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Madagascar, Factor 5: Climate Volatility

### **Reducing the Effects of Climate Volatility on the Availability of Food in Madagascar**

Madagascar is a place like no other. Located off the African mainland, it is home to many people, and it is graced with unique wildlife found nowhere else on Earth. One would think the island idyllic, but for many people in Madagascar, life is anything but idyllic. An estimated two-thirds of the Malagasy population are considered undernourished and 82% of the rural population falls below the national poverty line.(Royal Society) Madagascar has the world's fourth highest rate of chronic malnutrition, which affects almost half of all children under age 5("Madagascar |WFP"). The biggest threats to food security are severe droughts and flooding. Madagascar is often struck by cyclones, and the worst storms can leave hundreds dead and tens of thousands homeless("Our Africa Madagascar"). The storms can occur any time between October to May and all parts of the island are vulnerable. These natural disasters are worsened by climate change and increase the already high rates of erosion caused by excessive logging of the rain forests. The volatile climate also affects the waters of Madagascar, and in consequence, the lives of local fisherman, who will have to be supported in an inevitable switch to sustainable farming. Therefore, volatile climate is Madagascar's greatest threat to food security. However, Madagascar could be on par with more developed countries such as the USA in terms of food security if proper planning and strategies are implemented. There are multiple ways to combat the destabilizing effects of climate on the region, but among those that are the most promising are making the switch to crops that can survive the hostile climate, revitalizing the rain forest while simultaneously boosting the amount of food produced, and encouraging farmers in the more poverty-stricken regions to farm new crops that are adapted to the specific climate.

Before discussing solutions, the conditions under which a typical family in Madagascar are currently living must be considered. According to the article "Extreme Vulnerability Of Smallholder Farmers to Agricultural Risks and Climate Change in Madagascar,"published by the UK's Royal Society of Biological Sciences, "Farmers comprise approximately 70% of the population and most are smallholder farmers. Smallholder farmers cultivate primarily for subsistence, are chronically food insecure, and generally lack basic services, such as improved water sources and electricity." They go on to talk about the poor conditions these farmers struggle with. For example, most households depend on firewood for cooking and oil for light. More than half of the farmers obtain water directly from rivers, lakes or ponds, and only 13% have access to public water taps. Education levels are low for these farmers, as more than a fourth of the farmers are lacking any formal education and less than half have only completed primary school. Even though there are a small number of small hospitals concentrated in the major towns and cities, and they are free, the hospitals suffer from a shortage of staff. Families also have to pay for supplies such as bed sheets, dressings and food, which is hardship for most of the populace as they make less than \$1.25 a day("Extreme Vulnerabilities..."). The fact that most households are comprised of 4 or more people("Our Africa Madagascar"), but the average amount of farmland is a mere 1.3 hectares (3.2 acres), most of which is unusable or ravaged by the harsh weather, contributes to the economic hardships and poverty of the typical family. Rice, cassava and corn are the most commonly cultivated and eaten crops, cultivated by 89%, 91% and 72% of all farmers, respectively("Extreme Vulnerabilities"). However, these crops are affected by the climate of Madagascar, and in focus groups conducted by researchers funded by the Bill and Melinda Gates Foundation, "Farmers reported obtaining rice yields of only 0.7–0.8 tons per hectare, which is even lower than the national (low) average of 2.1 tons per hectare." (Extreme Vulnerabilities)

The first and foremost way to reduce the effects of severe weather events is with crops that are able to survive the severe flooding and droughts. Luckily, there are crops available that are resistant to these conditions. In response to the severe weather experienced during the recent El Nino in 2016, the Philippines Rice Institute and the International Rice Research Institute worked together to breed a plant that could thrive in such conditions “It is the poor farmers who suffer the most from the effects of climate change,” said Dr. Bruce Tolentino, IRRI’s deputy director general for communication and partnerships. “This is why IRRI has been working hard to develop climate change-ready rice varieties that can withstand extreme climatic conditions such as droughts, floods, heat, cold, and soil problems such as high salt and iron content.” Scientists at IRRI have already developed and released drought-tolerant varieties that can produce up to 1.2 tons more per hectare than varieties that perform poorly under drought conditions in several countries. These varieties include Sahbhagi dhan being used in India and the Sookha dhan varieties being used in Nepal(Santos-Peralta). As aforementioned, rice is one of the most important foods in Madagascar, and is incorporated into most dishes. Many families will eat rice for all three meals. If farmers in Madagascar switched to these drought resistant rice crops that are in development and already developed, the harvests would greatly increase during periods of extreme weather. Resources could be invested into researching and creating strains of more drought and flood resistant corn and cassava, the other two most widely grown and consumed crops.

Other than improving the resilience of already common crops, there is also potential to introduce new crops. One such crop is the cactus, specifically the Opuntia, also known the Indian Fig or Prickly-Pear Cactus. The Opuntia is a species of cactus that has long been a domesticated crop plant important in agricultural economies throughout arid and semiarid parts of the world. Opuntia are also very resilient and able to withstand flash floods and harsh winds. Opuntia are already being consumed more widely, and are consumed and grown in Ethiopia and South Africa, countries that are nearby to Madagascar. Therefore, it is not unreasonable to believe Opuntia could feed the people of Madagascar as well as provide value as a cash crop. Between 1907 and 1925, Luther Burbank introduced more than 60 spineless cacti of the Opuntia variety(“Spineless Cactus”). Spineless cacti are more consumer friendly, easier to harvest, and thus, have a greater chance to be implemented into Madagascan society. Despite this, a serious deficiency with the Opuntia is its lack of protein. However, a study in 2006 on the “Genetic transformation of prickly-pear cactus (*Opuntia ficus-indica*) by *Agrobacterium tumefaciens*” published in the “Plant Cell Tissue and Organ Culture Journal” stated that,“The nutritive value of its fruits compares favorably with that of apples, apricots, cherries and oranges. However, the low protein content of cactus pear is a problem for people whose diet is based largely on this plant. Advances in plant biotechnology have been used to alter metabolic pathways in plants; sometimes, these technologies have been directed towards increasing the nutritional value of plant-derived foods and feeds, which include modification of the levels of several essential amino acids, lipids, fatty acids, minerals, nutraceutical and anti nutritional compounds and aromas.”(Silos-Espino) They go on to say that further research could allow these modifications for Opuntia by introduction of genes with *Agrobacterium tumefaciens*.

The Opuntia would be an ideal crop for the southern region of Madagascar that is semi-arid. The region is constantly swept by a strong prevailing wind, the Tsiokatimo (“South Wind”). This southern region also suffers from recurrent drought, most recently aggravated by El Niño. Because of these factors, fishing is the primary source of food for the residents of Southern Madagascar. However, a profile of Madagascar by the New Agriculturist states that a combination of climate change and destructive fishing practices such as poison fishing and seine netting is having a devastating effect on coral reef systems. The Toliara reef, located along the shore areas of southern Madagascar, is the third largest in the world and supports nearly 20,000 fishermen, but it is dying, and needs time to recover(“Country Profile-Madagascar”). In September 2016, a joint assessment by the Ministry of Agriculture, the UN Food and Agriculture Organization and WFP found that 1.2 million people from the south are food insecure, with 600,000 severely food insecure.(Madagascar |WFP) Therefore, introducing the cactus plant as well as other plants that grow well in hot climates such as cowpeas, jerusalem artichoke and amaranth to local villagers and

encouraging a shift from fishing to farming could drastically change the amount of poverty. However, fishing is such a big part of the culture of the south that a transition will not be seamless, but looking to Zambia and how it handled dwindling fish in Lake Tanganyika in 2011 shows it is possible. The Lake Tanganyika Integrated Management Project (IMP) - sponsored by the UN Development Programme (UNDP) and the Global Environment Facility, an independent fund, aimed to reduce the pressure of overfishing and pollution on the lake by partnering with Zambia's ministry of tourism and environment, with assistance from the ministries of agriculture, forestry and fisheries ("Fishermen get hooked on farming"). There is currently no program like this in Madagascar, and an implementation of something similar would benefit the south. Aside from that time, is all that is required. Eventually, fishermen will see that there is much more money and stability in farming and make the switch.

Finally, sustainable agriculture is another challenge that is made harder by the volatile climate. Soil is becoming unusable and harvests are failing because of droughts and flooding. The most common response to this by farmers is slash and burn agriculture to make land for more crops. Estimates by WWF suggest that as much as 90 per cent of the country's primary forest has already been lost. The final result is very high rates of erosion, and the degradation of most remaining forests ("Country Profile-Madagascar"). This leads to a vicious cycle in which volatile climate ruins harvests and causes farmers to reduce the productive capacity for short term gain, leading to the effects of the volatile climate being even worse than before. Fortunately, there is a solution that solves both of these problems. A technique known as Inga alley cropping could be used to both restore the rainforests and improve crop yields at the same time. Using the Inga tree for alley cropping has been proposed as an alternative to the ecological destruction of slash and burn cultivation and been promoted by the Inga Foundation Founder and Director Mike Hands. Alley cropping is the planting of trees in rows with wide spaces in between, and in the alleyways between rows, planting your crops. The technique has also been shown to increase yields and allow the same plot to be cultivated over and over again thus eliminating the need for burning of the rainforests to get fertile plots. Mike Hands explains the process, "Once the Inga alleys have developed, the Inga trees are pruned at chest height. They have, at this stage, dominated the site and shaded out the terrible weeds. The branches are stripped of leaves and used as mulch, thus protecting the soil and preventing further weed growth. Larger branches are used as firewood, allowing families to obtain all the wood they need for cooking from the Inga plots and thereby tackling another important cause of deforestation. The crop is then planted through the mulch within the pruned alleys. As it grows the Inga also recovers and regrows, providing the crop with some shade and protection from the sun. Once fully matured the crop is harvested. The Inga is then left to grow until the next planting season arrives, by which time they have fully recovered and the whole cycle is ready to be repeated, starting with pruning the Inga alleys once more." ("Inga Alley Cropping") Intercropping is beginning to overtake slash and burn techniques in Madagascar, so it would not be unreasonable for this technique to become widespread and help both the rainforests and people of Madagascar.

These ideas are not new, but there are many problems with Madagascar that stand in the way of agricultural innovation and change. The Malagasy government is very poor and Madagascar itself is underdeveloped. Even though Madagascar has the potential to be a breadbasket, it is not able to subsidize farmers or provide adequate transportation for yields. The relative isolation of farmers and the multitude of other problems the Malagasy government faces make it unable to provide education to farmers and support them. This leaves the job of modernizing Madagascar's agriculture up to organizations outside of the government. Most notable of these organizations is the Food and Agriculture Organization of the United Nations (FAO), who has been working since 2004 to increase nutrition and food security in Madagascar. These efforts are in need of an update though, as they have been unsuccessful in stopping chronic malnutrition. A report from the FAO in 2014 stated that they would relaunch their nutrition policy and also aim to combat climate change through improving access to quality seeds of resistant crops, setting up Farmers Field Schools to strengthen farmers' expertise in climate smart agriculture, supplying agricultural equipment and improving post-harvest management, market access and

nutrition("Madagascar and the FAO"). Even though modernizing Madagascar will most likely be a job for organizations, the average citizen can still help. The average citizen can help the Malagasy people most through fundraisers that support organizations. Multiple organizations are dedicated to helping improve food security in the Indian Ocean region, and these efforts are spearheaded by the IOC (Indian Ocean Commission) and the aforementioned FAO. Together they aim to food and nutrition security in the Indian Ocean region with the the Food and Nutrition Security Regional Programme (FNSRP). Donating to these organizations is the best way the average citizen can help the people of Madagascar. In tandem with donating, people should also be spreading the word of the extreme poverty in Madagascar and through this encourage others to donate as well. Donating food would make Madagascar dependent on aid and disenfranchise local farmers as aid would be higher in demand. This problem is already present in other African countries. Rather, these organizations will help the people of Madagascar and surrounding countries become not just more food secure, but also promote nutrition and development through education which can spread from farmer to farmer and, in time, start an agricultural revolution in Madagascar.

Providing Opuntia, Inga and drought resistant rice are actions the international community can take to relieve the dire effects of poverty on the nation. However, it should not come in the form of direct food aid as that has proven to cause countries to become dependent. Most of the responsibility for these plans and if they will be successful or not lies on the shoulders of the international community and the organizations they fund. Said organizations will need to disperse these crops to their populace and provide education on how to grow and harvest these crops, as well as promoting the foods and methods like the Inga alley cropping. Lastly, there will still be major challenges in ensuring the people of Madagascar will adopt these methods and integrate these foods into their lifestyle and culture. With drought and flood resistant crops, Madagascans can significantly reduce the impact of the volatile climate. With the introduction of new semi-arid crops, the currently most poverty-stricken area of Madagascar can be revitalized. With the introduction of methods such as Inga alley cropping, the vicious cycle of poverty spurred by the relationship between the volatile climate and unsustainable practices can be ended. If these are all achieved, Madagascar will be able to use the great potential it has, and no longer be one of the countries who have experienced a stagnation coupled with a rise in poverty for the last decades.

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