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Madagascar: Community-Led Mangrove and Farmland Resilience for a Changing Climate

Madagascar is an island nation located off the eastern coast of Africa. Its total landmass is 226,658 mi², making it slightly bigger than Botswana (Kent & Covell, 2019). The population of Madagascar is 31 million people and is growing rapidly (WHO, 2024). Nearly two-fifths of the population is under the age of 15, and about half is under 18, while growth rates continue to trend high into the 21st century (UNICEF, 2024). However, the life expectancy for both Malagasy men and women is below the world average, at 63 for men and 66 for women. According to the CIA World Factbook, only 3.1% of the population is over the age of 65.

The average Malagasy household size in Madagascar is four to five people and is typically male-headed. The population is centered in the capital city of Antananarivo, with 40.6% residing in an urban area. The vast majority resides along the eastern coast, with the remainder of the country being sparsely populated.

About 70% of Madagascar's land is used for agriculture, with rice as the main staple crop grown on roughly half of that land ("Responsible Land Policy," 2023). The country is a leading exporter of vanilla, along with cloves and coffee ("Economic Growth in Madagascar," 2020). Most farming is small-scale and subsistence-based, with an average farm size of 1.3 hectares. A frequent farming method is slash-and-burn, which creates temporary fertile land at the expense of mangroves (Romberg, 2016). Many families also raise small livestock such as goats and poultry, while larger animals like Zebu cattle are kept as financial assets and sold only in times of need.

Madagascar's climate varies widely across the island, ranging from dry, drought-prone conditions in the south to wet rainforests in the east and temperate inland regions (Britanica, 2019). Frequent droughts in the south, called Keres, are becoming increasingly common due to climate change and often lead to severe food insecurity. The island is also highly biodiverse, with about 90% of its species found nowhere else in the world.

The Malagasy diet consists primarily of rice, which makes up about 63.1% of total food consumption, along with roughly 300 grams per day of other starchy staples like cassava and sweet potatoes (Golden et al, 2019). While some protein comes from seafood along the coast and livestock inland, overall meat consumption is low, resulting in a diet high in carbohydrates and low in fats. Many people also rely on foraging and hunting to supplement their diets and improve nutritional diversity.

Access to healthcare and infrastructure further compounds these challenges. Madagascar has only one doctor per 10,000 people, and many individuals must travel over five km to reach medical facilities (Philipp, 2020; World Population Review, 2024). Access to electricity also varies widely, with only 7% of rural residents having electricity compared to 57% in urban areas ("Madagascar Energy Factsheet," 2025). This lack of infrastructure impedes economic advancement and makes the population more vulnerable to environmental stressors.

In recent years, climate change has been intensifying tropical storms, causing heavier rainfall, stronger storm surges, and coastal flooding (Colbert, 2022). Storm surges oversalinate land that could be used for farming, leaving potential agricultural land temporarily useless. Madagascar is one of Africa's most

tropical storm-prone countries with an average of six storms per year ("Cyclone Slams Madagascar," 2026). Madagascar is expected to face increasing agricultural risks as storm intensity rises.

Tropical storms are often more catastrophic for rural, farming populations than urban populations. In 2019, two tropical storms struck Madagascar within a span of 14 days, causing damage to an estimated 27,000 homes and dwellings ("Cyclone Slams Madagascar," 2026). Many Malagasy live on less than $1.25 USD per day, and 81% live below the poverty threshold. If one harvest is destroyed, it will be hard for them to recover. 85% of households report using half or more of their rice harvests for personal consumption, and 45% of those households reserved 75%. In the most recent tropical storm that hit Madagascar, 29% of farmers lost over 25% of their land, and 10% lost over 75% (Harvey et al., 2014). This is especially detrimental to subsistence farmers. Furthermore, in the last 5 years, tropical storms have affected 51% of farmers in Madagascar, which leaves an estimated 3.8million people food insecure. Due to the high frequency of subsistence farming in Madagascar, the majority of farmers do not have any savings to recover from a tropical storm, and less than two percent of farmers have a registered savings account with a bank. Tropical storms are way more devastating to poor and farming communities.

Many Malagasy farming families use their livestock as a sort of "savings account". Raising poultry and goats is seen as a way to guarantee that families have a way to not starve if their crops fail, but with the increase in tropical storms, livestock are no longer as reliable as they used to be. Furthermore, only 37% of families have close market access, which makes it much more difficult for families to sell their livestock (Harvey et al, 2014).

Malagasy farming families adopt various strategies to cope with the effects of storms, such as reducing meals, sending family members out to work for other farms, and harvesting wild flora. While working on others' farms brings in short-term income, it slows recovery of their own farms, as there are fewer hands to repair their own land.

Madagascar does have some natural resistance and protection against the impacts of tropical storms. Madagascar currently has over 1700 km^2 of tidal flats that are primarily located along the western coast and provide habitat for mangrove species, as well as help lessen the impacts of storms. They also house native species of marine and avian life that rely on the mangrove ecosystem. Madagascar is home to 9.5% of Africa's mangroves, with a total of nine distinct species present on the island (Jones et al., 2016). Mangroves reduce coastal erosion and sequester carbon, but their presence has declined over time. (Wu, 2025; Bardou et al., 2024). Between 1972 and 2019, the population of mangroves in Madagascar reduced by 8.04% (Bardou et al., 2024). While the rate of loss has slowed in recent years, Madagascar's mangrove decline continues, particularly in areas with higher population density.

Mangrove reduction in Madagascar has been accelerated by human activity. Globally, an estimated 25% of mangroves worldwide have been lost to human activity between 1980 and 2005 (Hochard et al., 2021). Additionally, mangroves are being taken down and given to cattle to eat, and then the area is being used for rice production. Mangrove populations in Madagascar are reduced by harvesting for fuelwood and timber.

Madagascar is home to a diverse population of trees, but the total tree cover is declining due to deforestation and slash-and-burn agriculture, preventing the growth of new seedlings. (Suzzi-Simmons, 2023). Mangrove wood is the most prevalent; however, these repeated acts against the mangroves lessen their protective qualities for Madagascar.

A study on mangroves and tropical storms found that mangroves in India protected coastal communities from an additional estimated 1.72 deaths per village in the 1999 cyclone. However, when mangroves are destroyed for economic benefit, they lose their protective quality and leave communities vulnerable

(Hochard et al., 2019). In 2014, Madagascar banned the extraction and sale of mangrove timber within ecosystems. Currently, over 900 km^2 of land is a protected mangrove ecosystem, but increasing that number would help protect future generations from the impending increase in tropical storms (Bardou et al., 2024).

A common solution to the declining mangrove population is tree planting to reverse deforestation. While beneficial, restoration efforts often fail without continued investment in the area. Global efforts like the Bonn Challenge, which pledges to restore 350 million hectares by 2030, have brought positive growth, but have also faced criticism for only using one species of plant and not fully restoring forests (Pearce, 2019). Madagascar pledged to restore 4 million hectares in 2015 (WWF, 2018). Blanket forest and tree restoration projects like the Bonn Challenge can help launch conservation efforts, but often fail to capture the nuances of varied ecosystems, limiting long-term success. Leveraging the rich expertise of locals is key to restoration. For example, specific mangroves require different salinity levels and therefore need to occupy specific areas in the ecosystem. Simply planting as many mangroves as possible might not be the best strategy. Instead, mangrove reforestation would need to be a collaborative effort between the non-governmental organizations (NGOs), like the Bonn Challenge, and the local Malagasy community.

The restoration of mangroves in Madagascar would take time and would need to have continued funding to see the project through. The eventual increase of mangroves in Madagascar would benefit only the coastal farmers and communities initially, but all farmers and people of Madagascar would benefit in the long run as they would be better protected against tropical storms. Healthier and denser mangrove populations would create stronger protections for farmland and therefore better support the Madagascar economy, as it would be better cushioned against the effects of climate change.

Another proposed solution to help restore Madagascar's mangroves would be to pay locals not to cut down the mangroves for firewood and instead guard and plant them. Current projects, such as the Tahiry Honko Project, aim to restore and build up the mangroves while also making sure that community members have an active role in their longevity (Tsipy, 2021). This is accomplished by including marginalized groups, such as women and children, to further their involvement and increase their stake in the restoration. Women and children have also been introduced to alternative ways of making a livelihood, such as cucumber farming and mangrove beekeeping ("Tahiry Honko", 2018). This helps create agency and reduce reliance on the mangroves and could help to stabilize household income. An additional initiative is taking place in Madagascar right now in the Eden: People + Planet Project, which is an NGO that has been working in Madagascar since 2007 and has planted over 5 million trees while providing fair wages to local workers (Reuters, 2016). Supporting the citizens of Madagascar through their Employ to Plant program provides people with consistent wages–Payment for Economic Services (PES)–allowing people to buy basic necessities and acts as a safety net to explore other methods of farming with new technology and ideas. It also provides the opportunity to send their kids to school, which is a chance to break the cycle of poverty. The Employ to Plant Initiative also promotes less destructive behaviors towards the environment, such as using the mangroves for charcoal fuel. The PES system has found success in other parts of the world facing tree loss, such as in Costa Rica. In 1950, an estimated half of Costa Rica was covered in forests, but that number dropped to a quarter by 1995 (UNFCCC, 2021). In order to try to reverse this, Costa Rica began entering into multi-year contracts with farmers and landowners to try to restore the forest by offering monetary incentives for positive ecological practices. The PES system in Costa Rica has had many positive outcomes for native communities, women, and children. It has allowed them to build and restore infrastructure and increase access to doctors. The continued implementation of an equivalent program in Madagascar is likely to have a similar effect in benefiting citizens.

Solutions to mangrove loss in Madagascar vary, but must all center on the Malagasy people by ensuring long-term community sustainability. Keeping local leaders and respected community members in

leadership when implementing these would increase buy-in from the community members. Consulting local leaders would make the efforts more culturally cognizant and have greater long-term viability and longevity. For all solutions, the most important thing is making sure that local needs stay at the forefront of decision-making.

In order to best restore and preserve mangrove populations, the best solution may be to provide monetary incentives to the Malagasy people through a PES system. This solution would be the most long-term and sustainable, as it would set up the Malagasy people through the creation of a financial cushion due to consistent wages and the ability to explore new farming techniques. This solution has the ability to revitalize the way farming and food production are conducted in Madagascar. These efforts will result in the betterment of mangrove forest health and abundance, which will then offer the island more protection against tropical storms, causing less damage to farmland and putting less strain on farmers. In addition to farmers' crops faring better due to the presence of the mangroves, they will also be supplemented with consistent payments from the PES system, which, when combined, should allow the farmers to restore their land more efficiently and enable Malagasy families to recover faster from tropical storms and other disasters. Moreover, the PES payments give farming families the ability to invest in more sustainable farming practices such as rice intensification and regenerative agriculture. The consistent PES payments will also allow more children to attend and finish school, providing the opportunity to end the poverty cycle in low-income families.

The PES plan would require significant funding to start and maintain. In the beginning, the project should be funded by a combination of NGOs and the Government of Madagascar. The payments should be high at the beginning as there will be significant progress made in restoring and protecting the mangroves. These large initial payments should be used to improve current agricultural systems and transition them to more sustainable technologies and methods. The payments will ensure farmers are not devastated if new farming practices are not successful. Smaller, continuing follow-up payments will provide a steady source of income, improving quality of life and long-term savings. This PES plan should not be phased out over time. By continuing PES even after mangrove ecosystems have been restored to a healthy level, it encourages people to leave the mangroves alone and let them thrive. Climate change is heightening the severity and frequency of tropical storms, so new farming techniques and technology that stem from the PES, combined with the restored mangrove ecosystems, will help to make sure that Madagascar's farmland can thrive.

In order for this project to be successful, it is necessary that the Government of Madagascar place more restrictions and fines on the use of mangroves by fuel and fishing corporations. Mangrove restoration efforts could be easily reversed if the mangroves are immediately being chopped down again for fuel and slash-and-burn farming. Severe fines must be placed on any entities that harm the restoration of the mangroves. All the money collected by fines would then go back into the PES and restoration funds.

As previously mentioned, the leadership of any project regarding mangroves should include the knowledge and experience of local leaders in Madagascar. The people of Madagascar are more likely to participate in an initiative headed by local and cultural leaders who understand their values, rather than outsiders. NGOs, non-profits dedicated to reforestation, and scientific experts should all be a part of the conversation as well. It is evident that the restoration of Malagasy mangrove forests must be a multilateral effort.

The most valuable resource in the fight against mangrove deforestation is the Malagasy people's cultural and ecological knowledge of mangroves and their ecosystems. Locals know how to care for and support these integral mangroves, but persistent poverty and resource scarcity have left many with little choice but to rely on unsustainable practices for survival. The locals hold so much knowledge about the mangroves

that has been passed down from generation to generation, and they are the key to restoring the groves to their former glory. Lasting mangrove restoration will depend not only on environmental policy and funding, but on empowering local communities to apply the knowledge they have preserved for generations.

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