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Madagascar, Malnutrition

Madagascar: Insects as a Protein Alternative to Reduce Malnutrition

On the east coast of Mozambique Africa, lies an island in the Indian Ocean part of Southern Africa. Madagascar is just under twice the size of Arizona, but the 4th largest island in the world with 3,000 miles of coastline. It has a population of 28,812,195 ranking it 53rd compared to all countries (*Madagascar - The World Factbook*, 2023). Their population will continue to grow at a 2.65% growth rate with 32.6% considered urban, leaving the rest in rural areas (*Madagascar*, 2023). Its economy is based upon agricultural products such as rice, sugar cane, and tropical fruits. Nearly 80% of Malagasy families are employed on 2.5 million small farms (*Madagascar*, n.d.). These landowners own less than 3 acres of land each (*Madagascar | World Food Programme*, 2022). They have three main sub sectors of agriculture, fishery, and livestock. Their agriculture is not very diverse as 86% of households grow rice (*Madagascar*, n.d.).

Madagascar has a very unique ecosystem with its plants and animals found nowhere else in the world. Their climate is tropical along the coast with a temperate inland climate. Madagascar has a narrow coastal plain with high plateaus and mountains towards the center. Unfortunately, “a quarter of the population lives in areas highly prone to cyclones, floods or drought” (*Madagascar | World Food Programme*, 2022). These weather patterns contribute to shocks and food insecurity. Not only has it caused food shortages, it’s brought disease and epidemics like malaria. Due to the fact that malnourishment is widespread and consistent, it is important to create dependable income and food production opportunities. Rural families need a constant income to afford food at markets, and they can’t do that with irregular harvests from an erratic climate.

The climate is beginning to provide more and more challenges for crop producers. In 2016, a 75% drop in rainfall caused 95% of crops to be lost making more than one million people food insecure (World Bank Group, 2022). Many parts of Madagascar have been drying up for years, spreading to three different regions. This type of detrimental weather has “pushed the South into a severe food crisis” (World Bank Group, 2022). The World Bank (2022) estimated that by March of 2023, over two million were likely to be acutely food insecure. In the far south of Madagascar, child malnutrition rates have reached 27% (*Child Malnutrition Expected to Quadruple in Southern Madagascar*, 2021). This type of malnutrition will cause stunting, poor brain development, and illnesses.

Madagascar has a semi-presidential republic government with a popularly elected president. There is lots of political instability which declines the country's economic growth, leaving poor citizens with no way to afford food. Madagascar has plenty of resources yet they remain “one of the world’s highest poverty rates” (*Madagascar Overview*, 2023). Madagascar has a poor structure and it’s developing slowly. Poverty is on the rise in urban areas as many families flock to rural areas because of lack of work in the cities (*Madagascar Overview*, 2023). The Covid-19 pandemic and Ukraine conflict have all contributed to fueling the inflation making household spending for priced goods a challenge.

Most Malagasy live in rural areas and work in agriculture. Recent laws have been improving equality between men and women. Most marriages today are joint unions, but it isn't too uncommon to see arranged marriages in villages. Divorce is not uncommon for Malagasy, and it's more common to see single mothers than fathers. They have a pretty typical household with both the male and female as the head, although women tend to dominate the caring for the family, meals, and laundry. Extended family households may include grandparents or aunts, and uncles. Infants are often attached to their mothers using a cloth or *lamba (Madagascar; Countries and Their Culture, n.d.)*. Education is typically between the age of 6-14, but in rural villages oftentimes children are contributing to agriculture work. These types of children learn wisdom from their elders as opposed to school based knowledge (*Madagascar; Countries and Their Culture*, n.d.). Additionally, Malnourishment in children provides challenges to learn efficiently.

Rice is the staple of Malagasy diet (*Madagascar; Countries and Their Culture*, n.d.). A protein like fish, chicken, or beans is usually paired with it. Many of the vegetables they use like carrots, potatoes, and peppers are available year round with fruits being more seasonal but, these foods are unaffordable on a daily basis, and the general population goes undernourished. The locally known insect *sakondry* are planthoppers that have been traditionally consumed in Madagascar (*Project Sakondry - Edible Insect Farming*, n.d.). According to Madagascar Biodiversity Center, "insects are an indispensable part of seasonal diets for many ethnic groups" (*Edible Insects*). Malagasy consume what they can to maintain their nutrition as much as possible.

Fishing has been a way of life for many Malagasy, but resources have become scarce because of its overuse in communities. For the Malagasy diet, fish contributes to 20% of their animal protein consumption (World Bank, 2021). It also provides 1.5 million people with money due to its annual production capacity at $750 million (World Bank, 2021). Now with the fishing industry's growing popularity; harmful practices and overfishing have begun to stress the wildlife. Many fishing boats are not registered and are operated by young fishermen. Malagasy citizens do not have the education to understand conservation practices, and they are pressured to provide food and money for their families.

Malagasy people will continue to become more and more malnourished. With chronic malnutrition being one of the largest issues for Madagascar, a solution must be found to improve the economic value of crops and create protein alternatives. They have limited ways to grow food during consistent natural disasters, climate changes, and now the overuse of water resources due to overfishing. The seaweed market has an abundance of potential for small villages surrounding the coast of Madagascar. The production of seaweed can increase Madagascar's export potential and it can't be harmed from climate changes due to its growth in the ocean. Right now, many large fishing companies are taking roots in Madagascar's coast. It is important to develop independent seaweed farms built around villages so that they can increase their sources of income.

Seaweed is sold and used all around the world. It's most wanted for its special ingredient, carrageenan gel, that can be used in foods, cosmetics, and the pharmaceutical industry (*Seaweed Aquaculture*, 2019). The demand for seaweed has only increased over the last several years (Msuya et al., 2022). The *Kappaphycus alvarezii* (red seaweed) can be grown on ropes off the 3,000 miles of Madagascar's coast.

The continent of Africa is the third largest producer for red seaweed, but Madagascar has only 4.7% of production compared to Tanzania's 92% (Msuya et al., 2022). Madagascar can be part of the African coast that can be used to produce different types of seaweed. Another huge benefit to seaweed farming is the short production cycle of 40 days (*Seaweed Aquaculture*, 2019). Farmers will have a dependable source of income in a little over a month's time span consistently throughout the year.

Seaweed works simultaneously to make a cleaner environment. Seaweed takes carbon dioxide out of the water and uses it to grow. According to the National Oceanic and Atmospheric Administration, (2020) "seaweeds pull more of the greenhouse gas from the water than Eelgrass, mangroves, and salt marshes." Seaweeds also soak up a lot of nitrogen and phosphorus. Seaweed can be grown vertically and make dense plentiful harvests. Seaweed farming has started in eight villages in the bay of Madagascar, showing that seaweed farming is not too expensive to begin exploring (*Seaweed Aquaculture*, 2019). Many villagers already own a boat from their fishing careers, and many of the farming materials can be made from recycling old tools. Seaweed farming is a very real possibility for coastline communities.

Although seaweed can be used for human consumption, a seaweed diet will not help malnourishment in Madagascar. Insects can be a healthy protein packed alternative for the Malagasy. Insects are already widely eaten in Madagascar and they are very nutritious. Lots of research has been conducted to eat an insect called sakondry, instead of hunting Lemurs for protein (Kessler, 2019). Kessler (2019) found that Lemurs were being eaten as a last resort for malnourished families, and that sakondry bean beetles along with locusts are popularly eaten. Insect production is much easier than livestock. Insects take up less space, produce less pollutants, and are much easier to feed. An increase of seaweed production will allow for a new feed source for insects, which can then be eaten by humans, or even fed to small livestock like chickens.

Blaptica dubia (dubia cockroaches) are insects very high in protein. In fact, they are more nutritious than crickets, mealworms or superworms. Dubia cockroaches are some of the easiest to take care of and unlike most cockroaches, they don't invade homes (Allred, 2022). They aren't an invasive species and they don't carry diseases like typical American cockroaches. In their typical habitat of South America, they eat leaves and fruit from the forest floor (Allred, 2022). Dubia cockroaches can't climb vertically and only males have wings that allow them to slightly hover on a rare occasion. Most dubia's are used for pet food, but the good news is that they "can eat just about anything" (Allred, 2022). Dubia has a higher protein, fat, fiber, and calcium value than crickets and they don't make noise, jump, or have a decomposing odor (*Dubia Roaches Vs Common Feeder Insects*, 2020). Although it's uncommon, humans have consumed dubia cockroaches before.

Further research should be done to discover seaweed as a food source for dubia cockroaches. Malagasy can farm seaweed and sell the majority of their crop to industrial markets as an export, but they can use some of their harvest to feed dubia cockroaches to consume as their source of protein. Dubia roaches will not be able to survive off of seaweed alone, and it is a type of algae rather than their classic plant matter diet. Nevertheless, more research is needed to determine the effectiveness of a seaweed diet and the effects of dubia cockroaches with this diet on human nutrition. Malagasy can easily adopt dubia cockroaches to their diet and maintain their staple rice diet. Instead of topping rice with fish or wild protein sources, they can use dubia cockroaches as their protein source.

One problem of this solution is that seaweed farming and eating dubia cockroaches are relatively native to the Malagasy people. It will take support from government programs and help from resources across the world to start growing seaweed and caring for insects as a way to break through malnutrition in Madagascar. The dubia cockroaches are not native to Madagascar, so they would have to be imported, but any insect that can eat seaweed as a food source would be beneficial for the people. The government of Madagascar along with global relief and financial institutions can work together to set these programs in place. The United States can make an effort to purchase seaweed from Madagascar to help start markets and trade. Villages would need sponsorships from outside communities to startup seaweed farms and implement marketing strategies.

The government in Madagascar is continuing to improve. The past elections of Madagascar's president were all "accepted as free and fair" (International Trade Administration, 2021). As Madagascar's government increases in stability, it will open the door to more trade opportunities. Because of Madagascar's extreme poverty, it will take time and effort from the government to improve its economic development. Most citizens are "trapped in poverty and and are at high risk for becoming still poorer as natural resource stocks are permanently depleted" (*Environment and Climate Change | Madagascar | U.S. Agency for International Development*, n.d.). Madagascar is in need of steady income, and proper leadership to guide them towards living and not just surviving.

Providing education for a group of "experts" from Madagascar would be important to establish trust and commitment to crop improvements. These trained experts from areas all over the country would take knowledge and tools back to communities in a way our extension programs work in the United States. Farmers would be able to learn from and discuss progress with individuals from their local or surrounding community. The education style in Madagascar typically consists of wisdom from elders, so Malagasy are well adapted to share their practices to help their community. Financial support would have to come from organizations such as the World Bank and international aid organizations to help with upstart costs and methods.

Students from across the country can visit Madagascar to be educated on seaweed farming, cultural diversity, and unique island species. Once programs are in place to begin seaweed farming, these methods should be self-sustaining and provide a platform for future growth and understanding in the area of crop production. Sustainability is of utmost importance to ensure seaweed farming remains reliable. By establishing genetic diversity, international policies and regulations, and integrating other fed-aquaculture species, it is possible to keep seaweed farming around for a long time (*Eight Ways to Ensure a Sustainable Seaweed Farming Sector*, 2023). In time, many farmers will begin to appreciate the income assurance that a seaweed crop can give and the full stomachs they have from turning to insects.

After the use of seaweed farming has been functioning for a period of time, the hope is that the agricultural industry would make available new jobs, sustain more agriculture, and produce a nutritious product that can go to the market, or be used in the village to produce more food. Urban areas can begin to be repopulated to take stress off of rural land for food. Nutritious foods would be available to implement nutritional improvement programs and school meal programs to reduce malnutrition impacts on the many young people of the country. With these initiatives, the education sector of the country can be

improved leading to even better development of Madagascar. Better fed mothers give birth to healthier infants and well fed children are better able to fight disease, learn and eventually contribute to society. Addressing the economy through product production and increasing food sources is a priority for Madagascar.

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