

Celia Anthony

Century High School

Sykesville, MD, USA

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## **Aquaculture as A Multi-Sided Solution for Philippine Farmers**

In the Philippines, climate change is destroying already crumbling infrastructure and endangering the livelihood and food security of fishers and farmers alike. Alternative forms of farming like aquaculture may help boost the economy while simultaneously keeping farmers on their feet.

The Philippines is a volcanic archipelago in the west Pacific Ocean. Its islands can be categorized into three main groups: to the northwest, Luzon, Mindoro, and Palawan; in the center, the Visayan islands; and to the south, Mindanao. The Philippines is the 12<sup>th</sup> most populous country and will be home to an estimated 114,755,000 people by 2023. (“Philippines”)

The nation’s climate is monsoonal and tropical, with a wet season and a dry season. Typhoons, or tropical cyclones, frequently hit the Philippines from June to December. The northern and central islands usually take more damage from these storms than Mindanao.

Soil fertility varies throughout the islands, from the dark, mineral-rich soils found in the Visayas to sandy soils in the coastal plains and dry earth in eastern Luzon and Palawan. There are five main rivers in Luzon, and two main rivers in Mindanao. This provides the two large islands with rich soil and sediment from the rivers’ alluvial plains. The sloping hills and low mountains that make up the main parts of the islands have volcanic ash mixed with fertile soil.

The nation’s export crops include rice, corn, coffee, sugarcane, and various tropical tree fruits. Accordingly, agriculture is a major part of the Philippine economy, with one-third of the workforce making a living in the agricultural sector. However, in 2012 only about 23% of the Philippines’ total land was used for agricultural purposes. In the same year, the average size of a farm or holding was about 1.3 hectares, or about 2.5 football fields (Bersales).

Information concerning the life of a typical family has been collected through Unbound, an international nonprofit organization that supports families in poverty through sponsorships. (“Our Approach”) My family sponsors a 15-year-old girl named Maika, who lives in the Philippines with her parents and three brothers. Her house is made of bamboo with a thatched roof and a dirt floor. The beds are made of bamboo, with a mat and blankets. has electricity, but no running water. Maika’s family grows many native fruits and vegetables in their garden, including string beans, squash, ladyfingers, eggplant, mango, guava, coconut, and papaya. They also eat mudfish and rice, and they use firewood for cooking. They have access to roads, local markets, and a school, but in the past, Maika’s family’s income was barely enough to support educational needs and may have not met daily needs at times. However, through sponsorship, Maika’s family increased their food security and stability in school. (Maika to Jennifer Anthony et al, 19 Dec. 2017 – 6 Aug. 2020)

Maika’s father, mother, and older brother are employed, and her mother also takes care of the household. (Her parents both work in industries related to agriculture, with her mother serving at a restaurant and her father delivering fish and later working as a reaper operator assistant.) The family received government

relief goods during the pandemic and continue to receive funding from their sponsor through Unbound. Although Maika's parents' wages are unknown, the average monthly wage in the Philippines in 2020 ("2020") was 16,486 pesos (337 USD). This is less than one thirteenth of the US average monthly wage in the same year. (*National*)

One major issue that Maika's family and millions of others in the Philippines experience is the increasing severity of typhoons. Typhoons occur annually in the Philippines (about twenty each year) during the rainy season, but in recent years they have been happening more often and with more strength.

Farmers really struggle in the face of these natural disasters. Flooding and high winds from a singular typhoon can wash their entire harvest away, and before they have time to recover, another storm hits. In 2021, Philippine agricultural yields decreased by about 2.6% because of weather-induced crop damage. (Santos)

According to Deutsche Welle, fishing communities have similar problems- higher ocean temperatures harm the breeding grounds of the fish they depend on for food and income. Moreover, tropical storms make fishers' lives on the water much more dangerous.

While these trends create poverty in different ways, they all point back to two causes: climate change and underdevelopment. Climate change describes the rising sea levels, acidification, longer droughts and more intense storms that are products of the warming of Earth's atmosphere and oceans. A plethora of human-initiated practices, such as burning fossil fuels, unsustainable agricultural practices, and deforestation, are all responsible for releasing the greenhouse gases that trap heat in the atmosphere. ("Drawdown")

Despite releasing little greenhouse gas, the Philippines is currently one of the top ten countries most affected by climate change. It does not help that the country is still very underdeveloped. Weak infrastructure has exacerbated the impacts of typhoons on the country. Many homes, especially in rural areas, are not well constructed, and only 20% of the nation's roads are paved, leading to increasingly worse conditions during storms. (FutureLearn) Furthermore, in spite of its fast-growing economy, the Philippines still has high unemployment (*Unemployment*) and poverty rates. According to the International Labour Organization, over 40% of Filipinos were living on under \$2 a day in 2021. (*Philippines - Country Brief*)

As one can see, conditions in the Philippines are already precarious. With the onslaught of climate-change-powered typhoons (*Impacts*), however, the effects are disastrous. The damage that the storms cause to both farms and structures contributes to worse circumstances when the next storm rolls around, creating a vicious cycle. (Serrano)

It is clear that the nation needs to improve their infrastructure and increase humanitarian efforts (like those of Unbound) in order for communities to recover fully from natural disasters like typhoons. However, such a project would be on an exceptionally large scale and would require funds that the Philippines cannot spare. It is also clear that the nation needs an immediate alternative to their current farming crisis. Reforming the Philippines' infrastructure is necessary, but it would take much too long to supply a prompt solution.

On that account, ecologists are exploring other practices that may be more resistant against storms and produce more economic opportunities. Take, for instance, aquaculture. Aquaculture, or the farming of marine organisms (US Department of Commerce), is a rapidly growing industry worldwide. Unlike land farms, it does not have problems with pests and pesticides, weeds, high winds, or flooding. When organized the right way, aquafarms can even help restore ocean ecosystems, while providing a stable food

and income source. (Hausheer) And in the Philippines, it could boost the economy enough to begin major infrastructure projects.

In fact, the Philippines already uses aquafarming quite a lot. The nation is one of the top fifteen countries in farming aquatic organisms and has been raising some kinds of fish for food for over 50 years. (Soriano) So, scientifically speaking, it would not be hard for the country to expand its aquaculture production to a large extent.

Aquaculture is truly diverse in that different organisms are farmed using different methods, in waters with different salinities. For example, Fletcher writes that seaweed thrives in salt waters, and is healthiest when grown in open underwater beds. Some organisms, especially fish, can be bred in cage farms for a small investment. (Cline) Others, like clams, are raised in nursery boxes and eventually planted onsite. (“Clam”) And still other shellfish, like mussels, are best harvested in loops of line on both inshore and offshore farms. (Plew) Nonetheless, there are drawbacks to each of these methods: open farms require the owner to have a marine license, and closed cages can easily spread disease and attract predators. But with prior knowledge (from current aquaculture methods) of which organisms grow best in which areas, aquafarmers could maximize their harvests.

These various marine organisms are important to the Filipino diet and could provide a reliable export for the nation. But why stop at growing marine life- especially when there is a productive way to cultivate a food source that is even *more* essential to the Filipino and East Asian way of life? Rice is a major export crop and food staple in the Philippines and surrounding countries. It is also very vulnerable to spoilage and losses caused by climate change. Serrano explains that increases in temperatures, ocean levels and water salinities all dramatically reduce rice yields. One problem that the poorest rice farmers may especially face in coming years is drought. Rice is a crop that heavily relies on constant irrigation and high water levels to flourish. Without the usual rainfall to nourish their rice, farmers could be in big trouble.

One alternative to the rain-fed rice typically grown in the dry season is the installation of floating rice paddies. The rice plants would rest on floating paddies in bodies of freshwater. This way, farmers would not have to worry about the water levels that come with growing lowland crops. (*Floating*)

Another potential farming possibility is hydroponics. This practice involves the raising of plants without soil. (“Successful”) In the northern islands of the Philippines, where the soil is dry and not suitable for farming, hydroponics systems could be implemented.

The Philippine’s tropical climate is actually perfect for this- according to Hydroponic Way (“Successful”), warm areas that receive substantial sunlight are ideal for growing most crops. The most productive hydroponic systems for tropical areas are the ebb-and-flow system; the nutrient film technique (NFT); and the deep-water culture (DWC) system. The ebb-and-flow system is very easy to set up and has a simple mechanism: every couple hours, the crops are flooded, then drained. The NFT is slightly more complicated, but more efficient, pumping nutrient-filled water constantly past the crop’s roots. Last but not least, deep water culture hydroponics involve soaking the roots in a solution of water and nutrients, which is stirred by an underwater pump. (*How To Choose*)

Like aquaculture, hydroponics may also grow the Philippine economy to provide more funds for infrastructure. And if hydroponics succeeds (on a large scale) where land-based agriculture has failed, it may even serve as a nutritional replacement for the land harvest.

To initiate these practices, the wisest strategy would be to first set up offshore farming off the west coast of Mindanao, its Zamboanga Peninsula, MIMAROPA, and the Western Visayas (where typhoon damage

is minimal), and then expand to other regions. Caged fish farms could be started in more locations, but they must have the right water salinity and temperature. Likewise, small-scale hydroponics might be implemented almost anywhere in the Philippines; however, the larger operations should be located in Luzon, where the land is too arid for any other farming. This will allow for the most efficient use of land for agriculture throughout the country.

The harvest will need to be sustainably transported from farms to consumers through community markets. With a thriving economy, the Philippine government could collect the money they need to begin infrastructure projects.

But how would aquatic farming and hydroponics practices be implemented fast enough to support farmers? One way could be by putting the practices in the hands of the farmers themselves. Small-scale climate organizations could educate farming and fishing communities about aquaculture and how farmers and fishers could start their own aquacultural pursuits. One such organization, I Am HampasLupa, is founded by Filipino climate activist Ryan Bestre and advocates for ecological farming and a more positive image of farmers and fishers. (Bestre) Even digitally based organizations like DiscoverAgriculture (“Education”) have valuable resources that can inform farmers and fishers about sustainable aquatic farming.

However, while the farmers and fishers may be motivated to make aquaculture happen in their communities, it is very unlikely they will have the means to do so. Any small-scale aquaculture operation would need seed supplies and harvesting equipment such as cages, mesh nets, and rakes at minimum- not to mention boats, shellfish lines and buoys for offshore farms. Rice farms would need seedlings or young rice plants, paddies, manual harvesting tools, and most likely motor-operated harvesting equipment as well. For hydroponics systems, farmers would require seedlings, substrate, water pumps and piping, trays and grow beds for the crops, and the nutrient supplements to mix with the water. A larger system might even use a greenhouse to store the plants. (Rivera) These are all resources that most Filipino agricultural workers simply cannot afford. They would need considerable financial aid to purchase the minimum equipment.

This is where institutions such as Unbound, CARE International, and the World Food Programme come in. Unbound sends money directly to individuals based on their personal needs (“International”). CARE (“Community Based Adaptation”) implements locally based humanitarian development projects around the world. The World Food Programme (*Climate*) does a little of both, using a cash transfer program and climate management solutions to support millions of people. With these organizations on their side, the farmers and fishers of the rural Philippines would be able to successfully implement aquacultural practices.

From an outsider’s perspective, it may seem “easier” for these humanitarian aid groups to just supply the Philippines with the disaster relief it needs. However, that would not be an effective or efficient solution in the long run. The typhoons would keep coming, the nation would keep suffering, and the aid groups would only keep giving more and more money. Instead, here is a lasting answer to the issues of internally unstable agriculture and infrastructure. Like the proverb goes, “Give a man a fish and you feed him for a day. Teach him how to fish and you feed him for a lifetime.” This solution truly teaches Filipino farmers “how to fish,” in hopes that they will continue to be fed for many lifetimes.

Ultimately, an aquacultural approach in the Philippines would create a variety of economic opportunities and supply a sustainable alternative to the more vulnerable, inland agriculture. These practices would reduce harvest damage and could lift many farmers out of poverty. Last but not least, aquatic organisms, rice, and other such crops are already a staple of the Filipino diet. By increasing aquafarming, the nation would take a big step towards food security for its people.

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