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Indonesia, Climate Volatility

Indonesia: Mitigation and Adaptation Techniques to Improve Climate Change Caused Food Insecurity

Indonesia is an archipelago nation off the Southeast Asian coast, bordering Timor-Leste, Malaysia, and Papua New Guinea (“Indonesia,” *GlobalEDGE*). In 2021, Indonesia’s population was about 276,362,000, making it the fourth most populated country in the world. Approximately 56% of Indonesians live in urban areas and 44% live in rural areas (2019) (“Indonesia,” *UNdata*). President Joko Widodo leads a Presidential Republic (“Indonesia,” *GlobalEDGE*) from the capital Jakarta on the island of Java (McDivitt et al.). Indonesians face many issues with human rights, poverty, and infrastructure, all of which are interconnected, strain food security, and will only worsen with the impacts of climate volatility.

Indonesia has a tropical climate: hot and humid, though it is more moderate in the highlands. The terrain is mostly coastal lowlands with mountains on the larger islands’ interiors (“Indonesia,” *GlobalEDGE*). There are approximately four hundred volcanos, and about a quarter are still active. Lava and ash make the soil very rich and fertile, conducive to rice farming (“Culture”). Indonesia boasts the third largest tropical rainforest in the world and is home to the world’s largest tropical peatlands and mangrove forests (“The World”).

One-third of Indonesia’s land is cultivated for agriculture (“Agricultural”), representing the third largest economic sector and employing nearly 28% of Indonesian workers. Agriculture is dominated by small-scale subsistence farming with average farm size under one hectare (“FAO”). In comparison, the average US farm size in 2019 was 179.69 hectares (“Farms”). Rice is Indonesia's staple crop and predominant dietary energy source; other major food crops include corn, cassava, soybeans and peanuts (“Indonesia,” *WTO*). Beef, chicken and fish are common protein options. Some common vegetables in Indonesian diets are carrots, green beans, potatoes, and cabbage (“Culture”). The primary food agricultural practices are permanent irrigated rice farming called *sawah* and rotating swidden, a form of slash and burn (“Culture”). Indonesia is a top global producer and exporter of tree crops including rubber, copra, palm kernels, palm oil, coffee, cocoa, and spices (“Indonesia,” *WTO*). Because Indonesians depend on agriculture for their nutritional and economic needs, strategies to sustain production despite climate challenges are essential.

Family life varies greatly between rural and urban centers as “urban dwellers generally have a higher standard of living than their rural counterparts, but the availability of adequate housing, potable water, and public transportation services has remained a critical concern” (McDivitt et al.). Family sizes vary minimally, with most families in rural areas averaging 3.9 people per household (“Share”), a little higher than in urban areas. On Java, rural village homes are typically made from wood or bamboo, although wealthier families may build with locally made bricks. In most rural homes, the floors are made “of pounded earth, concrete, or raised wood, while wooden framing supports walls of woven bamboo matting; the roofs are of dried palm fibre, tiles, or wood” while urban floors are “of cement or tile”

(McDivitt et al.). Building materials and styles, and by extension the resilience and stability of homes, varies by urbanization.

Most people in Indonesia are lower to middle income: “around half of the population lives on the national poverty line, which is around \$16 per month and 28 million live below it” (“Indonesia,” *Educate*). If they are not farmers, workers have marginal wage jobs in manufacturing or service sectors (“Indonesia,” *GlobalEDGE*). In agriculture, men and women often share duties, especially in subsistence farms. The average monthly wage for most Indonesians in the agriculture sector is 1.97 million rupiahs, or 135.87 USD (“Share”). Other than farming, “men predominate in hunting and fishing. Women are found in the urban workforce in stores, small industries, and markets...but nearly always in fewer numbers than men”(“Culture”). Women usually teach in elementary schools, while men are usually teachers in secondary schools and colleges (“Culture”).

Poverty and urbanization influence a family’s access to education, healthcare, nutritious food, and physical infrastructure. A good education is uncommon for typical rural Indonesian families. Primary education enrollment rates are below 60% in these areas (“Indonesia,” *Educate*). Although many Indonesians have some education, there is little governmental funding for quality schooling. Similarly, the healthcare network is hard to reach, even in urban areas, because of medical staff shortages. Some rural families turn to more accessible traditional healers (McDivitt et al.). For most urban Indonesians, food is easily attainable by shopping local vendors, but rural communities struggle to get enough nutritious food, especially during off season farming. (McCarthy and Zohari). Nationwide, Indonesia faces challenges with physical infrastructure including potable water and sanitation, roads and transportation, internet, and emergency response. About “18 million Indonesians lack safe water and 20 million lack access to improved sanitation facilities” (“Indonesia,” *Water.org*). In 2017, a UNICEF survey found Yogyakarta, a smaller urban center, to have “89 percent of water sources and 67 percent of household drinking water were contaminated by fecal bacteria.” Furthermore, “only 7 percent of wastewater in Indonesia is treated” (“Water”). Poor quality roads and inadequate transportation modes make moving goods to rural areas difficult, isolating many communities from services, products and foodstuffs, and inflating their prices if they do have access to these resources (Tarahita and Rakhmat). In contrast, about 93.5% of rural Indonesians have access to some sort of internet (“The World”). However, only 3% of Indonesia’s population has fixed broadband connectivity, there are more than 26 million people with no connectivity or only 2G across Indonesia (“Indonesia Rural”). Additionally, Indonesia experiences an “... average of one major disaster every month, including earthquakes, volcanic eruptions, tsunamis and climate related events like floods, droughts, and landslides. The country’s size and geography pose significant logistical and operational challenges to emergency response” (“Indonesia,” *World*). Damage from disasters exacerbates health and food security challenges, especially for low-income and rural families.

Climate volatility in Indonesia is expected to cause many changes which will impact food security. The changes are due to a combination of human and natural factors, though fossil fuels and pollution are the biggest causes (“Indonesia,” *ClimateLinks*). Deforestation for palm oil is happening at an alarming rate (almost 500000 hectares per year) causing loss of habitats, biodiversity and the rainforest- a vital carbon sink (Dunne). The climate projections for Indonesia include increased/more frequent precipitation, sea level rise, and increased temperature. These climate changes will impact food security by altering growing seasons, soil quality, aquatic ecosystems, and natural disasters (“Indonesia,” *ClimateLinks*).

Warmer, more acidic oceans will rise and soil will get saltier, impacting what seafood and crops can be harvested for food. Climate Action Tracker rates Indonesia as “highly insufficient” indicating that “Indonesia’s climate policies and commitments lead to rising, rather than falling, emissions and are not at all consistent with the Paris Agreement’s 1.5°C temperature limit” (“Indonesia,” *Climate*). According to ClimateLinks, if they cannot find ways to adapt, it will be hard to import food because of the infrastructure difficulties they are facing, as well as the impending rising sea levels harming important coastal towns needed for imports and exports (“Indonesia,” *ClimateLinks*).

Climate volatility will have an even greater effect on women, children, the elderly, and minorities. Because men in Indonesia typically are the primary earners in the family, these groups are at a disadvantage in terms of being able to support themselves and their families. Flooding, droughts and different rain patterns will cause food prices to go up, putting them at an even worse disadvantage. For example, the Nairobi Global Centre on Resilient Ecosystems and Desertification states, “Recent changes to climate patterns and the devastating loss of income, following catastrophic weather conditions, has meant women in community have struggled to sustain their livelihoods while balancing their household responsibilities” (“Indonesia,” *Nairobi*). Women are the primary caregivers in many communities, and if these climate atrocities get worse and happen more frequently, the effects of food insecurities will worsen amongst children and the elderly. For Indonesia to adapt to climate volatility, substantial policies and goals must be enacted and followed through.

One possible solution that would benefit Indonesia is to increase mangrove conservation. Mangroves, one of the best natural carbon sinks, are found along Indonesia’s coastline. According to the World Wildlife Fund, “The amount of carbon stored beneath these trees is estimated to be up to four times greater than that stored by other tropical forests, making these coastal forests extremely valuable in the fight against climate change” (Barnes). By countering Indonesia's carbon dioxide emissions from inland deforestation and other industrial practices, the protection and expansion of mangrove forests will help the nation and the world. Mangroves are also proven to protect coasts and coastal communities from storms, flooding, rising sea levels, and erosion, all problems that Indonesia is predicted to face as a result of climate change (Barnes). By creating a plan to conserve and expand their mangrove forests, Indonesian coastlines, farms, and all communities will be better protected from climate change. Protection from flooding and erosion will allow farmers and fishermen to increase their yield as well as the quality of their product. Increasing the network of mangrove roots will protect infrastructure of ports, buildings, and roads from increased storm activity which will enable food transportation to remote, underserved areas. Mangroves have another added benefit of creating ecosystem biodiversity, which will increase the amount of fish and other organisms that could be caught by fishermen to feed their families or sell for income, improving food security.

This mangrove conservation plan could get a kickstart through outreach from organizations like Wildlife Conservation Society Indonesia and Mangroves for the Future, that go into these communities to do environmental assessments. During their initiatives, they can provide education to local fishermen on how to fish sustainably alongside the mangroves (Indonesia,” *Mangroves*). As part of their mission, these organizations also work with local governments to assist them in establishing community led conservation efforts, and financially support them until they have a solid program (“Wild Places”). After the protected areas are set up and secure, average Indonesia citizens can become even more involved with the planting

and conservation project alongside their government. The program and management could be run by community members, creating more jobs and income for families. From there, those local governments as well as the organizations could partner with schools to educate and involve school age children with conservation, which has economic benefits in their community. The community led programs could hold action events/planting events/education events, where families could go and help or learn about the mangroves. The events could be organized around existing community events and priorities, to make sure it is not a strain or viewed as a challenging thing to participate in.

Even with these advantages and help from the organizations, mangrove conservation has challenges. To ensure that there is no additional mangrove loss from human activities, the legal framework and the participation of stakeholders, and more importantly, community members, is needed to avoid conflicting with socioeconomic issues (Sidik et al.). Unfortunately, another challenge is that newly planted mangroves will take time to grow. Additionally, if any full grown trees get cut down or are damaged, the progress will be halted because of the release of the carbon dioxide that the trees store. However, because portions of Indonesia's mangroves are already under protection in conservation areas (Sidik et al.), it is possible to build from these efforts and increase conservation and growth of more mangrove forests.

Another more adaptive solution to climate volatility-induced food insecurity is rice integrated crop management systems. An example of this is the minapadi system of rice farming. The minapadi system, otherwise known as rice-fish farming, used to be a popular method in many parts of East and South Asia, but with new technology, the practice faded away ("Minapadi"). Now, minapadi is beginning to make a comeback. The system has many advantages for farmers, their communities, and the climate. Minapadi systems allow for minimal use of fertilizer. The fish are natural predators for any pests of the rice, and all of the weeding can be done by the fish, saving time and labor. In addition, the farmer can make double income by selling the fish (Matsuura and Sakagami). This is beneficial for rural families struggling with food security and income issues. Because farmers can produce two goods, they make more money, and are able to feed more people in their community. They save time and money implementing this system because "...the innovative rice-fish farming system uses a sustainable 'ecosystem approach' through zero pesticides and significantly reduced levels of chemical fertilizers" ("Minapadi"). With help from the Food and Agriculture Organization, a United Nations specialized agency, farmers around Indonesia have started to see results when implementing this technique with their rice. Indonesia became a member of the FAO in 1948. With their goal of achieving food security for all and making sure people have access to high quality food, the FAO is a reliable, well-known agency that is perfect for this project ("About FAO"). The FAO reports that "rice production increased, incomes went up, and levels of nutrition have started to improve. The average rice yield increased from 6.5 tonnes/ha to 9.3 tonnes/ha with higher quality rice as farmers can sell the rice as 'healthy rice'. Also, the sale of fish reached as much as Rp 42 million per ha per season" ("Minapadi"). With this method, farmers are able to make more money and produce more quality goods for their consumers.

This type of farming is attracting many nations because of its sustainability and success rates. The FAO reported that "representatives from 15 countries...expressed their interest to replicate the rice-fish farming approach in their own countries, and other parts of Indonesia" ("Minapadi"). By adopting this method, Indonesia can increase the amount of sustainable farming practices used and increase food security by producing more quality food, making it an appropriate solution to take on both challenges of climate

change and food insecurity. For Indonesia especially, it is appropriate because it is a technique that has been previously used, and can be easily implemented into the rice farms that are already there. With help from the FAO which is already in Indonesia, farmers can switch over to this more sustainable practice.

Implementing minapadi systems on a larger scale, however, may have some challenges. For example, for non-rice farms, this technique may not be viable. However, because rice is the staple crop and food in Indonesians' diet, transitioning to this sustainable technique for rice may prove a tangible first step. Another challenge that Indonesians may face while trying to promote this practice is education. In harder to reach rural areas, it may be harder to educate farmers on how to utilize this system and may prove costly trying to do so. However, with the help from the FAO with the Ministry of Marine Affairs and Fisheries and local authorities ("Minapadi"), this system might be able to be taught all over the country to make a meaningful impact on food security in Indonesia. The FAO "has contributed about half of million US dollars to develop and demonstrate the good practice, with around 500 farming families benefiting directly from the program ("Minapadi"). FAO representatives and farmers who have adopted this technique can set up more programs to enable access for others to implement this system. Learning this method from fellow experienced Indonesians could make the transition to the minapadi less intimidating for farmers that are being encouraged to make the switch.

Both of these solutions would help meet the food security and economic needs of many Indonesians. By implementing these two solutions at the same time, the country would be able to mitigate and adapt to climate volatility, improving access to their nutritional needs. Funding of similar projects through non-governmental organizations have had success, so using that same strategy for these proposals shows promise. Organizations like World Bank, USAID, WCS Indonesia, and Mangroves for our Future, some of which are currently doing this, can provide funding, education, support, and management to local governments and community members to get them started in mangrove conservation. Currently, the Wildlife Conservation Society Indonesia has conservation initiatives in multiple provinces (Patlis). By working together with the United Nations and the communities in Indonesia, organizations like the Wildlife Conservation Society Indonesia can work to expand the reach of these conservation efforts. Conserving the trees already there and planting new forests where mangroves do not naturally occur can be great ways to gain coastal protection from climate change events (Spalding et al.). By holding community plantings, and creating coastal management services, Indonesia can greatly increase healthy mangrove cover.

Education will also play a big part in both of these solutions. The FAO is already teaching many farmers how to benefit from the minapadi system. If the government gives incentives to farmers to teach their neighbors how to transition to this system, more and more farmers and their families will be able to increase their rice production profits and food security. In developing these plans, we have to consider that it may be difficult for farmers or communities to change their traditional way of earning income. That is why funding, outreach, and partnerships for educating rural communities is vital, for allowing communities to see the impact they can make on their country for the better. By protecting the environment with these sustainable solutions, hunger and poverty will be reduced in Indonesia.

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