

Sustainable Horticulture Crop Production in Madagascar

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Figure 1. Baobab Trees (*Adansonia digitata*) (Google Image, 2010)

Introduction

Madagascar is one of the most unique places for biodiversity and agriculture within the world. Located off the coast of Mozambique, a south-eastern country in the African continent, Madagascar is the fourth largest island on the Earth and lies on the latitude and longitude lines of twenty degrees South and forty-seven degrees East in the southern hemisphere. While the temperature conditions may be suitable for the majority of the country to produce agriculturally year round, much of the land contains mountainous terrain with extensive elevation change. In addition to infrequent elevations, rainfall is fairly inadequate and irregular, leading to a loss of land use for agricultural practices at any given time (Madagascar-Agriculture, 2009).

Madagascar has one of the highest levels of biodiversity in the world, as it contains a total of eight plant families, four bird families, and five primate families that live nowhere else on Earth. Because of this, there are a number of different wildlife preservation projects within the country (Lovegren, 2007). The country is inhabited by roughly seventeen million people, thirty percent of which live in urban environments. This means that the majority of the population is located in rural areas. Most of Madagascar's population lives on no more than one U.S. dollar per day, thus poverty is a major issue that has plagued the country for decades. Madagascar's natural resources include graphite, chromite, coal, bauxite, salt, quartz, tar sands, semiprecious stones, mica, fish, and the use of hydropower. However, Madagascar's main source of income is agricultural, an industry that employs nearly seventy-five percent of Madagascar's work force (Madagascar-Agriculture, 2009). The primary food crops of Madagascar are maize, rice, sweet potatoes, potatoes, groundnuts, cassava, and oranges. The primary cash crops include vanilla, cloves, coffee, cotton, cocoa, sugarcane, and sisal. Out of these crops, Madagascar profits the most from vanilla and cloves.

Thesis

This paper will examine Madagascar's definition of sustainable practices within agricultural production, as well as the implementation of sustainability. Finally, this paper will explore the current production statistics of Madagascar and help to give insight into expanding the country's agricultural and economical market.

Sustainability: Unconventional Definitions

Madagascar defines sustainability in terms of ecotourism. Since Madagascar is a major tourist destination for its diverse biology and national parks, the Republic of Madagascar focuses on bringing a positive influence to its environment. Sustainable tourism is defined as providing a benefit to the people and having a low impact on the environment of the tourists' destination. Since Madagascar has been slow to develop economically, the country can not afford many of the western practices of sustainable agriculture. Sustainable crop production, such as low input/high output crop yield based on cultural, chemical, and ecological treatments is just one example of what Madagascar's farmers do not take into consideration when raising products (Townsend, 2006). Due to this limiting factor of money, Madagascar's government focuses its sustainability efforts on the tourism industry in order to bolster the economy and decrease poverty rates while doing no harm to its ecosystems. The focus of sustainable ecotourism has led to a number of different practices implemented within Madagascar. For instance, Madagascar's National Parks gives one-half of their revenue from entry fees to local communities around parks. A number of businesses in Madagascar have initiated projects in collaboration with communities to develop a sustainable tourism partnership: to date there are a

significant number of community based tourism sites around Madagascar to improve sustainability of ecotourism. Furthermore, a number of European countries have helped Madagascar build up tourist-friendly sites and programs to encourage tourism (Townsend, 2006).

In addition to ecotourism sustainability, Madagascar is apart of the UN's Agenda 21 movement, a program that encourages sustainable development in nearly 180 nations worldwide.

The objectives of Agenda 21 are to

“...conduct a national review economic, sectoral and environmental policies, strategies and plans to ensure the progressive integration of environmental and developmental issues; to strengthen institutional structures to allow the full integration of environmental and developmental issues, at all levels of decision-making; to develop or improve mechanism to facilitate the involvement of concerned individuals, groups, and organizations in decision-making at all levels; and to establish domestically determined procedures to integrate environmental and developmental issues in decision-making” (UN, 2010).

The UN plans to accomplish these goals by helping with finance, researching environmental and developmental interactions and giving feedback, enhancing education and training, promoting local awareness, and strengthening the national institutional capacity (UN, 2010). Currently, Madagascar is in the development process, thus Agenda 21 actions have not yet been implemented within the country. However, in terms of sustainability, Madagascar will benefit highly from Agenda 21 in the upcoming years.

The efforts in Madagascar for sustainable ecotourism and the Agenda 21 movement are encouraging; however, due to lack of communications within the country, the projects have not yet produced any type of significant difference within the county's ecosystems or community

poverty rates. Despite this, the expectations of these programs are high and are said to increase Madagascar's economy and lower poverty rates greatly over the next couple of decades. This, in turn, will generate revenue for the country and allow them to obtain more sustainable technologies in crop production and agriculture (Townsend, 2006).

Agricultural Practices: A Painful Past

Madagascar's past agricultural methods are vastly different from those found in the United States. Structures such as greenhouses, low tunnels, high tunnels, and growing chambers have not been introduced to Madagascar due to the cost of such equipment and the cost of teaching farmers to use such equipment (Townsend, 2006). This leaves open fields for crop production, which unfortunately, due to lack of space within the country need to be constructed at the cost of demolishing the land. Thus, the largest agricultural practice that plagued the country for generations, and to some extent continues to this day in Madagascar, is the "slash-and-burn" methodology. Slash-and-burn agriculture is when brush and forest are cleared to make way for production, due to older fields no longer being able to support farming. One major problem with this past method is that it threatened the extensive wildlife present in the country's forests, thus going against the country's current ideals of sustainability and ecotourism (USAID, 2009, B). However, with farming being such a major part of the country's economic value, it was hard for the government to refuse this practice for agricultural land. Another negative issue with the slash-and-burn method is that it causes erosion and degradation of the soils, which reduced the forest area and coincidentally raised poverty rates due to the lack of living space provided for the farming (Cornell, 2007). The logging industries in Madagascar have not helped this issue either. "Black-market" wood from Madagascar use to be shipped out of the country

daily for a premium price. This type of demand set by the rest of the world for this wood only fed the method of slash-and-burn tactics (Brown, 2004). While these methods have nearly been eradicated, the United States Agency for International Development (USAID) has stepped in over the past decade and tried to completely eliminate slash-and-burn agriculture and illegal logging by working with the government and introducing new, more sustainable practices.

Current Production Statistics

Even though Madagascar may not be up to date with western agricultural practices, the industry still produces a lot of goods to be exported and distributed throughout the world. Agriculture in Madagascar produces roughly thirty percent of the country's GDP and employs seventy-five percent of the work force (Townsend, 2006). Major cash crops include: potatoes (*Solanum tuberosum*) at nearly 285,000 metric tons; cassava (*Manihot esculenta*) around 2,435,000 metric tons; bananas (*Musa acuminata*) at 265,000 metric tons; sweet potatoes (*Ipomoea batatas*) at 520,000 metric tons; and oranges (*Citrus sinensis*) at 85,000 metric tons, earning the country around 9.5 million U.S. dollars or 19 440.0449 Malagasy Franc. Madagascar is the world's leading natural vanilla (*Vanilla planifolia*) producer weighing in at about seventy-five percent of the entire global market (Madagascar-Agriculture, 2009). The second largest export crop that Madagascar produces is cloves (*Eugenia caryophyllata*). Around 17,000 metric tons of cloves are exported each year for a value of 88.5 million U.S. dollars or 190 080.4391 Malagasy Franc. Other cash crops that are significant to Madagascar's agricultural market include: peanuts (*Arachis hypogaea*) around 34,000 metric tons; sisal (*Agave decipiens*) at 18,000 metric tons; seed cotton (*Gossypium spp.*) exporting 33,000 metric tons; and cocoa (*Theobroma cacao*) around 4,000 metric tons. Pepper (*Capsicum spp.*) is another

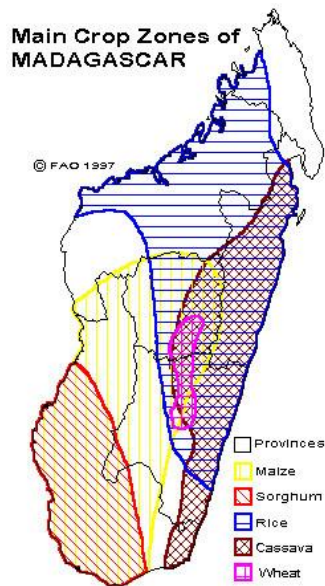


Figure 2. Madagascar Crop Zones (Food and Agriculture Organization of the United Nations, 2010)

important export crop that grosses 1.2 million U.S. dollars (2 160.0050 Malagasy Franc) at nearly 635 metric tons. Madagascar's total GDP is valued around 13 billion U.S. dollars or 28 080.0649 Malagasy Franc (Madagascar-Agriculture, 2009). Figure 2 illustrates a small portion of zones that are used to produce some of these crops.

Hope is on the Way

For many years, many of Madagascar's towns have been deprived of electricity and clean water. It has been noted that Madagascar is one of the world's poorest and most underdeveloped countries. Primitive agricultural techniques are used and there is little knowledge on how to successfully grow a variety of crops in an efficient and sustainable way. However, with the help of other countries, the UN, and Madagascar's 2002 elected president Marc Ravalomanana, an uncorrupted, liberal leader committed to forward progression for his country, Madagascar has made many strides in bringing itself into the 21st century from an agricultural standpoint by implementing more modern growing techniques.

Present Agricultural Practices: Modernizing Old Methods

Current production practices in Madagascar have been largely influenced by USAID. The Agricultural Diversification Program (ADP), created by USAID, has influenced the farmers of Madagascar immensely, by teaching more efficient and sustainable methods of crop production, correct food safety procedures, and business development services to obtain profit

from crop production. Techniques such as agricultural diversification and crop rotation have enabled the farmers of Madagascar to establish permanent land to produce crops. Thus increasing the intensity of crop security for their families. This in turn reduces the amount of slash-and-burn practices that still can occur within the country (USAID, 2009, B).

For Madagascar, agricultural diversification targets farmers to grow a variety of crops on the same farmlands throughout different seasons. By using this method, farms generate more profit, provide more jobs to its community, and allow for better food safety practices (USAID, 2009, A). In addition, USAID hopes that this increase in income will stimulate farmers to research and purchase newer agricultural technologies that are sustainable and generate positive effects on the surrounding environment.

Crop rotation or crop sequencing is a process of growing dissimilar crops in a relatively close area over a number of seasons. Crop rotation is used to prevent a pest or pathogenic outbreak that would more than likely kill an entire field if only one crop was planted. Crop rotation also plays a vital role in maintaining healthy, fertile soils and balanced nutrient levels, a problem Madagascar has had trouble with in the past.

Even though Madagascar's agricultural practices are relatively low-tech, the current trends in crop production, being agricultural diversification and crop rotation, help to eliminate the threat of slash-and-burn agriculture while also producing more positive crop yield. In addition, compared to slash-and-burn methods, agricultural diversity and crop rotation are considerably more sustainable from a land use, and input/output standpoint. These new methods introduced in Madagascar will hopefully stimulate the economy and eventually encourage new types of equipment to be used in production practices.

Production Practices: Ranked

Madagascar's past agricultural practices included open field farming with one crop until the land was bare and infertile. After this occurred, slash-and-burn methods (See Figure 3) that disposed of a rich biodiversity within the country were used to create space for more fertile farm land to feed its people and generate products for exportation. More recently, the people of Madagascar have accepted help from the UN, USAID, and other countries to adopt more sustainable and affordable methods of crop production, including agricultural diversification and crop rotation as well as Agenda 21's standards that will start being implemented within the next decade. Even though we in the United States may consider these methods to be somewhat primitive as they have been around for a while in our country, in Madagascar they are relatively new and on the forefront of progression. Ranking these methods would leave the slash-and-burn method of agriculture as the lowest level of sustainability possible while single crop production on an open field would be ranked as the second lowest. The top choices for sustainable agricultural practices in Madagascar are agricultural diversification and crop rotation due to the



Figure 3. Slash and Burn Agriculture (USAID, 2009)

advantages they produce. Figure 4 shows a farm where crop diversity is present creating healthier soils, less pathogens, less insect infestation and farm land stability. These are all sustainable outcomes of the two methods and will eventually lead to higher sustainable practices



Figure 4. Crop Diversity (Madagascar-Agriculture, 2009)

and better profit benefiting the country's people.

Sustainable Strategies

As a number of the current practices in Madagascar are, and will never be considered sustainable according to the definitions previously mentioned within this paper, only a few of the practices remain to be declared as finalized sustainability development strategies. These sustainable strategies are crop diversification and rotation. Crop diversification and rotation will allow the land and crops used for agricultural practices in Madagascar to remain healthy over a number of years. This process will also provide different types of crops to be raised in a single area. Economically, crop diversification and rotation has the potential to create more profit and jobs to the surrounding communities. Although these agricultural practices are good ideas to implement within a country such as Madagascar, physically doing so is a more challenging task. This is not due to cost-effectiveness or profitability, but rather to the lack of standards, legislation, and enforcement that the country may be able to provide. Even though Madagascar has made large strides in securing a healthy environment through industrial and political realms, the government is still largely corrupt, its people are still predominately poor and uneducated, and its land is still being destroyed everyday due to loggers and slash-and-burn agricultural

methods. Thus, the biggest constraint of this simplistic sustainability method is implementation and enforcement.

To accomplish this task, organizations such as the UN and USAID must first teach the agriculturalist of Madagascar the proper ways to grow, produce, and manage their farmlands. Hopefully, if the owners and top officials of the industry are taught the correct ways to grow in sustainable fashions, this knowledge will trickle down to the field workers. The next step is to enable government officials to see how critical implementing regulations and laws will positively affect the country. By doing so, Madagascar could eliminate practices such as the slash-and-burn method for good through enforcing new regulations.

As with any proposal, there are limitations and gaps in our understanding of what can ultimately be done. For one, there are no real records of top agricultural producers within Madagascar. A lack of infrastructure within the country and agricultural industry will present problems when trying to implement new strategies. Another piece of knowledge missing is the amount of enforcement that can be used to overlook these potential regulations and laws. Critical information such as this must be gathered and analyzed in order to take action in implementing a sustainable developmental strategy. Overall, Madagascar only has the potential to become more sustainable and profitable, the hardest task is structuring its people and businesses to do so.

A Future Sustainable Facility

Seeing as Madagascar has an average temperature of 14.5 degrees Celsius in July and 21.5 degrees Celsius in December, a need for a high tech greenhouse facility is non-existent. This tropical climate on top of 60 to 120 inches of rainfall per year, pended upon costal or inland

regions of the country, facilitates a diverse crop selection to choose from (Latimer Clarke Corporation, 2009). As for a future facility I would purpose a system of high tunnels and low tunnels to test crop yield within these facilities as compared to open-field production. Four high tunnels at 25' wide by 96' long by 8' high and four low tunnels at 3' wide by 40' long by 3' high will be constructed. Testing yield will account for weather conditions against crops, pathogens and pests that may affect crop yield, and human contact and error. I would purpose that this facility be located within the outskirts of the city of Andoany. Andoany is located in northern Madagascar near the coast at latitude 13° 24.0' S and longitude of 048° 17.0' E. The city is populated with roughly 30,000 people and contains one of Madagascar's major open ports (Latimer Clarke Corporation, 2009). My reasoning for placing this potential test facility here is due to Andoany containing one of the main ports of the country as well as having a large population and easy access that will allow this facility to be used and observed to its maximum potential.

The facility would be used to grow mainly natural vanilla, seeing as this is Madagascar's main cash crop and accounts for seventy-five percent of all natural vanilla in the world. The facility will also be used to grow rice, a means of living for many of the people going through poverty within the country. These two crops are the most important to the country, one being a major source of revenue and the other being a major source of food for Madagascar's people. Learning how to grow these crops more efficiently and effectively will benefit the country in a political, economical, and in social health. I would purpose basic tests, given the technological limits presented, to crop yield and crop quality in the high/low tunnels compared to that of open-field growth and quality. The experiment should be conducted over a three year cycle to account for irregularities in seasonal changes and to build a base for the experimental data. Due to such a

tropical climate, plantings of each crop should occur twice a year at six months apart from one another to see if the slight change in seasonal temperatures and rainfall effects the crop yield and quality.

Overall, this facility purposed in Madagascar will allow research to be conducted on two crops that can dramatically alter the country via economical and social status over the next decade. Being such a low-tech country, Madagascar will not be able to adopt advanced and expensive greenhouse production facilities. However, the demand for these types of facilities at this point in Madagascar's agricultural industry is non-existent. By introducing high tunnel and low tunnel growth facilities, Madagascar will be able to take the first steps into integrating sustainable agricultural practices within the industry.

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