Int. Journal of Water Management and Diplomacy
e-ISSN:2717-8277 Review Article

ANALYSIS OF THE EFFECTS OF DEFORESTATION ON THE ENVIRONMENT AND AGRICULTURE IN KENYA

[1*]**Benson Njora , Hasan Yilmaz**

Isparta University of Applied Sciences, Faculty of Agriculture,

Department of Agricultural Economics, Isparta, Turkey, 32260, Isparta, Turkey.

*Correspondence Author, e-mail: wanduben12@gmail.com

Abstract

Forests are known to have beneficial effects on the environment, influence the climate, water sources, and temperature. Forests help in conserving biodiversity, reducing harmful effects caused by chemicals from the soil, acting as a carbon sink, and protecting watersheds, all of these have great benefits to both humans and the environment. The ecosystem of the forests and the environmental sustainability is at risk as a result of deforestation. Deforestation also hampers the socio-economic development in many parts of the world. Through secondary research and a descriptive research design, this paper analyzes the impacts of deforestation on the Environment and Agriculture in Kenya. According to research, agricultural activities are the major cause of deforestation globally, it accounts for about 80% of total deforestation in developing countries. Other causes of deforestation are human population growth, poor governance and corruption, illegal logging, and wildfires. Deforestation affects the environment through climate change, water loss, decreased biodiversity, habitat loss, and conflicts. Several conservation measures have been tried in various places to slow down the rate of deforestation. These include; imposing bans, legislations, devolution, public participation, barriers, and modernizing forest management. It is therefore recommended that; people need be educated about the benefits of forests and their adverse impacts that may result from deforestation, population control to avoid invasion in forested areas, adoption of sustainable and environmental-friendly agricultural practices, strengthening institutions such as legislature and judiciary to curb corruption, reduction of the continued widespread dependence of household biomass sources of energy ad adoption of Geographic Information System (GIS) techniques to monitor activities in and around forests.

Keywords: Forest; deforestation; agriculture; climate change; environmental policies

1.0 INTRODUCTION

Deforestation is the practice of permanently removing or uprooting trees from the ground to give rise to something else other than forests (Derouin, 2019). The reasons for deforestation are mainly to ensure that there is sufficient land for cultivation, infrastructure purposes, residential purposes, and manufacturing or industrial purposes. Deforestation is not only caused by human intervention but it can also be caused by other natural causes (Cesareo et al., 2021). For example, when natural fires occur, large swathes of land covered by forests can be decimated within a short period. Forests are crucial for conservation and human survival.

Without forests, people will; lack the natural herbs they can use as medicine, without forests, the habitat for animals of all species will become destroyed. Forest cover also ensures that the air that the people breathe is filtered and the earth's surface is not affected by the harmful rays from the sun (Cesareo et al., 2021).

Despite the increasing importance of forest cover, many people contend that forests occupy lands that would otherwise be used for human settlement, development, and civilization. Forest cover utilizes land that can otherwise be used to provide settlement for millions of people now that in the world the population is fast rising (Cesareo et al., 2021). Forests cover occupies land that would otherwise be converted into farming areas to be used crop and livestock farming so that the population of the world remains fed.

The rise in urbanization steadily over the past few years has seen a decline in the forest cover in the world. Large towns and cities now stand in place of areas that were once booming forests. The Food and Agricultural Organization estimates that by 2050 at least 68% of the world's population will be living in urban centers (Youmatter, 2020). The current urban centers cannot sustain all these people leading to the expansion of towns and cities. The expansion of towns cannot happen without the decimation of the natural environment around them such as forests and other critical natural resources like Rivers.

1.1 Deforestation Situation in the World

Forests cover the Earth's land, an area of over 4 billion hectares. 93% of the world's forests are natural, 7% and are planted forests. Every year, the world loses 10 million hectares of the world's forests. Some 80% of the tropical rainforests are destroyed due to agriculture. Deforestation is the leading cause of 15% of carbon emissions. (*The Global Forest Goals Report 2021*). Deforestation is considered to be a significant problem in various parts of the planet when it comes to preventing changes in the climate and also conserving biodiversity. Some nations are cutting trees at alarming rates. As a result of deforestation, the global distribution of forests throughout the rest of the world is concentrated in a few countries as shown in the table below;

Table 1: Percentage of World Forests (%In Different Countries) Source: FAO and UNEP, 2020

Country	**Percentage of World Forests (%)**
Russian Federation	20
Brazil	12
Canada	9
United States of America	8
China	5
Australia	3
Democratic Republic of Congo	3
Indonesia	2
Peru	2
India	2
The Rest of the World	34

Deforestation increase affects the populations of world animals. With declining forest covers, the population of animals such as elephants and the orangutans will decline. Research by the World Wildlife Fund shows that if the current deforestation trend is not halted with strategic and sustainable solutions, over 420 million acres of forest cover will be lost between 2010 and 2030 (McGrath, 2019). Other areas that are deemed to be at risk in the increase in the forest losses are the Atlantic Forest, the Gran Chaco, the Borneo, the Cerrado, the Congo Basin, Eastern Democratic Republic of Congo, Eastern Australia, and also Eastern Africa (McGrath, 2019). Other areas that are at high risk of losing large areas of land that were previously forested include Sumatra, the Greater Mekong area, and the Papua Guinea areas. The above countries contain some of the most vital ecological and climate-sensitive forest lands in the world as they are home to some of the most endangered species in the world such as the rhino, the duck-billed platypus, the saola, and the Gharial (Onekindplanet.org, 2016).

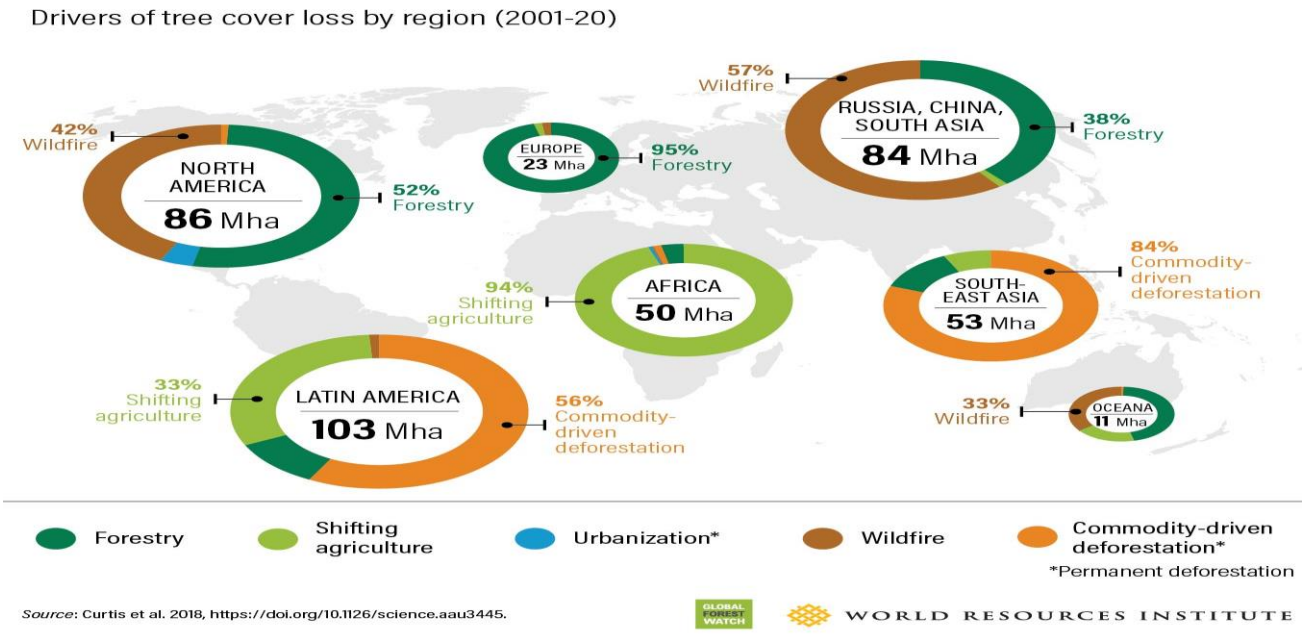

Figure 1: Drivers of tree cover loss by region (2001-2010)

According to the World Resources Institute, in 2020, Brazil was the nation in the world with the highest decline in forestation where about 1,400,000 hectares of forest land was decimated through deforestation. Other areas include DR Congo, Bolivia, Malaysia, Peru, Madagascar, Cameron, Colombia, and Indonesia. In the list above, there are three African countries among the nations that are at the highest risk of losing a major chunk of their forest cover. This shows that African countries are among the nations in the world that are at risk of losing large forested areas and if the situation is not reversed, the continent will be covered by large areas of land that have turned into deserts.

The Amazon is a widely known natural rainforest in the world. It has been in existence for the past 10 million years. New species continue to be discovered daily. It is home to over 390 billion trees. The Amazon is every biologist's dream of the vast area of biodiversity. Since the 1970s, the government led a massive advertisement for cheap land, and immigrants from Italy plus some members of the local community descended on the forest in droves to establish settlements. As a result, huge tracts of forest cover were cleared to make way for human settlement. Infrastructural development also contributed to the growth of deforestation in the region (Wolosin, M., & Harris, N. 2018).

Large tracts of land were cleared to pave way for electricity and telephone lines. The government's policy of allowing the people to settle in the Amazon also created an influx of wealthy individuals to come into the country and establish large tracts of land to be used as ranches. Politicians also contributed to the growth and development of deforestation in the area. The Ministry of Environment in Brazil had put in strong policies that compelled the people to be serious about deforestation through the introduction of fines that people were supposed to pay as a result of deforestation. However, the change in the regime prompted the relaxation of these policies (Silva Junior et al., 2021). The current President Bolosonaro is development-oriented and this has contributed to the increase in deforestation in the region.

As a result of these reasons between 1985 and 1999, at least 191, 664 square kilometers of forest land in Brazil was lacking forest cover (Silva Junior et al., 2021). Research has shown that 80% of the previously forested land in Brazil has been converted into cattle farming. The returns of cattle farming, sale of meat and hides are huge in the country and this has contributed to deforestation as forest lands are now being converted to ranches to be used for cattle farming (Silva Junior et al., 2021). Despite the above problems, there have been efforts to reduce deforestation in the country. There was a reduction of 84% of deforestation rate in 2012 compared to the year 2004 when the rate of deforestation rate was so high. This reduction can be attributed to some of the efforts that the government put in place particularly through working together with some International lobby organizations such as the Action Plan International for the Prevention and Control of Deforestation in the Legal Amazon Area (FAO & UNEP, 2020).

1.2 Deforestation Situation in Africa

According to the FAO 2020, 10% of the forest cover in Africa was destroyed through the problems of deforestation. The problem of deforestation in Africa has been huge and it has contributed to the encroachment of the Sub Saharan Desert in the region. In Africa, deforestation is both an environmental problem and a human rights and social problem. The act of deforestation deprives the rural African communities of their important source of livelihood. Poor rural communities depend on the forests for their medicinal value, shelter, and food. The 10% of the economies of Ghana and Cameroon are reliant on forests. Logging operations in the African continent particularly in the Central African Republic have been mentioned as the largest contributor to deforestation. Trees are indiscriminately cut so that they provide raw materials for furniture and other uses. The companies that carry out

logging activities in the continent and the country do so through efficient machines and labor-intensive operations that not only remove the trees but they also eradicate any vegetation that was existing on the ground surface. Mining activities especially in the Central African region and the Congo Basin have contributed to the problem of Deforestation (FAO, 2020).

Areas that are covered with rare minerals like the Democratic Republic of Congo have seen a large area of forest cover decline to give way for the miners to carry out their activities. In Congo, Copper, Gold, Diamond, uranium, and coltan are found deep in the soils in the areas with green lush forests (Harneis, 2018). The mining companies have to first cut down the trees, remove the vegetation, and then start their mining activities. Mining also has led to the destruction of the existing rainforests in the region. As seen in the image below, deforestation for mining purposes leads to a wide-scale decimation of the land. Trees are not only removed but the land is also left bare to the vagaries of the weather such as soil erosion.

Population increase, agricultural activities, urbanization, and economics are the possible drivers of deforestation within the East African countries of Kenya, Uganda and Tanzania, and Ethiopia. Apart from that, there has been a wide demand for forest trees to be used as fuelwood in the region (M, J. 2018). In the 1980s and the 1990s, the demand for forest wood for fuels grew not as a result of the need for forest food for subsistence use but because of the increased demand for forest wood in the urban areas. In these two countries, the urban centers led in the demand for wood charcoal. As a result, a large tract of land was felled so that they can provide charcoal. Within the region, there have been cases of land division where the administrators are involved in the sub-division of the land of the forests into smallholder farms to be distributed to the farmers. The impact of this land division is that after some time, no land can be used for the regeneration of forests.

Lack of training of the forest staff also seriously impacts the conservation efforts. Monies by most East African governments are only directed towards agricultural activities as a matter of political expediency but the departments that are tasked with the protection of forests have little to no funds that can be used to fund research (Wu, 2011). The major landmarks, which also serve as the large water catchment areas in East Africa are also areas that have huge forest covers. These areas include the Ngorongoro crater, the Shompole Conservancy, Mount Kilimanjaro, Mount Kenya, and the Mau Forest.

2.0 MATERIALS AND METHOD

The data gained for this research was done through secondary research. The data was sourced from the Kenya Forest Research Institute, the Kenya Wildlife Services, Food and Agricultural Organization (FAO), the Kenya Forest Service, the Kenya National Bureau of Statistics (KNBS), the National Environment and Management Authority of Kenya (NEMA-Kenya). To examine the policies that have been put in place to protect the forests, the Constitution of Kenya will be one of the key sources of data. Besides government institutions, data was also obtained from Non-Governmental Organizations Reports and related research articles and journals. In the analysis and synthesis phase, the data obtained

were evaluated, discussed, interpreted, and analyzed from different angles to determine the effects of deforestation on the environment and agriculture.

3.0 RESULTS AND DISCUSSIONS

3.1 Deforestation Situation in Kenya

Kenya's forest cover stood at 10% of the total landmass of the Republic of Kenya in 1964. However, this has dropped to 6%. Also between the 1990 year and 2010, Kenya on average lost an estimated 12,050 hectares of forest land which accounts for about a 0.32 % reduction in the forest cover size every year (Buttler, 2010). This reduction is alarming and it is projected that it may reach a time when the forest cover in Kenya is only 3% and below. In Kenya deforestation has affected the five major water towers which are the Aberdares, the Mau Forest Complex, Mount Kenya, and Mount Elgon. These water towers, which have around it many forested areas often supply the water that is filtered to the country's largest lakes and rivers. However, it is estimated that between the years 2000 and 2010, the rate of deforestation in these areas led to reduced forest cover by 50,000 hectares. This has also reduced the availability of water by 62 million cubic meters in that decade (Kogo et al., 2019).

The rapid population growth in the country, coupled with the issues of urbanization has made Kenya's forest resources to be depleted at an alarming rate. In the Coast region, for example, the growth of infrastructural development particularly the building of the tourist resorts, the dams, and the hotels that are used for the tourist attracts have made large hectares of the mangrove forests to be uprooted(M, J. 2018).

In 2010, Kenya had 3.18Mha of natural forest, extending over 5.7% of its land area. In 2020, it lost 17.2kha of natural forest, equivalent to 7.68Mt of CO_2 of emissions. From 2002 to 2020, Kenya lost 49.4kha of humid primary forest, making up 14% of its total tree cover loss in the same period. The total area of humid primary forest in Kenya decreased by 7.6% in this period. From 2001 to 2020, Kenya lost 361kha of tree cover, equivalent to an 11% decrease in tree cover since 2000, and 176Mt of CO_2 emissions. In Kenya from 2001 to 2019, 2.6% of tree cover loss occurred in areas where the dominant drivers of loss resulted in deforestation. From 2013 to 2020, 80% of tree cover loss in Kenya occurred within a natural forest. The total loss within the natural forest was equivalent to 45.8Mt of CO_2 emissions. In Kenya, the top 6 regions were responsible for 52% of all tree cover loss between 2001 and 2020. Narok had the most tree cover loss at 72.4kha compared to an average of 7.84kha (Global Forest Watch, 2021)

Table 2: Kenya top regions with highest tree cover loss (2001-2020)

Region	Forest cover Loss
Narok	72.4kha
Nakuru	31.5kha
Kilifi	24.9kha
Lamu	21.0kha
Kwale	18.6kha

Source: Global Forest Watch, 2021.

Table 3 represents the annual loss of primary forest cover and tree cover for Kenya by year. All area figures are in hectares (ha). Over time, Kenya has been losing a huge amount of forest and trees cover. Between the years 2001-2018, Kenya has lost 13.8 of its primary forest and tree cover as indicated below.

Table 3:Primary forest loss and tree cover loss: Kenya

Year	**Primary forest**	**Tree cover (30%)**
2001		19,107
2002	2,974	20,399
2003	1,568	13,621
2004	2,974	17,053
2005	1,703	17,053
2006	3,340	20,743
2007	3,440	26,213
2008	1,887	19,296
2009	1,596	17,750
2010	6,749	22,770
2011	1,410	17,364
2012	1,664	17,977
2013	1,623	13,622
2014	1,210	15,404
2015	3,055	15,654
2016	2,052	19,114
2017	3,134	22,235
2018	2,649	15,965
Primary loss 2002-2018	43,029	
Tree cover loss 2001-2018		312,233
Primary loss/ Total tree cover loss	13.8%	

Source: Mongabay, 2019.

Among the Kenyan plains, the rise in deforestation hugely affected the plains and the wooden grasslands. The rising cases of drought in many parts of Kenya have also prompted increased cases of deforestation. In the country, long periods affect the livelihood of the

people (Reliefweb.net, 2021). As a result, it reaches a point when the people do not have sufficient amounts of food or economic activity and they turn to deforestation such as lumbering so that they can sell these trees to the people who use them as charcoal or they are further sold to the urban centers to be used as building materials (Reliefweb.net, 2021). In the Central region of Kenya, specifically in the towns of Nairobi, Kiambu, Thika, and Kajiado, there has been witnessed a widespread rise in real estate. The migration of people to these towns in a rural-urban migration scenario has prompted the need to build their houses for them to live in. This has led to the huge demand for timber in those towns and this has also precipitated the growing deforestation in the region.

Deforestation in the country has also negatively affected the nation in terms of the capital injections and the returns from the economic activities affected by deforestation. In 2012, the then Kenya's Minister of Forests and Natural Resources, Prof. Noah Wekesa, said that deforestation in that year deprived the Kenyan economy of 5.8 billion while only 1.3 billion shillings (Kenyan Currency) were injected into the economy from the logging activities (U.N Office for Coordination of Humanitarian Affairs, 2021).

3.2 Deforestation Causes in Kenya

Generally, the causes of deforestation in Kenya are as follows: there are unregulated charcoal products, there is logging and livestock grazing, human settlement, landholding problem in the country, commercial farming, and cutting trees from lands to be used for mining activities.

3.2.1 Unregulated charcoal production in Kenya

Statistics from the Kenya Bureau of Statistics have listed charcoal as the top two sources of fuel for Kenya, after firewood. The energy use in Kenya defies the energy ladder theory where it is estimated that with the growth of the disposable income in the country, among the households in Kenya, people should transition from the cheap sources of energy like charcoal and firewood to more sustainable sources of energy like the Liquefied Petroleum gas (LPG) and electricity (Ndegwa et al., 2020). From the data represented in the figure below, between 2005 to 2009, charcoal use in Kenya among the percentage of the population rose by over 12% from 13% to 25%. This data only reduced slightly between 2009 and 2015 (Ndegwa et al., 2020). There are many charcoal kilns in the country, particularly in the forests. With unregulated charcoal business which is a booming business, many people pass the roadblocks mounted on the roads and sometimes they bribe the police officers so that they can be allowed to pass through with the charcoal (Ndegwa et al., 2020).

Table 4: Primary sources of domestic energy in Kenya (2005-2015)

Fuel type	2005 (% population)			2009 (% population)			2015 (% population)		
	Overall	Urban	Rural	Urban	P-Urban	Rural	Overall	Urban	Rural
Firewood	68.3	10	87.7	7.9	71.3	92.9	54.6	16.1	84.3
Charcoal	13.3	30.2	7.7	68.8	25.5	4.8	14.6	21.9	8.9
Kerosene	13.2	44.6	2.7	14		1.4	14	29	2.3
LPG	3.5	11.9	0.7				13.4	27.6	2.5
Electricity	0.6	1.8	0.2				1	2	0.3
Other fuels	1.1	1.5	1	5		0.9	2.4	3.4	1.7

Source: Ndegwa et al., 2020.

3.2.2 Logging

The Logging problem in the country has been fueled by the increasing rise in demand for wood products by large construction companies and the trees that are cut in the country do not even meet the demand for the raw materials for furniture making and building (Collins, 2020). The need for wood is often met through importation from other countries and also through the local forests. A report by the African business report also states that the logging problems persist because the existing sawmill machinery and the factories are ill-equipped to deal with the need to process large amounts of trees efficiently. The problem with this logging is that the timber that is often harvested when it is irregular in size sometimes is ill-treated making timber in the country to be poorly priced (Collins, 2020). Because of this poor pricing mechanism, the dealers have to cut a lot of timber so that they obtain the needed returns on their investment (Collins, 2020).

Figure 2: Logging Kisumu, Kenya. Source: Tom Otieno /NMG, 2019.
HPA January 15 2022

3.2.3 Cultivation in the indigenous forests

When the cultivation in the indigenous forests occurs, deforestation occurs because large parcels of land are cleared to pave way for the occurrence of crop farming (FAO, 2020). With the increase in the population, the land available for farming is becoming thinner and thinner and as a result, a vast majority of the population is pushed into the forests so that they can carry out their farming and/or cultivation activities. The reduction in the Arable land per capita in the country has also been blamed for the increase in the cultivation in the forested areas. Statistics below show how arable land per capita has been decreasing over the years (FAO, 2020). As indicated in figure 2, arable land in Kenya has been in a declining trend since the 1960s, this has led people to cultivate more in the indigenous forests leading to loss of forest cover.

Year(Period)	Arable land per hectare
The 1960s	2.2
The 1980s	1.24
The 1990s	0.89
2000	0.66
2020	0.48

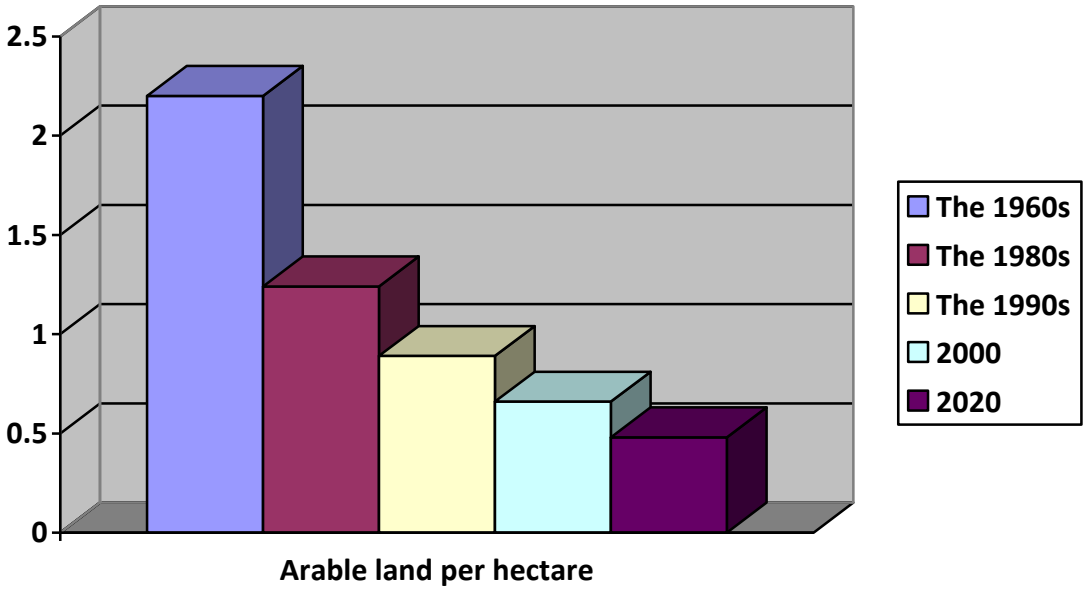

Figure 3: Arable land per hectare in Kenya

Source: FAO, 2020.

Aside from the cultivation in the indigenous forests, the problem of commercial farming has also led to deforestation. For example, there are many acres of land that have been cleared in the country to pave way for tea estates, the growth of the sisal, etc. In the Sugar producing belt of Kisumu, Kakamega, Muhoroni, and Bungoma towns in Kenya, in the

Western Region, the massive clearing of the forests and the bushes to give rise to the sugar cane plantations has led to deforestation in the region. In the counties of Kericho in areas such as Limuru, there are tee bushes that are standing currently in a place where there were large forests. Although there are policies that have been enacted to boost the production of sugar in the country so that the country can be food secure, these specific policies harm the growth of forests because even sugar cane farming uses a lot of fertilizers (Obidzinski et al., 2015).

3.2.4 Landholding problem

The rise in human population in the country both in the rural areas and the urban areas continues to put a strain on the forested areas and the large expansive lands. In the past, the land was bequeathed as a whole from generation to generation but with a high increase in population, land continues to be subdivided, and even then it is not enough. The subdivided land into plots makes it necessary to cut down trees so that other economic activities that can be supported by the small farms can be put in place. This has given rise to the high-cost plots of land in the urban and semi-urban areas that are exclusively used for residential purposes (Reliefweb.net. 2021).

3.2.5 Mining activities and livestock grazing

Intensive grazing of livestock on the shrubs and even the trees that would otherwise have formed forests in the country also contributes to deforestation. In Kenya, in the Laikipia plateau, in the Maasai Mara area, in the Lake Baringo Basin, and also in the Amboseli region, the Pokot region the number of pastoralist activities in the area have been blamed as the cause of deforestation. Most of these pastoralist communities own large numbers of animals especially cattle. With time, the growth in the numbers of livestock is not commensurate with the growth of the available land for grazing (Boles et al., 2019). Instead of grazing for a while and then leaving the grazing field with some time so that the trees and the grasses can be regenerated, the members of these communities carry out overgrazing leaving no vegetation on the ground.

Kakamega County in the western part of the country has been known as the gold rush area where conglomerates and even the local people often rush to take advantage of the gold in the area. However, gold causes siltation, covering the surface of the land with dust and the uprooting of the tree roots, the coloration of the stream water as a result of the finished wastes of the mining activities leads to insufficiency of water to be used in tree growth (Mulinya, 2020). The gaping holes that are found in the ground sometimes grow and this makes the ground not able to support any agricultural activities and hence there is no chance that the trees could be grown in the areas (Mulinya, 2020).

3.3 The Effects of Deforestation on the Environment and Agriculture

3.3.1 Desertification

The Northern Eastern and the Eastern Counties of Carissa, Turkana, Mandera, Marsabit, and Pokot have experienced desertification for a long time in Kenya. Because of desertification, the land is not suitable for crop farming activities (NEMA, 2020). According to Also, D. 2017, the persistence in the drought conditions has also made the land in these areas lack the resources to support any livestock keeping. Due to the increase in the levels of desertification in the region, many of the pastoralist communities have to travel long distances in the search of the elusive water and pasture to be used as a source of nourishment for their animals. As a result of this also, the animals sometimes become so malnourished to an extent that when they are sold they no longer fetch the high prices. Desertification hinders the development of these arid and semi-arid areas and when the current carrying capacity cannot exceed the amount of livestock in the area, livestock farming becomes a non-profitable activity (NEMA, 2020).

3.3.2 Soil erosion

Soil erosion leads to land degradation (Mulinge et al., 2015). Soil erosion is a serious problem in the country because at least 12 million people in the country live in lands that have undergone degradation. In The Manifestation of soil erosion in the country often occurs near the slopes of the mountains, close to the hilly areas, close to the riparian areas, and also banks of rivers and streams (Mulinge et al., 2015). When the trees are cut the soil is eroded to an extent that there is no loam soil available that can support the growth and the development of trees. Soil erosion in the country also comes at a cost. The rangeland degradation of land as a result of soil erosion is a factor that has reduced livestock farming because there is no grass on the surface of the earth. This leads to the reduced milk and meat production. Soil erosion in the country has also been noted as one of the threats to food security because the soil nutrients that would have otherwise supported wheat, rice, and maize farming are depleted (Mulinge et al., 2015).

3.3.3 Floods

Flood is the number 2 cause of the hazards in Kenya that affects or kills people as shown in figure 4 below, floods contributed 38% of total hazards in 2020.

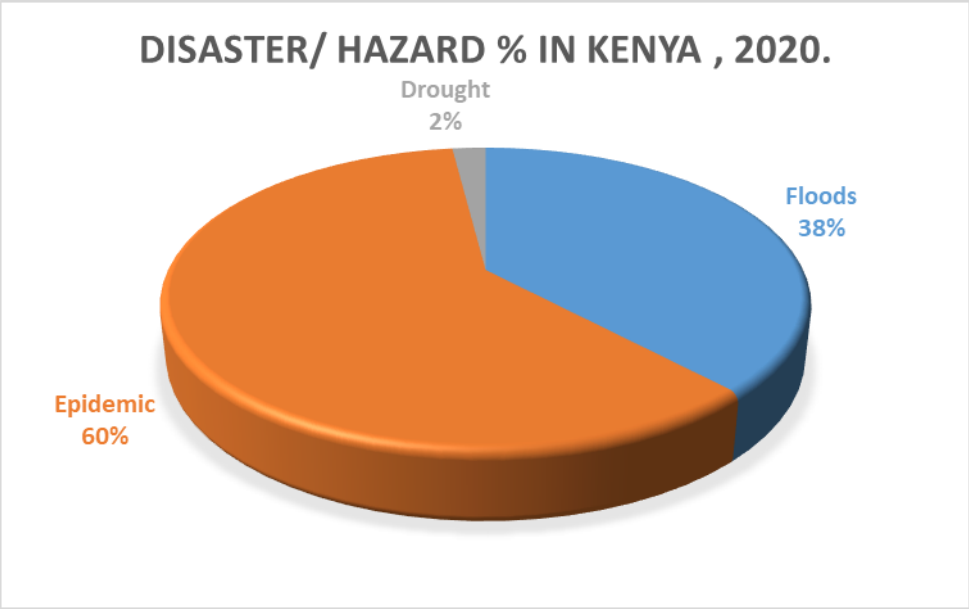

Figure 4: Disaster/Hazard % in Kenya, 2020

Source: Opere, 2020.

Deforestation in the Mount Elgon area for instance has caused the removal of trees that would have otherwise held and prevented the movement of the sediments of the soil (Opere, 2013). The accumulation of these sediments that often occurs over a long time leads to the expansion of the river bed and sometimes they change the course of River Nzoia which leads to the river bank sometimes breaking and the huge inflows of water seep into the neighboring lands. Flooding affects the environment because the flood water can be breeding grounds for pathogens that cause diseases such as the bilharzia and also it leads to the breeding of the female anopheles mosquito that wreaks havoc on the residents causing high incidences of malaria (Opere, 2013). If deforestation was not done especially in the Mountain slopes of Elgon, Suswa, and the Keiyo slopes, the tree roots would have held back the raging floodwater and reduced its speeds. The deposited silt as a result of the flooding causes the deposition of the black cotton soils which do not support agricultural production (Opere, 2013). Flooding also affects agricultural activities due to its destructive nature. The water destroys crops by breaking down. When the shoots and the seeds imbibe a lot of water due to floods, the quality of the yield is reduced.

3.3.4 Drought

Prolonged drought in 2016 in Kenya caused severe food shortages in the country. A report by UNICEF stated that in 2016, more than 4 million people were left without access to food as a result of the drought (Oloo, 2017). It was a real humanitarian crisis in the country as hunger, thirst, and disease almost left these people on the verge of death. The expansive large forests store moisture, it is this moisture that evaporates into the atmosphere leading to the formation of clouds that cause rainfall (Oloo, 2017). The forests also protect the soil

moisture which is often retained in the root systems of the trees. When these trees are cut, the rate of the diminishing of the soil moisture occurs at a similar rate to the rate of the diminishing of the clouds (Macdonald, 2018). Lack of formation of clouds leads to prolonged drought as the rain does not fall for long periods. With no rain, the planted maize, wheat, potatoes, and other crops, shoots shrivel and die up leading to low harvests. In maize production, for instance, the long periods of drought cause stress that makes it difficult for the seeds to germinate and flourish. Long periods of drought in the country are responsible for the occurrence of fluctuated crop yields in the country over a long time.

4.0 RECOMMENDATIONS

A diplomacy approach policy needs to be instituted especially among the communities that reside in the forest areas. This approach will be collaborative and the local people will be hugely involved in the resolution of some of the problems they may in sharing natural resources. The local community has been residing in the forested areas for a long time and as a result, they have gained useful experience in identifying plants and living in harmony with the wildlife. The government needs to tap into the natural experience of these local people and use them in the forest conservation process. They can do this by giving them incentives to plant even more trees and coordinating with the existing forest rangers to protect the existing trees.

The government has achieved is the creation of awareness through partnerships with international organizations like the United Nations (National Environment Management Authority (NEMA) -, n.d.). For example, the United Nations Convention on Combating Desertification works with the local government to train the local communities, the women, and the children for instance to better interact with the natural resources so that they can fully participate in activities that help in the restoration of the forest cover. Some of the key initiatives that have been taking place include the Desertification Day where the wide-ranging awareness programs are laid out and the members of the community are reminded of the need to be cooperative, collaborate, and actively engage in the environmental conversation activities (National Environment Management Authority (NEMA, 2020).

The Forest Conservation Act of 1980 has been the single-unifying policy of India that was adopted to protein the forest regions in the country and this act has yielded fruits and the same can be replicated in Kenya (Verma, 2020). The importance of the policy is that is a unifying piece of legislation and over the years it has achieved the following: it has promoted the protection of the territory, the individuality, and the economic value of the forests. It came with the penalties that prevented the forests from being converted into residential areas and plots. The centrality of the top authority in making some key decisions about the forests also made sure that the State and the local governments from coming up with their restrictions concerning forested areas (Verma, 2020).

In the country, the Forest Conservation and Management Act that appeared in the Kenyan laws as gazette notice number 34 was the single most still in force legal ban on the logging of trees. This act has helped in taming the indiscriminate logging of trees from the forested

areas but more needs to be done especially on the implementation of the ban so that it is more effective. Eradication of corruption and unfair business practices would help in the implementation of the ban(*Kenya Law | Kenya Gazette*, 2016).

Over time, other policies that have been implemented by the government of Kenya include the Kenya environmental policy that is designed by the National Environmental Management Agency, the acts that established the Kenya Forest Service which is a government-based institution that could help in the reduction of deforestation in the country. The government has also put together the Rangelands Management Policy which is tasked with the provision of guidelines to promote forestation in the Arid and Semi-Arid Areas, but not all these policies have been implemented by the government. The government had an ambitious plan of restoring the forest cover in the country to be about 10% or more through the Introduction of the Sessional Paper Number 1 on Forestry of 2007. This sessional paper focused on the threats that currently bedevil the forests in the region. However, the problem of urbanization and other threats that are emerging periodically reveals that there is a need for this policy to be updated so that it reflects the current threats (Ph.D. Candidate) et al., 2016).

The Supreme legislative piece in the Republic of Kenya is the Kenyan Constitution, Chapter 5 and section 69(1), sub-article (b), states that it's the mandate of the state to ensure that 10% of land forest cover is maintained throughout the country. Genetic resources and diversity protection is etched in Part e of the constitution of Kenya. Areas used in catching the water are identified in section 62(1) (g) of the constitution of Kenya and this also identified the presence of the national and game reserves which are placed under the public utilities. Besides them being public utilities, they can be managed and acquired by certain Kenyan communities. These communities may also use these forested areas as shrines. An Act of Parliament is the one that often specifies how forested and public land should be used. It is furthermore, the responsibility of the State government to ensure that the environment and the forests are properly managed, conserved, and exploited. Under this protection are also the natural resources (Verma, A. 2020).

The new constitution of Kenya 2010 states that both the national government and the country governments must join hands to ensure that the forests are protected. The 2015 Transitional implementation plan mandated all the county governments to come up with their strategies to be used in national goals of forest conservation. This work was supposed to be done in consultation with the Kenya Forest Service. Also, the same constitutional dispensation Chapter 5, section 69 (1) d, gives processes where people who live close to the forests to be allowed to take part in the forest conservation measures. Lack of clear forest boundaries is an issue in the nation. However, erected fences, to some extent have reduced human-animal conflicts. This policy helped to save forests from the increased encroachment of the people and exploitation. Some protected Kenyan forests include Shimba Hills National Park, Aberdares National Park, Mwea National Park, and Lake Nakuru National Park, etc. The provision of roads at the forest edges has also been said to be an activity that acts as a buffer zone. The establishment of the Nyayo tea zones has also led to the protection of the unique

species of trees and effectively made sure there is no encroachment of forests in the Aberdare forest. The 2007 KWS report on banning non-legal entry into Mount Kenya revealed some sure improvement where the 6013.5 forest land that had suffered the long periods of degradation is on the path of recovery after extreme deforestation was reported in 2003. In the Mount Kenya reserve, the stopping of the illegal cutting of trees in the 2003 to 2007 period was an efficient way of stopping the destruction of the forest ecosystem. Key programs of Forest conservation implemented by the National government over the years are as follows: (i) Forest Conservation and Management, (ii) Forest Plantations and Enterprise, and (iii) Farm and Dryland Forestry Development (Kenya Forest Service, 2015).

Forest conservation measures are also etched in the vision 2030, visionary development-based legislation of the government of Kenya. Vision 2030 Fourth Pillar is about the environment and it is stated as, "A nation living in a clean, secure and sustainable environment." This vision continues to identify some of the natural forest management practices that are unsustainable and which need to stop. Some of these unsustainable forest management practices include poaching, conflicts between human beings and wildlife, wrong policies, and a poor regulatory framework. The Vision 2030 proposes the following measures to protect the forests: conservation, pollution and waste management control and the land management in the Arid and Semi-Arid Areas, planning and good governance incorporation (Thugge, Ndung'u & Otieno, 2008).

The 2010 Kenyan constitution established the Transitional Authority which explains how the counties in the Kenyan Republic should manage the existing forest resources. County governments according to the constitution are supposed to ensure that housing estates are established where there is at least 5% of the landmass dedicated to forests. The establishment and the management of a recreational center is also a legally established mandate of the county governments. The 2012 Forest Charcoal Act of the County governments also gives them the power to regulate charcoal production in the counties. Each county may set up its bylaws and policies to implement the forest growth and development activities (Kenya Forest Service, 2015).

It is not only the forest policies in Kenya that can contribute to the reduction of deforestation in the country. Other vital policies include the Intensive Agricultural policies which propose intensive farming on a small piece of land rather than farming in a huge area. Also to be developed is a policy framework that reduces the incentives that are offered to the companies and the individuals who cut timber. In Kenya, without the support of the banking institutions that offer credit activities, not many people will be able to harvest timber. This policy should further be extended to a situation where the government is extremely strict on the people who carry out the illegal harvesting of timber. Bottlenecks should be instituted to make it extremely hard to obtain licenses to carry out deforestation. This will create a deterrence effect and discourage people from the indiscriminate cutting and harvesting of trees.

5.0 CONCLUSION

The importance of the forests to humanity cannot be overrated. Their responsibility in the maintenance of the ecosystem and promotion of continual economic growth has been well enumerated in the paper. Despite all this, a spike in deforestation closely linked to agriculture, rise in human population, logging, inadequate governance structure, fraud, fires in the wild, and poor living conditions have placed the people and the whole ecosystem at risk. Changes in the climate are attributable to deforestation.

As climate changes, like the floods, drought, and even the occurrence of cyclones rise. Deforestation also leads to soil erosion and a rise in the destruction of the soil biodiversity. Government institutions like the Kenya World Life Service and the Kenya Forest Service play a unique role, together with other international and NGO partners in coming up with measures that will successfully hinder people from encroaching on the forests. Some of these measures include banning tree logging, gazetting forests as protected areas, forest boundary marking, collaborative approach where the members of the public are involved in forest conservation, awareness of the public members so that they can know the existing rules, and regulations that govern forest conservation measures. The impediment is also a strategy of the authorities where physical boundaries are placed around the forests to prevent the people from encroachment on the forests and patrolling. Technology may also be involved in forest conservation specifically social media education approach and carrying out aerial surveillance to detect the encroachers on forests.

Creating awareness on how deforestation affects agriculture and the environment will be important to encourage them to comply with forest conservation programs and make informed daily choices. The government of Kenya has been planting trees over time but also it has imposed restrictions on logging and charcoal burning. The combination of environmental policies and agricultural policies will ensure there is sustainable agriculture and at the same time protect natural resources. Kenya National government has implemented different forest conservation programs such as Forest Conservation and Management, Forest Plantations and enterprises, and Farm and Dryland Forestry Development. These programs are not only working to reduce deforestation but also in reforestation and land reclamation. The programs align with Kenya Vision 2030 Fourth Pillar, achieving a country with a clean, secure, and sustainable environment.

Acknowledgment

There was no funding involved.

Author Contributions

Both authors contributed substantially to the research design, data collection, data analysis, write-up, and editing of the manuscript. The submitted version is checked and approved by both authors.

Conflict of Interest

The authors confirm that there are no conflicts of interest.

References

Also, D. (2017). *In Kenya, severe drought threatens to leave 4 million food insecure*. Unicef.org. https://www.unicef.org/stories/kenya-severe-drought-threatens-leave-4-million-food-insecure

Boles, O. J. et al (2019). Historical Ecologies of Pastoralist Overgrazing in Kenya: Long-Term Perspectives on Cause and Effect. *Human Ecology*, *47*(3), 419–434. https://doi.org/10.1007/s10745-019-0072-9

Buttler, R. (2010). *Kenya Forest Information and Data*. Rainforests.mongabay.com. https://rainforests.mongabay.com/deforestation/2000/Kenya.htm

Cesareo, K., Walker, L., Varela, J., & Smith, A. (2021). *Deforestation and Forest Degradation | Threats | WWF*. World Wildlife Fund. https://www.worldwildlife.org/threats/deforestation-and-forest-degradation#causes

Collins, T. (2020). *Kenya faces a timber shortage as demand for wood grows*. African Business. https://african.business/2020/11/energy-resources/kenya-faces-timber-shortage-as-demand-for-wood-grows/

Derouin, S. (2019). *Deforestation: Facts, Causes & Effects*. Live Science; Live Science. https://www.livescience.com/27692-deforestation.html

FAO and UNEP. 2020. *The State of the World's Forests 2020. Forests, biodiversity, and people.* Rome. https://doi.org/10.4060/ca8642en

Food and Agriculture Organization. (2020). *FOSA Country Report - Kenya*. Www.fao.org. http://www.fao.org/3/AB569E/AB569E03.htm

Harneis, J. (2018). *Mining in the DRC*. Cool Earth. https://www.coolearth.org/2018/09/mining-drc/

Kenya Law | Kenya Gazette. (2016). Kenyalaw.org. http://kenyalaw.org/kenya_gazette/gazette/volume/MTY2OA--/Vol.CXX-No.28/

Kenya Maize yield, 1960-2020 - knoema.com. (n.d.). Knoema. Retrieved June 10, 2021, from https://knoema.com/atlas/Kenya/topics/Agriculture/Crops-Production-Yield/Maize-yield

Kideghesho, J. R. (2015). Realities on Deforestation in Tanzania — Trends, Drivers, Implications and the Way Forward. *Precious Forests - Precious Earth*. https://doi.org/10.5772/61002

Kogo, B. K., Kumar, L., & Koech, R. (2019). Forest cover dynamics and underlying driving forces affecting ecosystem services in western Kenya. *Remote Sensing Applications: Society and Environment*, *14*, 75-83. https://doi.org/10.1016/j.rsase.2019.02.007

M, J. (2018). Deforestation in Uganda: Population increase, forests loss, and climate change. *Environmental Risk Assessment and Remediation*, *02*(02). https://doi.org/10.4066/2529-8046.100040

Macdonald, J. (2018). *Does Deforestation Lead to Drought? | JSTOR Daily*. JSTOR Daily. https://daily.jstor.org/deforestation-lead-drought/

Martins, F. S., Cunha, J. A. C. da, & Serra, F. A. R. (2018). Secondary Data in Research – Uses and Opportunities. *Revista Ibero-Americana de Estratégia*, *17*(04), 01–04. https://doi.org/10.5585/ijsm.v17i4.2723

McGrath, M. (2019). Deforestation: Tropical tree losses persist at high levels. *BBC News*. https://www.bbc.com/news/science-environment-48037913

Mongabay (2019). *Deforestation statistics for Kenya*. https://rainforests.mongabay.com/deforestation/archive/Kenya.htm

Mulinge, W., Gicheru, P., Murithi, F., Maingi, P., Kihiu, E., Kirui, O. K., & Mirzabaev, A. (2015). Economics of Land Degradation and Improvement in Kenya. *Economics of Land Degradation and Improvement – a Global Assessment for Sustainable Development*, 471–498. https://doi.org/10.1007/978-3-319-19168-3_16

Mulinya, C. (2020). *Gold Mining Industry and Its Implications on the Environment Kakamega South Sub-County, Kakamega County, Kenya*. ResearchGate. https://www.researchgate.net/publication/344908287_Gold_Mining_Industry_and_Its_Implications_on_the_Environmentin_Kakamega_South_Sub-County_Kakamega_County_Kenya

National Environment Management Authority (NEMA) - Desertification and Drought Day 2020. (n.d.). Www.nema.go.ke. Retrieved June 10, 2021, from https://www.nema.go.ke/index.php?option=com_content&view=category&id=2&Itemid=469

National Environment Management Authority (NEMA) -. (n.d.). *Desertification and Drought Day 2020*. Www.nema.go.ke. https://www.nema.go.ke/index.php?option=com_content&view=category&id=2&Itemid=469

Ndegwa, G., Sola, P., Iiyama, M., Okeyo, I., Njenga, M., Siko, I., & Muriuki, J. (2020). *Charcoal value chains in Kenya: a 20-year synthesis*. https://doi.org/10.5716/wp20026.pdf

Obidzinski, K., Kusters, K., & Gnych, S. (2015). Taking the Bitter with the Sweet: Sugarcane's Return as a Driver of Tropical Deforestation. *Conservation Letters*, *8*(6), 449–455. https://doi.org/10.1111/conl.12172

Onekindplanet.org. (2016). *Top 10 - The World's Most Endangered Animals - OneKind*. OneKindPlanet. https://onekindplanet.org/top-10/top-10-worlds-most-endangered-animals/

Opere, A. (2020). Floods in Kenya. *Developments in Earth Surface Processes*, 315–330. https://doi.org/10.1016/b978-0-444-59559-1.00021-9

Dr. E. W. (2016). Processes Of Track Three Diplomacy In The Management Of Cross-Border Security Relations Between Kenya And Somalia. *The International Journal of Social Sciences and Humanities Invention*. https://doi.org/10.18535/ijsshi/v3i7.03

Reliefweb.net. (2021). *Kenya: IRIN Focus on dangers of deforestation - Kenya*. ReliefWeb. https://reliefweb.int/report/kenya/kenya-irin-focus-dangers-deforestation

Reliefweb.org. (2014). *Kenya: Drought - 2014-2019*. ReliefWeb. https://reliefweb.int/disaster/dr-2014-000131-ken

Silva Junior, C. H. L., Pessôa, A. C. M., Carvalho, N. S., Reis, J. B. C., Anderson, L. O., & Aragão, L. E. O. C. (2021). The Brazilian Amazon deforestation rate in 2020 is the greatest of the decade. *Nature Ecology & Evolution*, *5*(2), 144–145. https://doi.org/10.1038/s41559-020-01368-x

U.N Office for Coordination of Humanitarian Affairs. (2021). *Kenya: IRIN Focus on dangers of deforestation - Kenya*. ReliefWeb. https://reliefweb.int/report/kenya/kenya-irin-focus-dangers-deforestation

Venkateswarlu, B., & Singh, A. K. (2015). Climate Change Adaptation and Mitigation Strategies in Rainfed Agriculture. Climate Change Modelling, Planning and Policy for Agriculture, 1-11. doi:10.1007/978-81-322-2157-9_1

Verma, A. (2020). *All you need to know about the Forest Conservation Act, 1980*. IP leaders. https://blog.ipleaders.in/need-know-forest-conservation-act-1980/

Vizzuality. (n.d.). *Kenya deforestation rates & statistics | GFW*. Forest Monitoring, Land Use & Deforestation Trends | Global Forest Watch.

Voumatter. (2020). *Deforestation - What Is It? What Are Its Causes, Effects, And Solutions?* Youmatter. https://youmatter.world/en/definition/definitions-what-is-definition-deforestation-causes-effects/

Wolosin, M., & Harris, N. (2018). Tropical Forests and Climate Change: The Latest Science. Ending Tropical Deforestation: A Stock-Take of Progress and Challenges, 1. Retrieved from https://wriorg.s3.amazonaws.com/s3fs-public/ending-tropical-deforestation-tropical-forests-climate-change.pdf

Wu, Y. (2011). *Investigation of Deforestation in East Africa on Regional Scales* [Undergraduate Dissertation]. https://www.diva-portal.org/smash/get/diva2:450729/FULLTEXT01.pdf9%20(Accessed

Yohannes, H. (2015). A Review on Relationship between Climate Change and Agriculture. Journal of Earth Science & Climatic Change, 07(02). doi:10.4172/2157-7617.1000335.