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Madagascar, Factor 11: Malnutrition

Malnutrition in Madagascar

Starvation continues to be a significant problem for the people of Madagascar, especially the children, despite interventions from organizations around the world. Madagascar is a country located off the southeastern coast of Africa in the Indian Ocean (Britannica, n.d.). This country is known officially as the Republic of Madagascar and has a population of approximately 27 million. While Madagascar is located closer to the continent of Africa and is part of the African continent, the population developed primarily from Indonesian roots (One World Nations Online, n.d.). The official languages of this country are Malagasy and French (World Atlas, n.d.). The population is a combination of urban (37.2%) and rural (62.8%). With a landmass of 226,498 square miles, it is the fourth largest island in the world. The climate in Madagascar is primarily tropical with variations due to changes in elevation and location related to the southeastern trade winds and monsoon winds from the northwest (USAID, 2021). The two seasons include the dry, cooler season from May to October and the rainy, hot season from November to April. Cyclones often occur on the eastern coast leading to landslides and flooding. Because of the size and diverse geography of Madagascar which includes rainforests, beaches, and mountainous areas, the weather can vary significantly (Britannica, n.d.). As a result of Madagascar's fluctuating climate conditions and difficult terrain that impact the amount of crops successfully harvested on a consistent basis, as well as the lack of crops and clean water that are available to meet the nutritional deficiency needs of the Magalsy people, malnutrition continues to be a problem. In order to adequately address the problem of malnutrition in Madagascar, focused efforts must be implemented into the development of farming techniques that withstand significant changes in climate and difficult terrain, as well as the promotion of foods and water with high nutritional value.

With its designation as an economically developing country, the poverty levels in Madagascar are high with an estimated two-thirds of the Malagasy people living in poverty (Zinkweg, 2019) which further complicates food insecurity in this country. The country consists of a small wealthy class, a small middle class, and a large lower class. Family life in Madagascar is fairly traditional. Approximately 50 percent of the population is Christian with traditional indigenous Malagasy beliefs being practiced by others (Britannica, n.d.). With approximately 70% of the population being involved in agriculture, families tend to be large. The patterns of marriage among Malagasy people are associated with socioeconomic status. The typical household consists of a male and female head of household and children from their union. Extended families may live in neighboring homes. For farming households, families contain an average of 5 to 6 children (USAID, 2018). Due to poverty levels, one in four children between the ages of 5 and 17 work to help provide for their families. Despite large families, homes tend to be small and built from bamboo sticks and mud bricks. They often lack running water and electricity. These harsh living conditions, along with obstacles to education, contribute to significant problems for the people of Madagascar.

A major problem with the educational system in Madagascar is the lack of clean drinking water with estimates of only 18% of schools having access to clean drinking water (Siddiqui, 2014). Children between the ages of 6 and 13 are required to attend school. People in the plateau areas are more likely to attend school longer than those living in the coastal areas (Harvey et al., 2014). In more remote areas where children are needed to help with the farms, school becomes secondary. In a research study conducted of 600 smallholder Malagasy farmers by Harvey *et al.*, 27% of the farmers did not have any formal education and 48% only had a primary school education (Harvey *et al.,* 2014). While poverty and associated factors are significant, these are just a few of the challenges faced by the people of Madagascar.

Along with these arduous cultural demographics, agriculture in itself presents many challenges. The main staple of the Malagasy diet is rice with protein from fish, chicken, meat, or beans (Global Nutrition Report, n.d.). Water is the typical beverage, but this is an additional factor impacting malnutrition as approximately 22.9 million people in Madagascar lack access to safe, clean water (Waller, 2017). This is especially true in rural areas where wells are often contaminated with bacteria and viruses, as well as surface water of rivers being contaminated, lack of water due to droughts, and poor sanitation for a majority of the population (African Volunteer Network). Although there have been interventions by organizations such as the Water & Sanitation for the Urban Poor (WSAP), UNICEF, by 2020, and others using filtration methods, solar disinfection, rainwater harvesting, water treatment, and safe water cube fountains, the absence of clean water continues to be a major factor contributing to malnutrition as water is an essential nutrient for good health (Waller, 2017, Alfaham, 2020). While a number of vegetables and fruits are grown in Madagascar, they are not always available due to cost, poor crop production, and lack of access in rural areas (Rubin, 2020). According to Harvey *et al.*"Even in normal years, three-quarters of the farming households lack sufficient food to feed their families and spend on average, 3.8 months without sufficient food" (Harvey *et al.*, 2014, p. 12). It is estimated that 49% of Malagasy children under the age of 5 suffer from stunted growth and anemia, which leads to developmental delays as a result of poor nutrition (Desrosiers, 2019). The rates of Vitamin A, iodine, zinc, and iron deficiencies tend to be high, especially in children and women (World Bank Group, 2020). Further complicating the health problems associated with malnutrition is the fact that there is very limited or no access to adequate medical treatment.

Most hospitals and healthcare facilities are in urban areas. The Christian missions operate some hospitals in rural areas. Health insurance and similar benefits are also primarily available to white-collar workers in urban areas. Most of the people in rural areas do not have access to adequate healthcare and are susceptible to diseases from unhygienic living conditions, lack of clean water, and malnutrition (Reesor, 2017; Spicer, 2017; Waller, 2017). According to UNICEF (2014), Madagascar ranks as one of the worst countries with regard to health coverage and child survival as lack of adequate nutritious food further undermines the health of children and their families. This absence leaves the Malagasy people starving both physically and psychologically. Under these circumstances, developing effective agricultural practices to meet the nutritional needs is difficult and further exacerbated by practices of smallholder farming.

Most farmers in Madagascar practice subsistence farming, growing crops to meet the needs of their families (Rubin, 2020). The average farm size for smallholder farmers is 1.3 hectares, which is equivalent to approximately 3.2 acres (New Agriculturist, 2013). The crops grown in Madagascar vary by region due to the diversity of terrain and weather conditions. Rice, which is the main crop grown in this country, is common in the central region. Sugarcane plantations are found in the northwest and on the east coast. Bananas are also grown on the east coast. Potatoes and yams are grown primarily in the highland areas. Corn is common in the south, west, and central plateau. Coffee is grown on the plateau and east coast. Other significant crops produced in Madagascar include apples, pears, plums, grapes, citrus fruits, mangoes, avocados, peanuts, coconuts, cacao, beans, tobacco, and cotton. Madagascar is the world's largest producer of vanilla beans with approximately 80% of the beans produced in this country. Many rural farmers also depend on livestock as a source of income. Smallholder farmers often have pigs, sheep, goats, chickens, ducks, and turkeys on their farms. Cattle, consisting mainly of zebu, are found all over the island. An issue that interferes with the government's attempts to encourage cattle use for dietary consumption or export is the belief of Malagasy people that having large herds of cattle is a sign of wealth and the practice of using cattle for religious sacrifice (New Agriculturalist, 2013).

Agricultural practices in Madagascar have included tavy or slash-and-burn methods which involve clearing the forest for farmland which has led to erosion and loss of productive land for farming

(Rubin, 2020). While the variety of food may lead one to believe that there would be more than an adequate supply of crops to feed the Malagasy people, most of their harvest is exported as the main source of income. In addition, a significant amount of harvest is lost due to poor soil quality, variable weather conditions, and pests. Along with poor harvests, the crops grown do not have the necessary nutrients needed for adequate health and nutrition. These circumstances contribute to both an inadequate amount of food, as well as a lack of nutrient-rich food for the people of Madagascar.

Furthermore, other factors that have impacted the smallholder farmers of Madagascar include poverty, pest and disease outbreaks, dwindling forests due to slash and burn agriculture which has led to land erosion, unpredictable weather patterns, dependency on farming for a livelihood, physical isolation, lack of accessible roads and transportation, limited agricultural resources and education, and lack of a safety net from the government (USAID, 2021; New Agriculturist, 2013). These have all contributed to food insecurity and malnutrition (Harvey et al, 2014). Farming is made more difficult as farmers try to combat their own struggles with malnutrition while doing this strenuous work.

Approximately 70% of the population lives in rural areas and can often be isolated from basic services such as clean drinking water and food markets (Rubin, 2020). In their research on smallholder farmers in Madagascar, Harvey *et al.* (2014) noted "Because smallholder farmers typically depend directly on agriculture for their livelihoods and have limited resources and capacity to cope with shocks, any reductions to agricultural productivity can have significant impacts on their food security, nutrition, income, and well-being" (Harvey *et al.*, 2014, p. 2). Other barriers families who are smallholder farmers face are limited agricultural education, low technology practices, lack of fertilizers and pesticides, and limited seed varieties (Harvey et al, 2014; New Agriculturist, 2013; Rubin, 2020). As a result of these factors, the Malagasy people are in need of help to grow sustainable, nutritious crops in their challenging environment to address problems of malnutrition related to inadequate and healthy food supplies. Agricultural biotechnology is increasingly being used in Africa with some success. According to the Young African Leaders Initiative, "biotech crops are part of the solution to the challenges of food security and climate change" (Young African Leaders Initiative, 2018, p.1). For this reason, agricultural biotechnology interventions would appear to be a viable addition to the strategies that have been implemented in Madagascar thus far.

Despite ongoing efforts to address malnutrition in Madagascar from programs including Pausens, UNICEF, and USAID, malnutrition continues to be a constant problem in this country (USAID, 2021). UNICEF has provided vitamin supplements, nutrition education, immunizations, and water sanitation in efforts to combat malnutrition (Wagner, 2014). USAID (2021) has helped the Malagasy people through maternal and child nutrition programs, dietary supplementation, and has worked with groups of farmers on improving farming techniques to increase the production of food and reforesting land. The Madagascar Emergency Support to Critical Education, Health and Nutrition Services is a ten-year program approved in 2012 to help fight malnutrition in Madagascar (World Bank Group, 2020). According to the "Global Nutrition Report", "Madagascar is 'off course' to meet all of the global nutrition targets for which there was sufficient data to assess progress" (Global Nutrition Report, 2020, p. 1). Climate change is also predicted to worsen natural disasters such as cyclones, floods, drought, and infestations of locusts in Madagascar which will negatively impact crop production and in turn increase malnutrition (Lipp, 2017).

Although a number of programs have been implemented to help Madagascar address malnutrition, it is evident that further efforts are needed to help the Malagasy people. The current efforts have not been fully effective in addressing malnutrition because of not adequately addressing ways to help farmers sustain consistent, high nutrient crop production. In particular, a focus on crops that are nutritionally dense with an emphasis on Vitamin A, iodine, zinc, and iron which have been reported as being deficient in the diets of people in Madagascar is needed (The World Food Bank). In order to

address the problems of malnutrition in Madagascar, a focus on farming techniques to address climate change and difficult terrain in conjunction with technologies to fortify the nutritional quality of crops is needed.

For instance, the combination of biotechnology and biofortification could be an exemplary resolution. The use of biotechnology techniques to improve the viability of crops in harsh climate conditions, as well as guarding against pests, can be used with biofortification to improve the nutritional quality of crops. Biofortification which involves making plants more nutritious as they are growing rather than adding nutrients during food processing and production could be achieved through genetic engineering or conventional selective breeding of crops. The biofortification of crops with nutrients lacking in the Malagasy diet such as Vitamin A, iodine, zinc, and iron could be significant for addressing malnutrition in Madagascar. While some organizations have worked to provide dietary supplements to address deficiencies, the reach of this can be limited because of difficulties gaining access to people in remote areas of Madagascar or having the people understand the need for consistent supplementation.

If crops are biofortified, nutritional deficiencies will be addressed as the people consume these nutritionally fortified foods. Golden rice and golden banana are two examples of how genetic engineering has significantly improved the nutritional quality of foods (Norero, 2018). The increased levels of beta-carotene, which is a precursor for Vitamin A, are available in these foods and are also being increased in other foods such as cassava, oranges, and potatoes through genetic engineering, all of which are crops grown in Madagascar. Other nutrients deficient in the Malagasy diet such as iron, zinc, iodine, and folic acid can also be addressed through biofortification (Garg, 2018). These strategies can be combined with concepts from nutrition-sensitive food systems and polyculture-farming techniques advocated by Dr. Shakuntala Haraksingh Thilsted (World Food Prize Foundation, 2021). Thilstead's research with the use of fish to supplement diets in economically developing countries would be beneficial in Madagascar as Malagasy farmers often add fish ponds to their farms or fish in nearby rivers to supplement crops grown on their farms as a means of subsistence (Rubin, 2020). With these concepts in mind, similar strategies can be used to address the need for clean, safe water in Madagascar.

In addition to the biofortification of crops, water filtration systems that filter out bacteria and other contaminants could also be further developed to enhance the water with micronutrients. While the water is filtered to remove harmful substances, additional steps could be taken to add health-promoting substances. Fortified waters are a huge and growing business in first-world countries as water is enhanced with vitamins, minerals, and protein. Researchers and health experts are increasingly promoting the benefits of water enhanced with vitamins and minerals as an inexpensive source for helping to address malnutrition (Polaki & Yarla, 2014). Partnerships can be made with companies that develop and manufacture water filtration systems and enhanced water beverages which typically have extensive research teams and organizations that work with economically developing countries. These collaborations could use the research that has already been done by these companies to develop systems that could be used to provide clean, nutrient-rich water in third-world countries such as Madagascar. Funding could come from companies willing to provide their expertise and capital to facilitate these projects. These ventures could also be done in conjunction with universities doing research in similar areas. Similar collaborations could be made with companies involved in the biofortification of crops along with universities and organizations providing aid to economically developing countries. In addition, similar joint efforts could be used to address the deterioration of agricultural land.

While many of the farmers in Madagascar are aware of the detrimental effects of slash-and-burn methods on their land, they have struggled with finding alternatives (Madagascar Fauna and Flora Group). The degradation of the agricultural land along with climate changes impact crop production. Untreated farmland erosion leads to soil infertility. This leads to exponentially negative repercussions on crop yields year after year. Fertile, sustainable farmland is essential for crop production and is

challenging in Madagascar. There are several steps that can be taken to address these issues. If farmers plant some sort of cover crop in between planting seasons, it will help decrease the erosion of farmland. These crops can then be turned over to provide nutrients back into the soil when farmers are ready to plant again (University of Rhode Island, 2014). To prevent wind erosion, farmers should try to plant windbreaks like trees. Another thing to avoid is tilling the soil as much as possible. Because parts of Madagascan farms are on hillsides, contour farming and terracing would not only be an effective solution to preventing soil erosion, but also a way to help control and conserve rainwater (Britannica, 2019).

By using polyculture-farming practices, along with preventative soil erosion methods, soil can be improved and an increased variety of nutritious crops could be made available for consumption. Polyculture fields take up less space and resources. Crops planted in a polyculture style are less susceptible to disease and weather variations (Perroni, 2017). These regenerative agricultural practices along with the use of biofortification and biotechnology will enable the Magalesy people to increase the production of nutrient-rich crops. Just as collaborations between businesses, universities, and organizations could provide aid that can be used to support biofortification and biotechnology efforts, similar collaborations can be made to address the development of fertile farmland for crop production which in turn will assist in the efforts to address food insecurity. These partnerships can provide the resources such as financing, research, agricultural materials, and staff to implement these strategies. Despite the possible effectiveness of these strategies and partnerships, there are political and social circumstances that will need to be taken into consideration for the implementation of these plans.

While the use of biotechnologies and genetic engineering to nutritionally fortify crops and water, along with helping make land more tolerable to harsh conditions, could make significant contributions to address malnutrition in Madagascar, there are political and social issues that have interfered with the success of these interventions. There has been much controversy about the use of GMOs in Africa (Cornell Alliance for Science). In order to successfully use biotechnologies and genetic engineering to help countries like Madagascar, a focus would need to be on education about the safety and practical use of GMOs. Also, work would need to be done with the government of Madagascar to address political concerns related to this technology in societies that have significant inequities. In addition, since the use of GMOs and biotechnologies are often more prevalent in large-scale farms, those with higher levels of education, and farmers with access to information, significant education would be needed for small land farmers in Madagascar (National Geographic, 2020).

To improve malnutrition in Madagascar one must use a multi-step approach to be able to use the biotechnology and advanced agricultural techniques that are available but not easily implemented in economically developing countries. It is evident that many organizations and individuals have attempted to address the issue of malnutrition in Madagascar but have not been successful in fully addressing this problem on a long-term basis. The goal would be to eventually make the country independent for food security; able to grow their own food and feed their own families. Education of sustainable agricultural practices like creating and maintaining healthy soil for crops, continuing and expanding programs such as Water Aid (Tennyson, 2017) for minimizing water and climate pollution, and developing ways to better utilize Madagascar's bio-diverse climate and geography (Union of Concerned Scientists, 2017) is important. Composting, making silage from the nutritional waste of crops that people normally consume are additional ideas that can be expanded upon. Teaching the Malagasy people how to grow crops that are vitamin reinforced such as golden rice (International Rice Research Institute, 2018) could help improve the nutritional quality of foods. Agricultural education is key and pamphlets could be used to teach the Malagasy people such things as the use of biotechnologies; food preservation techniques in case of poor harvests; where, how, and when to grow certain crops; and soil enrichment processes. These ideas would need to be implemented on both a micro and macro level. Educators would need to work with groups who would then go out to work with individual farmers to address specific issues. Regardless of the approach, an essential part of this multi-step plan would need to focus on financial sustainability.

Expectedly, a major issue with the suggested resolutions is funding. There are already many agencies working on providing assistance to Madagascar including UNICEF, USAID, Water Aid, Seed Madagascar, Blue Ventures, Action Against Hunger, and Feedback Madagascar (Tennyson, 2017). There needs to be better collaboration between agencies working with Madagascar which will help expand the services that can be provided. In addition, efforts to work with universities doing research in agricultural fields such as genetic engineering, biological pest control, hydroponics, soil erosion, climate change, and water management could provide much-needed resources to these efforts. Including major companies involved in agriculture, food production, water filtration, water production, water management, and land management would be essential due to the benefits that they can offer through their capital resources and knowledge. In order to have success with a program that focuses on biotechnology, genetic engineering, and farming techniques for land/climate management, significant work would need to be done to develop an alliance with the political and governmental systems in Madagascar. Ultimately, it cannot be emphasized enough how important this alliance is for bringing any solutions that would address malnutrition in Madagascar to fruition.

It is obvious that Madagascar is a country in need of significant assistance to decrease malnutrition, and by proxy food security, for its people. Extreme poverty, climate conditions, diverse geography, limited education, political unrest, and lack of basic resources such as clean water, sanitation, and electricity are all factors that need to be taken into consideration when helping the Malagasy people. Through the collaboration of multiple agencies with a focus on the use of biotechnology, genetic engineering, and improved land usage for agriculture, consequential reductions in malnutrition can be made in Madagascar. The fact that the people of Madagascar continue to push through the tremendous obstacles that have been put before them demonstrates that they are a very determined and resourceful nation. The agencies and people looking to help them have to be just as resourceful and determined, as it is evident that this is not an easy task, but it is a necessary step to end malnutrition.

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