in that order accounted for the highest deforestation rate.

Table 5: Countries in the Latin America with highest deforestation rate and highest net annual forest area change Deforestation rate 2000-2005 Annual net loss 2000-2005

country	Annual change rate in % (1000ha/year)	Country	Annual change in 1000 ha/year (in % negative change)
Honduras	-3.0% (-156)	Brazil	-3,103 (-0.6%)
El Salvador	-1.7% (-5)	Venezuela	-288 (-0.6%)
Ecuador	-1.7% (-198)	Bolivia	-270 (-0.5%)
Guatemala	-1.3% (-54)	Mexico	-260 (-0.4%)
Nicaragua	-1.3% (-70)	Ecuador	-198 (-1.7%)

Source: FAO, 2006

Southeast Asia

Southeast Asia reported a net gain of approximately 1.0 million hectares per year (equivalent to 0.4% of the entire Southeast Asian forest cover), due to large-scale afforestation projects in China, and an average annual positive change rate of 0.18% between 2000 and 2005 (FAO, 2006). Table 6 below presents the five Southeast Asian countries with the largest

annual net deforestation rate and the largest net loss in forest area for the period from 2000 to 2005. Within this mentioned year, Indonesia has a high annual net forest loss, followed by Myanmar, Cambodia, Philippines and then Malaysia. Deforestation rate is highest in Philippines and Pakistan followed by Indonesia, Cambodia and Sri Lanka.

Table 6: Countries in the Latin America with highest deforestation rate and highest net annual forest area change Deforestation rate 2000-2005 Annual net loss 2000-2005

country	Annual change rate in % (1000ha/year)	Country	Annual change in 1000 ha/year (in % negative change)
Philippines	-2.1% (-157)	Indonesia	-1,871 (-2.0%)
Pakistan	-2.1% (-43)	Myanmar	- 466 (-1.4%)
Indonesia	-2.0% (-1,871)	Cambodia	-219 (-2.0%)
Cambodia	-219 (-2.0%)	Philippines	-2.1% (-157)
Sri Lanka	1.5% (-30)	Malaysia	-140 (-0.7%)

Source: FAO, 2006

Figure 1 shows the ten countries of the world with worst deforestation rate of their primary forest.

Currently, Nigeria has the highest rate of its primary forest declining among other nations of the world

followed by Vietnam with Guatemala the last on the list. Nigeria is considered the highest deforested country, from 1990 to 2010; Nigeria has lost 55.7% of its primary forest with an average yearly lost rate of

409,700 hectares (FAO, 2006). The situation appears alarming that the FAO states that all the primary forest in Nigeria will disappear by 2020 if the current rate of forest depletion continues unabated.

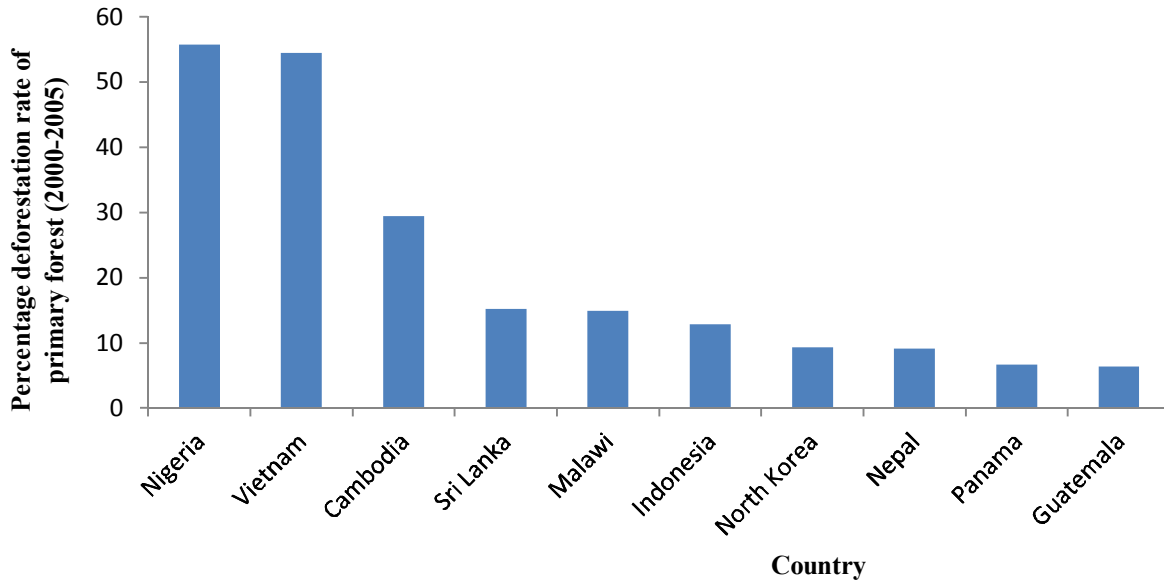


Figure 1: Ten countries of the world with the worst Deforestation rate of primary forests (2000-2005). Source: Rhett, 2005

Table 7: Important agents of deforestation, forest degradation and fragmentation.

Agents	Links to deforestation, degradation and fragmentation
Slash-and-burn farmers	<ul style="list-style-type: none"> Clears forest to grow subsistence and cash crops
Commercial farmers	<ul style="list-style-type: none"> Clears the forest to plant commercial cash crops, sometimes displace slash-and-burn farmers who then move to a new forest land
Cattle ranchers	<ul style="list-style-type: none"> Clear the forest to plant pasture, sometimes displace slash-and-burn farmers who then move to a new forest land
Livestock herders	<ul style="list-style-type: none"> Intensification of herding activities can lead to deforestation
Loggers	<ul style="list-style-type: none"> Remove commercial timber, logging roads provide access to other land users
commercial tree planters	<ul style="list-style-type: none"> Clear mostly forest fallow or previously logged forests to establish plantations to supply fibre to the pulp and paper industry
firewood collectors	<ul style="list-style-type: none"> Intensification of firewood collection can lead to deforestation
mining and petroleum industrialists	<ul style="list-style-type: none"> Roads and seismic lines provide access to other land users, localized deforestation related to their operations
land settlement planners	<ul style="list-style-type: none"> Relocation of people into forested areas as well as settlement projects displacing local people who then move to the forest
infrastructure developers	<ul style="list-style-type: none"> New access for other land users from road and highway construction through forested areas, flooding by hydroelectric dams.

Source: Adapted from FAO, 2007

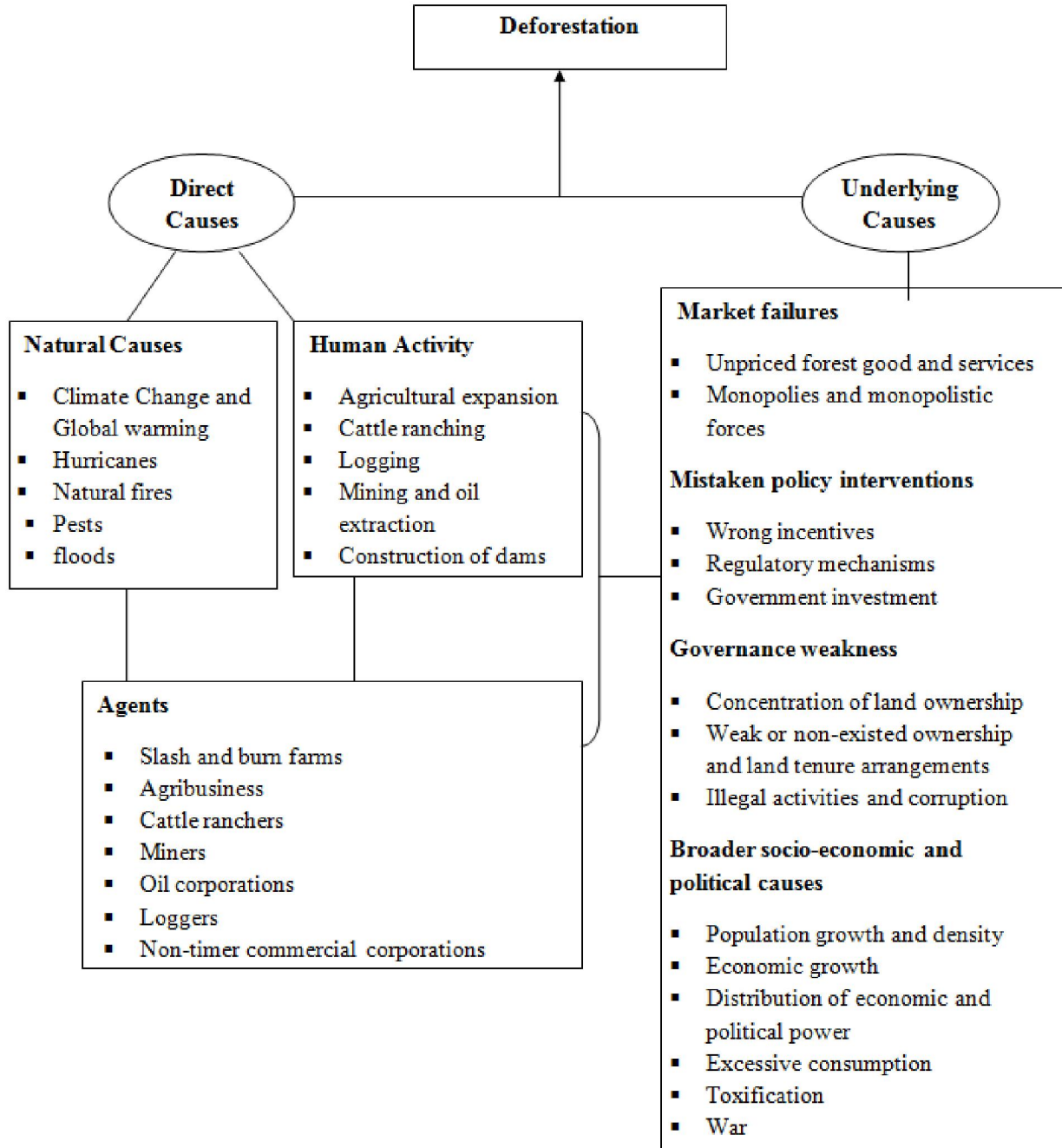
Agents and Causes of Deforestation

Deforestation is brought about by natural occurrences and human activities as it is true with many other environmental problems. It may occur abruptly when the forest is cleared for agricultural production or more gradually as a result of unsustainable logging practices (Houghton, 2005).

Other practices that contribute to forest loss include; persistent bush burning, intensive grazing, highly reduced or absence of bush fallow periods, pollution, as well as erratic extension of agricultural farmlands. It is important to distinguish between the agent of deforestation and its causes. These two deforestation terms can be distinguished by asking

these questions: who is doing the deforestation? And what forces drives the doer? Simply, the agents of deforestation are those individuals, corporations, government or non-government agencies, or development projects that clear the forest while the

causes of deforestation are the forces that motivate the agents of deforestation (FAO, 2007). This definition suggests that while the causes of deforestation could be natural or anthropogenic, the agents are basically human as shown in table 7 and figure 2.



Source: Adapted from Contreras-Hermosilia, 2000 and modified

Figure 2: Diagram showing the direct and underlying causes of forest decline.

Human Activities Causes Of Deforestation, Forest Degradation And Fragmentation

Human activities have been the major cause of deforestation and such activities are as follow:

i. **Logging:** Cutting down of trees for timber is a major threat to forest health especially when trees are not replanted. It causes serious forest degradation (Putz *et al.*, 2001). It aggravates forest degradation in that loggers destroy other trees and vegetation while creating access roads to the desired location within the forest.

ii. **Agriculture croplands and pastures expansion:** clearing of forests for agricultural settlement causes deforestation (Myers, 1991). Deforestation is proxy by expansion of agricultural lands. Shifting cultivation both on subsistence and commercial scales as well as the use of forest trees to provide fodder for grazing animals can also be problem. Animals stripped trees and remove vegetation thereby denuding the forest.

iii. **Urbanization:** expansion of cities and towns for development require land to accommodate the infrastructure necessary to support urbanization and growing population which done by clearing the forests (Mather, 1991; Kaimowitz and Angelsen, 1998; Sands, 2005). The construction of roads, buildings, railways, airports etc has led to the decline of the world forest.

iv. **Fuel wood collection:** Fuel wood gathering is often common in the tropical dry forests (Rowe *et al.*, 1992) where it is a major cause of deforestation and degradation. Trees are deliberately felled, left to be dried and then cut and harvested as source of energy for various domestic and industrial uses.

v. **Mining and resource extraction:** Mather (1991) and Sands (2005) said that mining is very intensive and very destructive. If this occurs in the forest areas, it involves the removal of substantial trees both at the site of extraction and access road leading to it. Mining worsen deforestation if wood is again the source of fuel in mining operations.

vi. **Hunting, slash and burn practices:** unsustainable hunting practices within the forest areas as well as agricultural practices in the adjacent farmland to forest areas are possible causes of deforestation and forest degradation. Setting of bush on fire in hunting; and slash and burn practices in agriculture can cause uncontrolled fire outbreak that will destroy many forest trees and if this occurs too often, it can lead to the extinction of many forest plant and animal species as well as the degradation of the entire forest.

Concept Of Food Security

Food security fundamentally refers to the accessibility of people to the adequate quantity and

quality of food required for healthy living at all times. Broadly, food security means the availability and accessibility of all members of a household or every person in a country to foods that provide them with balance diet at all times. In essence, a household or a country should not be considered to be food-secured only when there is availability and accessibility to adequate food quantity needed by the population, but more importantly when the consumption of such food do not pose any health hazard to them (Nneji, 2013). Food security includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies) (USDA, 2008). Food insecurity ranges from the fear of starvation to full-scale famine. Food insecurity encompasses: the fear of food unavailability/starvation, inadequate food quantity, poor or inadequate food quality and instability of food.

According to the World Health Organization (2003) and FAO (2009), food security is determined by: food availability, food accessibility, food utilization and food stability. Food availability refers to the adequate food supply to people through production, distribution and exchange (Gregory *et al.*, 2005). Food accessibility refers to the ability of people to obtain food. Food accessibility measures the allocation and affordability of preferred food by people. Food utilization refers to the metabolism of food by individual (Tweeten, 1999). It explains the usability and safe of food when ingested to meet the physiological requirement of each individual (Ecker and Breisinger, 2012), and food stability mean to obtain adequate food over time.

Relationship between deforestation and food insecurity

Deforestation has direct and indirect relationship with food insecurity. It directly impact on food security through loss of biodiversity and removal of trees that supply man with vegetable, fruits, medicine and house various animals species that are food to man, as shown in figure 2. Deforestation negatively and indirectly impact on food security through soil degradation and alteration in weather element which in turn affect soil quality. Agricultural crop yield depends on the health of the soil and hence, any impact on the soil is interpreted on the productivity of the agricultural produce. Conclusively, deforestation increases food insecurity.

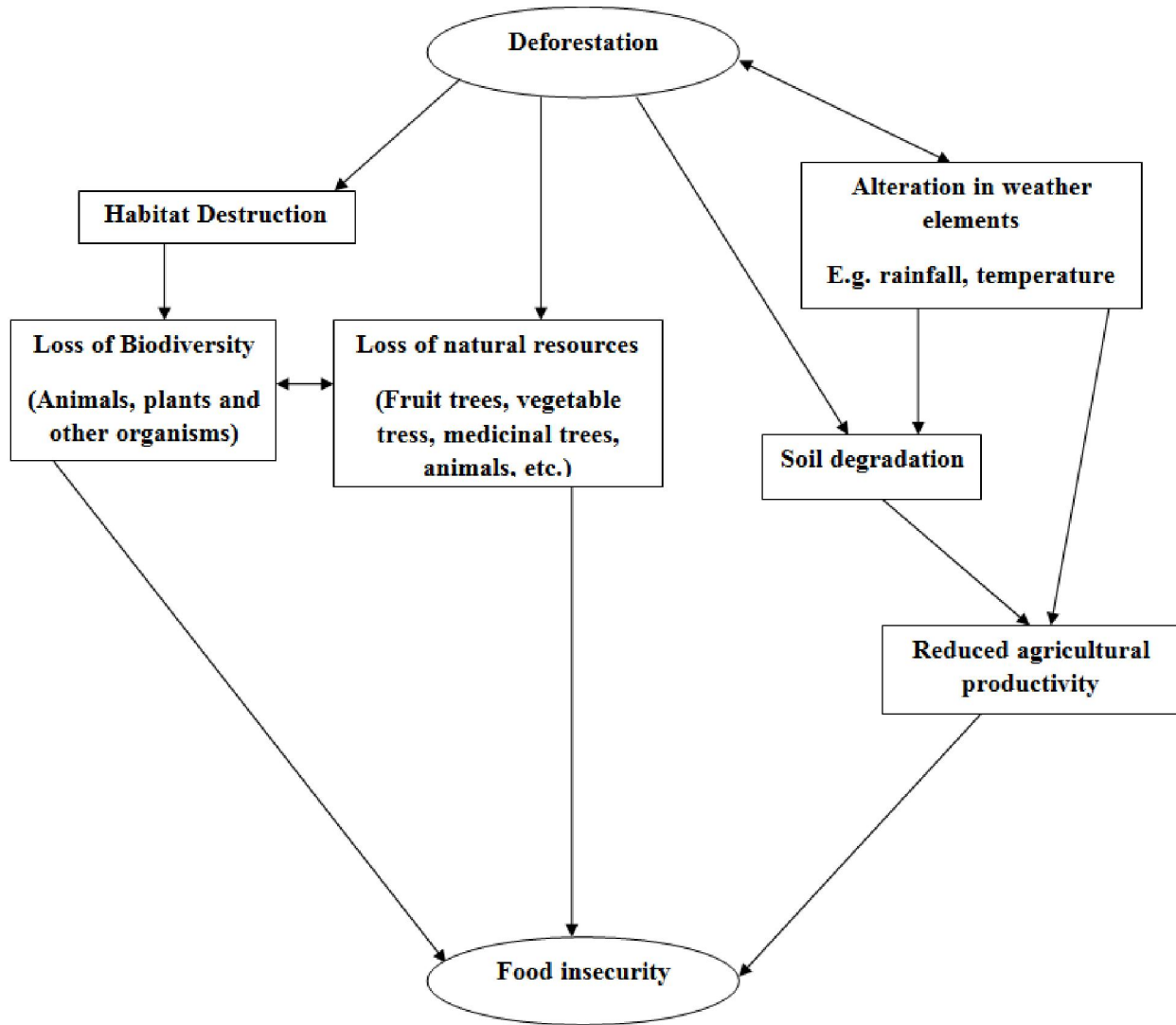


Figure 3: Diagram showing the relationship between human-induced deforestation and food insecurity

Impacts Of Human-Induced Deforestation, Forest Degradation And Fragmentation On Food Security

There are associations between human-induced forest deteriorations and agricultural productivity, and invariably food security. Basically, deforestation, forest degradation and fragmentation impact on food security directly by causing the loss of biodiversity that are direct source of human food, and indirectly by influencing the soil and local climatic elements such as rainfall, temperature, etc. of areas where agriculture that produces human foods are practiced. Persistent and substantial reduction in the ecosystem health as a result of deforestation is a great threat to agricultural productivity as there is a link between deforestation and soil ecosystems which in turn influence agricultural crop yield.

Deforestation has been implicated to be one of the major factors that take away about 14million tones of soil essential nutrients (Nneji, 2013). Removal of

trees causes alterations in the biogeochemical cycle that return nutrients ultimately back to the soil. Trees extract nutrients from the soil for its growth, and the taking away of such tree from its place means that tones of soil essential nutrients has be taking away. Also, deforestation exposes the soil to erosion that removes the topsoil. Hence, deforestation renders essential nutrients such as nitrogen and phosphorus unreachable to agricultural crops grown in such deforested area.

Deforestation causes destruction of natural habitat of wild animals, destruction of vegetable species, fruit trees, and trees of medicinal importance as well as the disruption of essential microbial ecosystems. This condition leads to the loss of biodiversity (Diaz, 2006), degrade the soil and it also encourages soil erosion as heavily deforested areas are left bare at the expense of runoffs during rainfall. Reducing the biodiversity directly affects the food and

health of the local people who depend on the forest for fruits, vegetables, medicine and different animal (Per and Rajul, 1995). Some genetic strains of cultivated plants which form the basis of the food and health of the world's population today originate from the forest: their disappearance can affect the possibility of producing plant-based medicines to combat specific diseases or epidemics (Hulme, 2001).

Costa *et al.* (2003) have attributed increases flood risk to deforestation, as there is limited interception of rainfall and reduced evaporation of water from the canopy (Bradshaw *et al.*, 2007). Bradshaw *et al.* (2007) also report that flood frequency was negatively correlated with the amount of remaining forest, but positively correlated with the amount of forest area lost. Modelling indicates that a 10% decrease in natural forest area results in an increased flood frequency between 4% and 28%, depending on the country being modelled. The same 10% decrease in forest cover also results in a 4-8% increase in total flood duration. For instance, the annual discharges into a river in the southeast Amazon have been estimated to have increased by 25% following conversion of forest to agriculture land (Costa *et al.*, 2003). Spracklen *et al.* (2012) suggested that decreased evapotranspiration due to deforestation could increase localised run-off and raise river levels. Many of agricultural lands adjacent to degraded forest or crops grown along the coast have been lost to flood, and this has contributed to the reduction in the annual agricultural produce and economic losses, thereby impacting on food security.

In 2006, Food and Agriculture Organization (FAO) estimated that population growth will lead to a 50 per cent rise in the demand for food by 2050 (FAO, 2006). A growing population cannot afford to lose fertile land which is essential to food security, biodiversity conservation and climate change mitigation (Nneji, 2013). This population explosion will instigate the need to produce more food to meet the needs of the people. New agricultural lands will be developed at the expense of the forest, causing an increase in the risk that land which is unsuitable for intensive farming, or which should be protected to prevent biodiversity loss, will be claimed for agricultural purposes; it thus also increases the risk that such land will become more degraded. Given the high rates of population growth in recent decades across the globe, adequate levels of food production has reduced significantly to feed local populations as well as supply maximum food for the growing populace (FEPAE, 2006). However, if the extent of deforestation is not reversed in the coming years, food yields in many affected areas are likely to decline.

Deforestation also has indirect impacts on rainfall level and pattern. For example, modelling

suggests the widespread reduction in rainfall of 1mm/day locally (Werth and Avissar, 2005), with a 2-3mm/day decrease in the dry season (Semazzi and Song, 2001) after complete tropical African deforestation. These models suggest reduction in rainfall in some part and increase but irregular pattern in some other places in Africa. Adequate soil moisture is necessary for productive agricultural yields. Many farmers of the developing countries depends on the natural source of precipitation (mainly rainfall) as an essential need for their agricultural production, and as such, any reduction or irregular pattern will impact negative on their agricultural produce. For instance, Western Kenyan agriculture production was expected to reduce following decreased rainfall linked to local forest loss (Otieno and Anyah, 2012).

Another indirect impact of deforestation is the alteration in surface temperature. Forest is essential in moderating the temperature especially on a local scale (Cao *et al.*, 2001). Increase in temperature will occur if forests are substantially converted to non-forest land due to the reduction in evaporative cooling associated with vegetation loss (Synder, 2010). If such change is abrupt and the rainfall pattern is altered, crop harvest will be reduced. In 2011, Lobell *et al.* (2011) estimated an approximate 10% reduction in crop yield for a 1°C rise in temperature under a condition of abrupt change in rainfall and surface temperature.

Approaches To Combating Deforestation, Forest Degradation And Fragmentation

Approaches to reduce deforestation are best through the collaborative efforts among individuals, organizations, governments and non-government agencies. Combating deforestation can be effective and rapid through the method that embraces environmental enlightenment, avoided deforestation and continuous afforestation backed by adequate sustainable forestry policy and legislature. Some of the strategies of combating deforestation, forest degradation and fragmentation include the following:

i. Environmental education and literacy

Understanding the context of environment and the knowledge of how human interactions can influence the environment is a basis for curtailing deforestation and other environmental problems. Environmental education and literacy can help create a stewardship ethic- a sense of duty to care for and manage wisely our natural environment and endowment and our productive resources for the long haul (Cunningham and Cunningham, 2006). Environmental literacy of all stakeholders will help to preventing deforestation and reducing adverse effects associated with it as well as taking appropriate action when possible. Outcome of environmental education should enable every person to be environmentally sound in terms of natural context, social context,

valuing context and action context as it is indicated in the table 8.

Table 8: Outcomes from Environmental Education

Context	Outcome
The natural context	An environmentally educated person understands the scientific concepts and facts that underlie environmental issues and the interrelationships that shape the nature.
The social context	An environmentally educated person understands how human society is influencing the environment, as well as the economic, legal, and political mechanisms that provide avenues for addressing issues and situations.
The valuing context	An environmentally educated person explores his or her values in relation to environmental issues; from an understanding of the natural and social contexts, the person decides whether to keep or change those values.
The action context	An environmentally educated person becomes involved in activities to improve, maintain, or restore natural resources and environmental quality for all.

Source: Cunningham and Cunningham, 2006.

ii. Encouragement agroforestry practice

Agroforestry is the production of trees and non-tree crops or animals on a piece of land at a particular period of time. The integration of growing crops and/or animal with trees on the same piece of land will increase forest areas and reduce the dependence on primary forest. Also, trees in agroforestry system help in soil management through holding the soil against erosion and improving soil fertility (Martin and Sherman, 1992; Popoola, 2014).

iii. Increase of protected area

Since ancient times, sacred areas that include forests have been set aside for cultural and religious purposes or pleasuring grounds for royalty (Cunningham and Cunningham, 2006) but in the recent, such areas have been encroached due to urbanization. The provision of protected areas is fundamental in any attempt to conserve biodiversity (Myers and Mittermeier, 2000; Nepstad *et al.*, 2006). Increasing the protected forest area will assist to combat deforestation as such area will be devoid of human deleterious impacts.

iv. Development of Alternatives

Encouraging substitutes for all purpose where forest products especially timber are utilized is necessary to decline the rate of deforestation. Also, combining of non-forest product with forest products in manufacturing for example furniture will greatly reducing the market and utilization of wood products and consequently reduce deforestation.

v. Policy and enforcement

FAO (2010b) considered that half of the current tropical deforestation could be stopped if the governments of deforesting countries were determined to do so. There is need to develop new policy statements, legislative and regulatory measures, and modified existing ones to combat deforestation but there is also the need to for enforcement for effectiveness. Such laws, policies and legislations should be such that they encourages local people and

institutional participation in forestry management and conservation along with safeguarding indigenous people's traditional rights and tenure with rightful sharing of benefits. The following strategies could be employed for effectiveness measure against deforestation: negotiation, warnings, cancelling work orders, notices of violation, fines, arrests and court action.

vi. Reforestation, afforestation and avoided deforestation

Increasing the area of forest plantation by replanting tress to replace the deforested ones is vital in managing deforestation (Williams, 2002). This could be done by using vacant or unused lands and waste lands for forest plantations and avoiding cutting down of trees in the already establish forest will help to combat deforestation and associated devastating impacts. Planting trees on roadside, along railway tracts, on contours, avenues, boundaries and other non-forest areas will reduce pressure on the primary and established forests and thereby reduce deforestation.

Conclusion

Forests are invaluable resources to the continuous existence of the world and the mankind living therein. The various environmental, economic and socio-cultural functions of the forest are threatened by various human activities leading to deforestation, forest degradation and fragmentation. Deforestation is on the increase in many countries of the world but most severe in Africa with notable effect on food security; food availability, accessibility, utilization and stability. However, deforestation can be combated through structured strategies of environmental education and literacy, agroforestry practice, increasing of protected area, development of alternatives, development of policy and enforcement measures and, reforestation, afforestation and avoided deforestation.

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1/7/2015