

Deforestation in Madagascar: Consequences of Population Growth and Unsustainable Agricultural Processes

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Abstract

Located in the Indian Ocean just off the east side of Africa, Madagascar is an island country struggling with problems of deforestation and soil erosion, like many other African countries. Deforestation is due in part to a rising need of using land for food production. However, as it turns out, deforestation has actually damaged Madagascar's agricultural prospects. Furthermore, deforestation in Madagascar is the source for a loss of habitats for unique species, an increase of carbon dioxide emissions, and soil erosion. This article provides an overview of Madagascar's deforestation crisis. It reviews Madagascar's loss of forests, the species at risk due to deforestation, and the negative aspects of deforestation on the local ecosystems and communities. The article also discusses some possible solutions for reversing deforestation in this country.

I. Introduction

Madagascar, the world's fourth largest island, is home to some of the world's most diverse and unique forests. However, Madagascar is struggling with severe problems of deforestation. Furthermore, Madagascar also suffers from soil erosion, largely due to deforestation and harsh agricultural activities that degrade the land. Although the degradation of the land in Madagascar has been ongoing, there has been little governmental concern about it (Harper et al., 2007). This kind of ongoing forest destruction is threatening thousands of species of animals and could possibly lead to their extinction (Harper et al., 2007). This kind of damage is long lasting and sometimes impossible to reverse.

Like many developing countries, especially in Africa, Madagascar is beginning to feel the consequences of unsustainable agricultural processes. As a result of a booming population and, hence, an increase in mouths to feed, agricultural production had received a priority over environmental protection. However, today, it is clear that unless Madagascar promotes

sustainable agriculture, its land will be negatively impacted and hurt long-run agricultural production.

This article focuses on Madagascar's deforestation. Following a brief literature review and some empirical background, the subject of deforestation in Madagascar is broken down in reviewing the causes of deforestation and discussing the main effects of deforestation in Madagascar. The article closes with some conclusions and suggestions.

II. Literature Review

There is a plethora of literature on deforestation in Africa. While there is far less literature specific on Madagascar's deforestation, it has still been discussed for many years now and is beginning to take on more and more sophisticated issues. The following paragraphs provide some examples of various media forms that cover Madagascar's deforestation, including academic articles, news articles, websites, films and atlases.

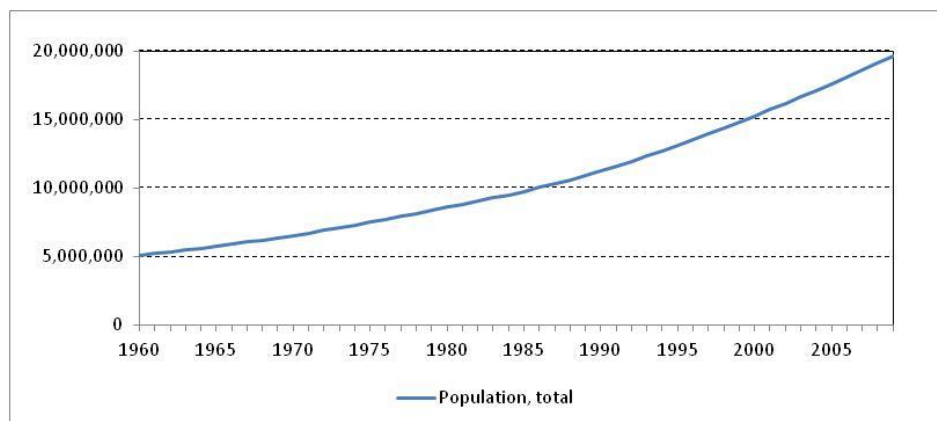
- The article entitled *Deforestation in the Madagascar Highlands—Established “Truth” and Uncertainty* by Jorgen Klein (2002) touches on many of the topics central to this article on deforestation in Madagascar. It discusses the relationship between humans and the environment, environmental change in developing countries, and specifically the problem of deforestation in Madagascar. It also includes how deforestation began in Madagascar.
- The article titled *Fifty Years of Deforestation and Forest Fragmentation in Madagascar* by Grady J. Harper et al. (2007) discusses a bit about deforestation regarding Madagascar's forests while detailing a study that mapped Madagascar into different types of forest cover. Although the study on forest cover was not as much of interest to this article, the information in the summary and introduction on tropical forests and deforestation is very useful. It also discusses the images taken of Madagascar with aerial photographs and gives specific information and percentages on the decreases in forest cover.
- In the news article in the British Daily *The Independent*, Daniel Howden (2007) explains the harsh reality of deforestation and what it means to us globally. It gives some good statistics about deforestation. The articles also explains why forests are a vitally important natural resource, how slash and burn techniques in Madagascar are damaging to the atmosphere, and how incentives for sustainable agriculture need to be put in place by the government.
- The website *Earth Trends* by the World Resources Institute (2007) gives country profiles for Madagascar concerning various themes, including biodiversity, protected areas, forests and grasslands.
- The Atlas edited by Rebecca Johnson and Munyaradzi Chenje (2008), published by the United Nations Environment Programme (UNEP), provides in-depth information on Africa's and Madagascar's geography, changing environment, ecosystems and protected areas, transboundary water resources, and transboundary movement of people and pollutants.
- Lastly, a film entitled *Madagascar: Agro-Ecology* by Films on Demand (2009) gives a

good background on Madagascar and the inhabitants that live there while also going into depth on sustainable agriculture practices such as direct sowing, mulch-based and conservation agriculture (usually referred to as DMC). It touches on the ways that Madagascar can improve their agriculture and decrease the deforestation and land erosion. It also discusses why the poor people who rely on agriculture don't always want to change their ways of agriculture to adapt more sustainable practices.

III. Empirical Background

Madagascar is the world's fourth-largest island, strategically located along the Mozambique Channel. Due to high population growth, which resulted in a four-fold increase in Madagascar's population during the last 50 years (see Figure 1), Madagascar has today about 20 million inhabitants, most of them are very poor. According to the latest data available by the World Bank (2011), in 2005, 68 percent of Madagascar's population lived below \$1.25-a-day and 90 percent of Madagascar's population lived below \$2-a-day. Fertility remains with an average of 4.6 children per woman very high in Madagascar (even though it is slightly below that of other developing countries in Africa (SSA), which have an average fertility rate of 5.0 births per woman).¹

Figure 1: Population of Madagascar, 1960-2009



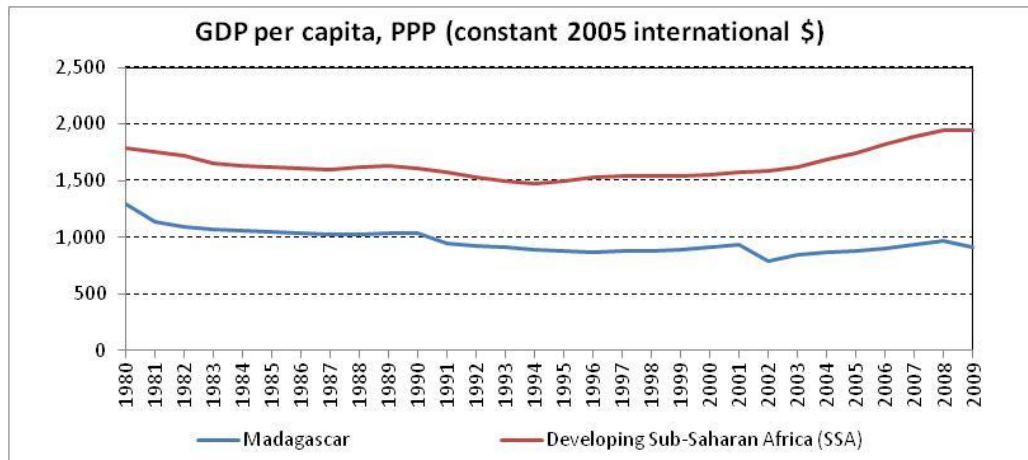
Source: Created by author based on World Bank (2011) *World Development Indicators* (as posted on the World Bank website; downloaded on June 7, 2011).

Figure 2 shows GDP per capita based on purchasing power parity (PPP) for Madagascar and SSA from 1980-2009. While Madagascar has always been poorer than the average SSA country, the difference between Madagascar and SSA has increased sharply during the last ten years. While GDP per capita (in constant 2005 international dollars) increased marginally from 1980 to 2009 for SSA, it actually decreased over the same period for Madagascar. Today, an average person in Madagascar earns less than half of an average person in SSA. The overwhelming majority of Madagascar's population lives in rural areas (70 percent) and works in agriculture: 81.5 percent of Madagascar's male employees and 82.5 percent of Madagascar's female

¹ World Bank (2011).

employees.²

Figure 2: GDP per capita (PPP) for Madagascar and SSA



Source: Created by author based on World Bank (2011) *World Development Indicators* (as posted on the World Bank website; downloaded on June 7, 2011).

In Madagascar, there is rampant illegal deforestation as a result of slash and burn techniques, conflicts over land, increasing cost of fertilizers, and poor productivity. The growing need for sustainable agriculture has become more present than ever in Madagascar, but has been placed too far down on the list of priorities.

IV. Definition, Degree and Causes of Deforestation

IV.1. Definition

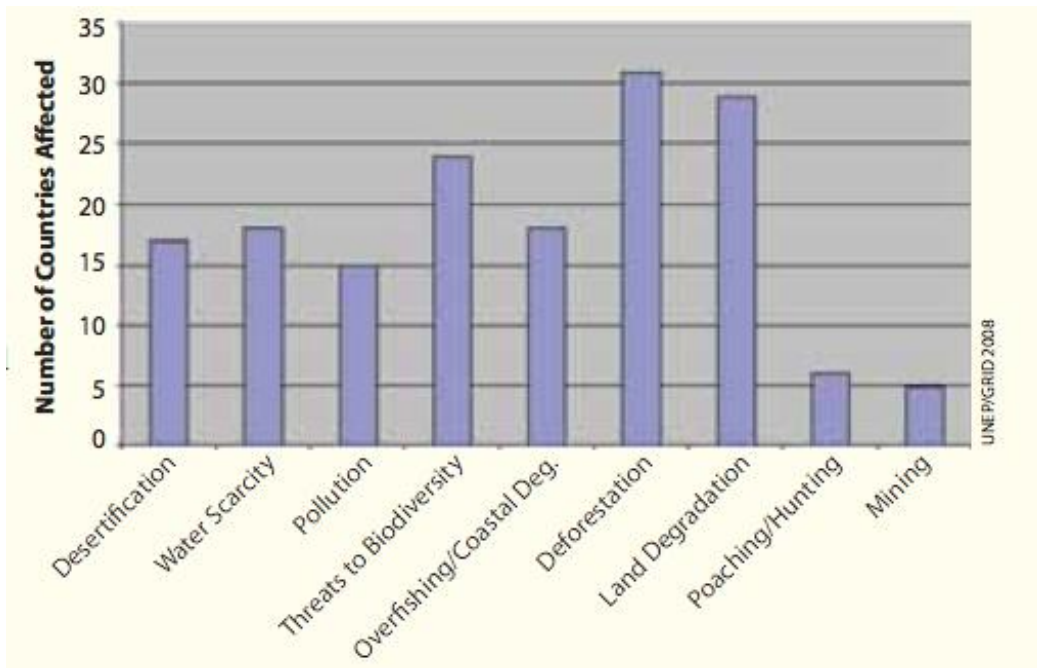
According to Johnson and Chenje (2008), deforestation is when a once forested area gets removed for the use of agriculture, pasture, urban development, logging, or wasteland. When this destruction of a natural environment occurs, a degraded ecosystem is likely to follow. A degraded ecosystem is the result of a loss of habitat and a reduction in biodiversity. Also, the erosion of soil is usually a consequence of deforestation.

IV.2. Degree of Deforestation in Africa and Madagascar

As shown in Figure 3, Africa, as a whole, is facing many environmental issues that need addressing, including desertification, water scarcity, pollution, threats to biodiversity, overfishing/coastal degradation, deforestation, land degradation, poaching/hunting, and mining. Based on the number of countries affected by these kinds of environmental issues, deforestation is the most common problem in African countries, followed by land degradation. In comparison to other continents, Africa is facing huge deforestation issues. The rate of deforestation is higher in Africa than in any other continent and of the ten countries in the world with the largest annual net loss of forested area, six are in Africa (Johnson and Chenje, 2008).

² World Bank (2011).

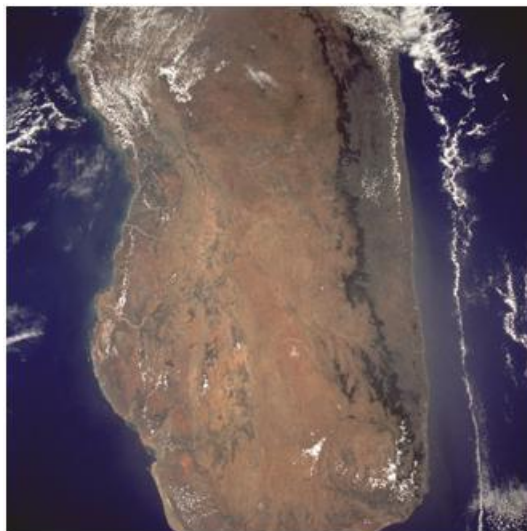
Figure 3: Examples of Important Environmental Issues in Africa



Source: Johnson and Chenje (2008).

Based on various studies that try to estimate Madagascar's previous forest cover, Madagascar has lost between at least 50 percent to about 90 percent of its forests throughout human history (see Johnson and Chenje, 2008). Figure 4 shows an image of Southern Madagascar, where, with the exception of a narrow line towards the eastern coast, basically all forest has disappeared.

Figure 4: Aerial Image of South of Madagascar

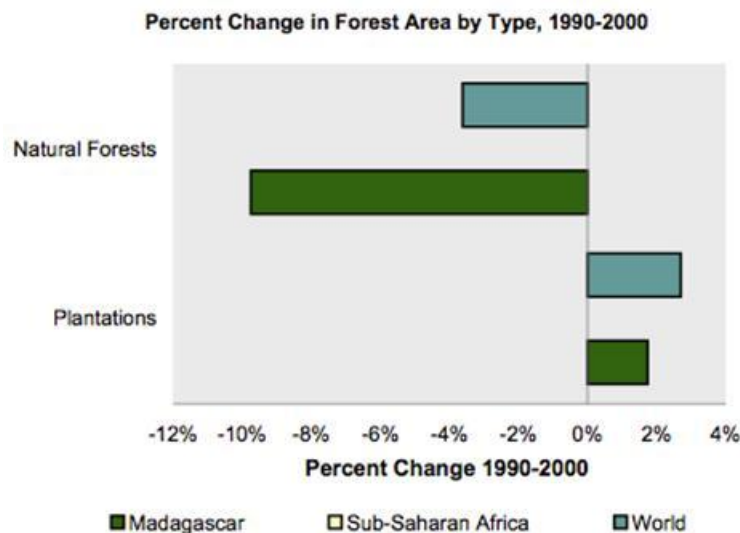


Source: <http://www.earthphotogallery.com/africa/south/madagascar.shtml>.

Based on an analysis of more recent aerial photographs, Harper et al. (2007) conclude that forests covered 27 percent of Madagascar in 1950, which declined to only 16 percent by 2000. That is a huge loss (about 40 percent) in a time span of only 50 years. This data conflicts however with World Bank (2011) data, which has put Madagascar's forests at 22.6 percent of all land area in 2005. Furthermore, according to World Bank (2011), Madagascar's recent deforestation has been less severe, with a decrease in forest area from 23.6 percent in 1990 to 22.6 percent in 2000 and 21.6 percent in 2010.

The World Bank (2011) data is also inconsistent with that of the World Resources Institute (2007) *Earth Trends* data, shown in Figure 5. Figure 5 shows the percent change in forest area, disaggregated for natural forests and plantation forest, in Madagascar as well as the world between 1990 and 2000. For Madagascar, natural forests declined by about 10 percent, while plantation forests increased by less than 2 percent; hence, there is an overall loss of 8 percent between 1990 and 2000. At the global level, natural forests declined by about 4 percent, while plantation forests increased by about 3 percent.

Figure 5: Percentage Change in Forest Area by Type, 1990-2000



Source: World Resources Institute (2007) *Earth Trends: The Environmental Information Portal*.

Despite some debate about the degree of Madagascar's deforestation, it has been largely agreed upon that the highlands of Madagascar were almost completely forested at the time of human settlement and have been gradually deforested as a result of human activities (Klein, 2002). Research has proven this hypothesis through the presence of tree trunks and tree fruits when discovering fossils of extinct animals (Klein, 2002). Also, pollen spectra dated from about AD 1000 can be interpreted as being from forest vegetation, proving that forests did once cover land that is no longer forested (Klein, 2002).

In conclusion, there is no disagreement that forests once covered a majority of Madagascar, but the exact percentage it is debatable. Despite the disagreement about the amount of forested land that used to exist on Madagascar, it is evident that the deforestation that has been ongoing in

Madagascar for centuries.

IV.3. Causes of Deforestation

Most of the causes of deforestation, including logging, land conversion to agriculture, wildfires, cutting down trees for firewood, and conflict over land rights tend to be caused by increased population growth and a need for more land mostly for agricultural production (Johnson and Chenje, 2008). Increased population growth is also the primary cause of deforestation in Africa and certainly in Madagascar.

Most of the deforestation in low income countries is carried out via slash and burn. Slash and burn is an agricultural technique that involves the cutting and burning of forests to create fields (Klein, 2002). It is a practice that has existed for hundreds of years. Slash and burn requires little technology or tools because it mainly relies on the use of fire to burn down forests. The practice of slash and burn techniques has always been a central element in Madagascar's traditional environmental management (Klein, 2002).

V. Main Consequences of Deforestation

V.1. Temporary Increase in Agricultural Production

Burning of pastures has always been a useful tool for the farmers because it works for them in the short-run, which is what most subsistence farmers are concerned with in Madagascar. Burning aids farmers with fertilization, space for new production lands, and even wards off invading locusts and rats (Klein, 2002). The ash from the burning of the trees fertilizes the soil and makes crops easy to plant at the beginning of the next rainy season (Klein, 2002). However, after a few seasons, the soil quality begins to decline and can no longer support crops. When this occurs, farmers usually are forced to abandon the fields and move on to new forests and repeat the process all over again.

The continuation of slash and burn techniques in society today is hugely detrimental because the effects are long lasting and difficult to restore. Still, many farmers in Madagascar strongly believe in the traditional methods of farming, even if those methods are hazardous to the environment and lead to increased deforestation. Slash and burn techniques has generated huge amounts of conflict between the local farmers and the government for over a hundred years (Klein, 2002). The conflict of slash and burn techniques is a parallel to the conflict between the western scientific view of agriculture and the traditional land-use methods of peasant farmers (Klein, 2002). Although the local farmers are the ones using slash and burn techniques, they are also the ones who are feeling the impact of these techniques the most in the long-run.

V.2. Land Erosion and River Contamination

Deforestation also leads to detrimental land erosion. Erosion in Madagascar is severe and exists on a large amount of hillsides and on slopes (Klein, 2002). The gullies of Madagascar's highlands have erosion rates that are about seven times the global average (Klein, 2002). This erosion on hillsides and gullies leads to extensive amounts of sediment in streams and rivers and causes a major problem for farmers. This kind of extensive deforestation in Madagascar is a good indicator of the types of erosion that can form when lands have been extensively degraded. Deforestation also leads to drought as the land is eroded and trees do not block the pathway of water or soak in the water. Instead, the water picks up sediment from the ground and overflows

the rivers into people's crops. This kind of overflow can contaminate crops and result in poor food quality. In Madagascar, many poor farmers are facing this problem as many of their rivers are contaminated with sediment (Films Media Group, 2009).

V.3. Emission of Carbon Dioxide

Deforestation impacts the global carbon cycle as a result of an increase in carbon released when trees are cut, burned, or decomposed. The increase in carbon adds to the problem of global warming. Forests soak in the carbon dioxide in the environment and essentially are the thermostat for the Earth (Howden, 2007). The damaging slashing and burning technique that many people carry out in Madagascar and around the world is the second largest source of emission of greenhouse gases. It is second only to the burning of fossil fuels. Deforestation has become such a problem of epic proportions that scientists are going as far to say, "one days' deforestation is equivalent to the carbon footprint of eight million people flying to New York" (Howden, 2007).

V.4. Endangered Species

Deforestation leads to the destruction of natural habitats, the endangerment of species, and the decrease in earth's biodiversity. Forests contain 60 percent of the earth's biodiversity and forests supply us with over 25 percent of our medicine from tropical plants (Howden, 2007). Globally, Africa's forests are needed for climate regulation and sanctuaries for an abundance of species and plants (Johnson and Chenje, 2008).

As a result of the loss of Madagascar's forests, an estimated 8,000 endemic species have been put at risk (Johnson and Chenje). Madagascar and the Indian Ocean Islands are home to exceptional biodiversity. Eight plant families, four bird families, and five primate families are found in these places and nowhere else on Earth (Johnson and Chenje). Madagascar alone has more than 50 lemur species, although 15 have become extinct as a result of human action (Johnson and Chenje). This kind of biodiversity needs to be protected or else more species will go extinct.

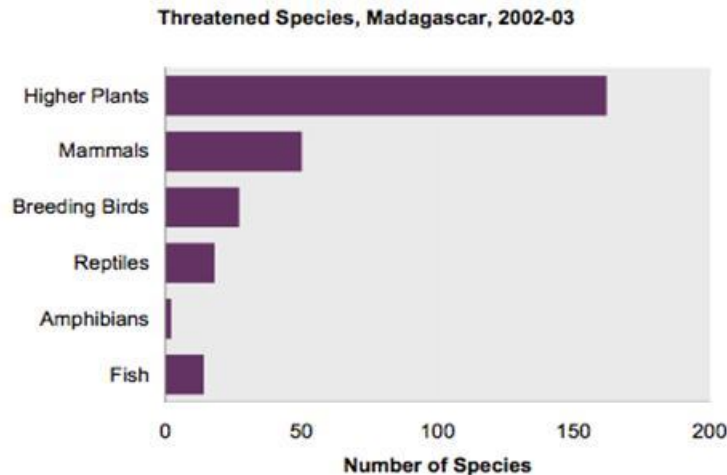
An example of a species found in Madagascar that has been lead to near extinction is the pinstripe dambo. The pinstripe dambo is a type of fish that used to be found in a small region of Madagascar but now most of the population of this species can be found only in captivity. It is guessed that this species is completely extinct in its natural habitat. This extinction is due mostly to deforestation, introduction of foreign species, and overfishing (Johnson and Chenje). There are many species like the pinstripe dambo that have faced extinction, or actually have become extinct, due to human actions of chopping down forests and destroying these animals' natural habitat.

It is vitally important to stop deforestation in Madagascar to prevent the loss of certain animal species. More than 90 percent of Madagascar's endemic animal species live exclusively in the forests (Harper et al., 2007). Forests are the natural habitat for so many species in Madagascar that the issue of deforestation becomes not just a problem for us humans, but also an even bigger problem for all the animals that depend on the forests. The forests of Madagascar are some of the highest priority areas in the world for biodiversity conservation (Harper et al., 2007). This alone is reason enough to put an end to this rapid deforestation. Also, there is a delayed effect of species extinction following habitat destruction where the results of deforestation on species are

not seen until a later time. This could mean that many species in Madagascar are living on “borrowed time” and could be nearing extinction (Harper et al., 2007).

Figure 6 shows the species that are threatened by extinction in Madagascar. Table 1 shows the species richness in Madagascar. Both Figure 6 and Table 1 give a visual example of how diverse Madagascar really is in terms of different species and represent why these species need to be protected.

Figure 6: Threatened Species, Madagascar, 2002-2003



Source: World Resources Institute (2007) *Earth Trends: The Environmental Information Portal*.

Table 1: Species Richness and Endemism in Madagascar

Table 1 Species richness and endemism in Madagascar.

<i>Taxon</i>	<i>No. of species</i>	<i>% Endemic</i>	<i>Source</i>
Plants	12 000	85%	Gautier & Goodman (2003)
Birds	209 (breeding)	51%	Hawkins & Goodman (2003)
Mammals	117	90%	Garbutt (1999)
Reptiles	346	>90%	Raxworthy (2003)
Amphibians	199	99%	Glaw & Vences (2003)

Source: Harper et al. (2007)

VI. Conclusions and Suggestions

Although Africa has a large population that is increasing rapidly, the constant chopping down of forested areas to convert to agricultural land needs to either decline or use more sustainable methods. Converting forests to farms is obviously necessary for food production, but soon the environmental impacts resulting from the degradation of land will be too much to bear for the people in Madagascar and other developing countries. Habitats will be lost, species will die off, the carbon cycle will be negatively impacted, global warming will increase, and a decrease in

arable land will result.

Deforestation is a serious subject for the world and for developing countries such as Madagascar. The people of Madagascar depend on their local forests for shelter, food, energy, shade, medicine, soil protection, and much more. The animals of Madagascar also depend on the forests to continue living. As evidenced by the pinstripe dambo, many species of Madagascar are suffering from the poor agricultural procedures and the growing human population. Unless something is done to decrease deforestation, the people of Madagascar may find themselves without any kind of forest and will become increasingly susceptible to global warming.

The parts of Madagascar that have already been deforested act as a sort of warning sign of what will happen to the rest of the forests on the island if action is not taken (Klein, 2002). The deforested land also acts as a warning sign to other countries going through similar problems. The deforested areas of Madagascar fully exemplify the consequences of deforestation on a population and on the land. The effects of deforestation have not only been severe on environment, but also on the local people and species. Deforestation impoverishes not only the land, but also the people (Klein, 2002).

The government of Madagascar has not approached the problem with the correct methods. So far, the main approach of the government has been to discourage deforestation through taxes and fines. This approach has not only been unsuccessful, it actually has impoverished the farmers further. The end result is increased amounts of poverty and a continuation of slash and burn techniques due to the fact that poor farmers often have no other choice than to use unsustainable farming methods (Klein, 2002).

In order to work against deforestation in the future, conservation programs must work with the local farmers, because without their participation in the fight against deforestation, nothing can be accomplished. We must integrate local communities into the environmental policy and provide further incentives for sustainable agricultural practices (Klein, 2002). Most importantly for Madagascar, we must halt further primary forest clearance as soon as possible and work towards forest restoration (Harper et al., 2007). Also, a continuation of support for halting deforestation must continue through increased education and understanding of deforestation in Madagascar (Harper et al., 2007). Without continued support for this cause, nothing can or will be done since the people of Madagascar will not be able to fully end the deforestation themselves.

Madagascar needs to work toward sustainable agriculture methods such as direct sowing, mulch-based and conservation agriculture (DMC). DMC does not require farmers to plant the land anymore, instead with DMC, farmers let the stocks rot and fertilize the soil naturally and form a protective layer over the ground. Through DMC, farmers do not need to use harmful fertilizers or pesticides, but instead they are cultivating the soil sustainably. DMC also requires a certain kind or organization of crops by putting certain plants with crops of interest. This prevents erosion and creates better quality food. However, not all farmers are convinced of the benefits of DMC. The biggest problem of DMC is educating farmers on how DMC can help boost their crop production while protecting the environment, and convince them to change their ways. Many farmers have become attached to traditional farming techniques and therefore, it is difficult to convince them to change their ways.

A related problem is that most poor farmers do not own the land they farm on, so they do not care much about long-term benefits of their farming. More solutions to reduce deforestation and

promote better farming methods are to promote stronger property rights and increase government involvement in sustainable agriculture through laws against techniques such as slash and burn that damage the environment. If farmers actually own the land they farm, they will be less likely to erode the land and make efforts to protect it.

If government involvement creates the incentives for sustainable agriculture and develops laws against deforestation, then huge progress can be made and the rate of deforestation can be decreased.

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