



USAID DEVELOPING A SUSTAINABLE SEAFOOD INDUSTRY INFRASTRUCTURE IN MYANMAR AND ITS POTENTIAL EFFECTS ON THE COUNTRY'S ENVIRONMENTAL, ECONOMIC, AND SOCIAL SECTORS

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COUNTRY'S ENVIRONMENTAL, ECONOMIC, AND SOCIAL SECTORS

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Abstract

Sustainability is the intersection of the environmental, economic, and social sectors. A goal USAID project in Myanmar is to institutionalize sustainability in all three sectors of the seafood industry, especially the aquaculture. Myanmar is currently in a state of political, economic, and environmental turmoil, and a sustainable seafood industry and aquaculture would benefit the nation. The plan involves restoring invaluable aquatic natural resources, improving the supply chain and governance of the seafood industry, and creating stability through food security and social equity. The effects that each of these central goals of the project have on the country are guided through the principles that the GPO, a World Bank organization, uses in assessing programs with the goal of sustainability. The effects will also be confirmed through the comparison to Vietnam, a nation that has experienced a rapid growth in their aquaculture. However, because of the lack of sufficient resources placed in the environmental sector, aquaculture is experiencing problems that are affecting the economic and social sectors. This proves that not only will the desired results create sustainability in the seafood industry of Myanmar, but also demonstrates the importance of finding a balance between each of the three sectors.

Statement of Purpose and Relevance

The purpose of this research is to demonstrate that sustainable aquaculture has the ability to improve the environmental, economic, and social landscapes of a nation. When only one of these three sectors is considered in any business or system, it is inevitable that the resources will be used too rapidly, the economy will grow without any concern for environmental or social impacts, or the population will be at risk of food insecurity and inequality.¹ The goal is to prove that without considering each of the aspects of sustainability, the aquaculture business will not have long-term viability.

Myanmar is a developing, southeastern Asian country, that has recently switched from a military rule to a representative democracy. This governmental change has allowed the University of Arizona, as well as the other public and private interests to enter and assist the country in developing their sustainable aquaculture plan. While Myanmar has had a large fishing industry and aquaculture systems, their standards and business practices are not in line to be sustainable for the future. In addition, there was a 2008 natural disaster, Cyclone Nargis, that damaged the Myanmar fishing industry. It destroyed many fishing boats and aquaculture systems. Therefore, Myanmar is in an optimal position to develop sustainable aquaculture and fishery practices. There have already been many aquaculture systems advanced in developing countries across the world, however the sustainability of the systems have not been fully maintained. The successes from the implementation of the “plan” would make Myanmar an example for how future aquaculture systems should be developed to effectively yield sustainable systems.

¹ Ove Hoegh-Guldberg et al., *Indispensable Ocean: Aligning Ocean Health and Human Well-Being - Guidance From the Blue Ribbon Panel to the Global Partnerships for Oceans* (Washington, D.C.: World Bank, 2013), 12.

Introduction to Sustainable Aquaculture

In the modern world the health of the oceans has declined, directly affecting the countries that depend on marine resources. The lack of environmental consciousness has led to 75 percent of the world's coral reefs being at risk, in addition to the endangering of many other critical habitats such as mangroves, oyster beds, and estuaries.² Furthermore, when this lack of environmental consciousness is coupled with economic problems from mismanaged resources, detrimental results occur, such as in 2004 when an estimated \$50 billion was lost by fisheries.³ These vital ecosystems are facing degradation across the globe, and while the world leaders look at climate change and resulting temperature increases as the principal issue that needs attention, overfishing cannot be overlooked as a global phenomenon. The ocean was once thought of as an unlimited resource that could be used without any concern for the revival of the fish populations. Now, many countries that are dependent on fishing for both subsistence for the country, as well as their economies, are facing the greatest challenges. Often, these are the countries that have the highest rates of poverty. They have needed to turn to different methods in order to maintain their aquatic industries. Aquaculture has demonstrated the ability to fulfill an important niche in the survival of the low-income countries, however the need for sustainability of the aquaculture methods is often overlooked.

Aquaculture, or the farming of aquatic species, has demonstrated the ability to meet the demands of the fishing-based economies. Aquaculture can either be with marine species, including oyster, clams, mussels, shrimp, salmon and many others, or freshwater species from rivers and lakes, such as catfish, trout, tilapia, and bass. With both the marine and the freshwater species, aquaculture can be performed in the common water, meaning directly in the rivers,

² Ove Hoegh-Guldberg et al., *Indispensable Ocean*, 11.

³ *Ibid*, 11.

lakes, and bays, or adjacent to the common water.⁴ The main methods that are used in the common water are open-net pen and suspended-aquaculture, while methods such as raceways, recirculation systems, and ponds which are land-based. The previous methods can be classified as either high-risk or low risk methods. For example, open-net pen systems are considered high-risk methods as they allow for the unregulated exchange of waste, chemicals, parasites, and disease between the pens and surrounding water, and they also attract marine predators that can be injured or killed by the nets.⁵ Closed systems that are managed near common water are better alternatives, because they contain the wastes, diseases and other pollutants that escape through the net systems, in addition to removing the possibility that other marine animals are affected. Suspended aquaculture, used in growing primarily shellfish, also contributes to avoiding polluting the natural waters, as the species do not need any anthropogenic additions.⁶ The methods are used adjacent to the common water such as raceways, recirculation systems, and ponds, are low-risk as the water does not mix with the natural resources, or the water is treated to remove a majority of pollutants in the water. Countries that are dependent on fishing, and countries that are shifting towards aquaculture as their primary source of protein or industry, must use methods that will not damage the surrounding environment. At the same time, the environmental costs must be balanced with the social and economic costs, resulting in sustainable aquaculture.

With the increases in the world population, health consciousness, and poverty, aquaculture is a vital resource to many countries. From 1995 to 2007, aquaculture doubled, and

⁴ Kevin Fitzsimmons, *Where are the Needs and Opportunities for Investment in Myanmar's Aquaculture Sector?* (2015).

⁵ *Aquaculture Methods*, <http://www.seachoice.org/state-of-our-oceans-2/aquaculture-issues/aquaculture-methods/>.

⁶ Ibid.

according to the World Bank, it must double once more in future years in order to accommodate the growing need for the seafood industry.⁷ However, it must be done sustainably; meaning that it must be done where not only the economy or the society is considered. Without the proper ecological awareness, the ecosystems would not be able to handle the pressure from the increases of aquaculture. The three sectors, environmental, economic, and social, that must be incorporated into sustainable aquaculture are described below.

Environmental

Environmental protection is essential to maintaining the rate of development of aquaculture, and meeting the growing need of the seafood industry. The underlying goal of a sustainable aquaculture system must be to avoid any major disturbance to the ecosystem, which can result from a variety of factors. The first disturbances that can occur are the damages to wildlife that can result from aquaculture. As previously described, the open-pen net systems have the potential to attract marine predators that can become injured and killed when they become tangled in the nets. While this can be corrected through the closed systems, wildlife can be further damaged from using wild fish as fish feed. This can reduce the populations of ocean fish, and it would be unsustainable for these ecosystems as demand for seafood continues to increase.⁸ Because of this, aquaculture is starting to shift towards plant based feeds, which then leads to the necessity of agriculture, primarily soy, to meet the demand of seafood. This can be another environmental issue, because of the run off of nutrients and chemicals, such as nitrogen and phosphorus, from the farms. Run off can directly lead to eutrophication of water, and the lack of oxygen will kill the fish populations. In addition, there is the land demand from aquaculture. This

⁷ Randall Brummett, "Growing Aquaculture in Sustainable Ecosystems," *Agriculture and Environmental Sciences Department Notes*, Issue 5 (2013), 1.

⁸ Jillian P. Fry et al., "Environmental health impacts of feeding crops to farmed fish," *Elsevier Environmental International* 91 (2016), 201.

can result from the land requirement from agriculture, as well as the amount of land required for the aquaculture methods. While there are methods that can function within the natural bodies of water, the methods that need adjacent ponds and tanks can require vital coastal and riparian lands. One final environmental issue is the potential for the spread of disease from aquaculture. Many seafood industries world wide have lost billions of dollars and sometimes jobs, all because of diseases such as the white spot virus that affects shrimp, or salmon anemia.⁹

The environmental issues listed above can be mitigated through different practices. The conservation of the coastal lands that are fundamental to the ecosystems, such as mangroves, wetlands, and coral reefs is the most important environmental goal to accomplish. This can be done through ensuring that the exchange of wastes and other pollution generated from aquaculture does not reach the natural waters. Water quality must be maintained for the ecosystems, in order to improve the wild fish populations. Another way that the fish populations could be improved is through restocking or ensuring that the juvenile fish and eggs are not captured. Restocking involves aquaculture, in which the fish are grown and then released into the wild. Finally, there are different practices that can mitigate the disease outbreaks in seafood. There is the exclusion method, which involve limiting the exchange of water between aquaculture and natural waters. This method would be difficult to utilize in the aquaculture systems that are built in the natural waters. For these systems, improved management and control of the stocks of fish, water quality, and nutrition available could lead to healthier fish populations. New genetic technology also allows aquaculture farmers to feed their stocks

⁹ Mimako Kobayashi and Randall Brummett, *Disease Management in Aquaculture*, <http://www.agriskmanagementforum.org/content/disease-management-aquaculture>.

specific feed, and selectively breed for genetic resistance.¹⁰ While this does not require infrastructure changes, there is a time delay. Tested shrimp populations have required between 5-10 years to demonstrate the desired genetic resistance. The environmental problems that are being experienced stem from the lack of knowledge, which is unavoidable. Many developing countries that have started aquaculture do not have the environmental or scientific backgrounds necessary to account for the ecological effects that can arise.

While the environmental issues must be considered when looking at aquaculture, the impacts must be weighed against the impacts from other protein sources, such as beef, pork, and chicken. There are many statistics provided from the World Bank, but the following numbers demonstrate just how beneficial seafood, and consequently aquaculture, is to the world. Finfish have the lowest kilogram of feed to kilogram edible weight ratio, which means that finfish produce the most edible food relative to the amount of feed they are given. This is supplemented by the fact that fish have the highest protein efficiency as well. Finfish have the third lowest amount of nitrogen and phosphorus emissions relative to the amount of protein produced, just behind chicken. The lowest amount of emissions relative to protein produced are bivalve mollusks, such as clams and oysters, because they typically filter feed from their environment. They can be grown directly in the natural waters, without any necessary nutrient additions. The World Bank also reports the consumptive water use, and while beef is the highest user by far, finfish ranks slightly above both chicken and pork. However, water that is used in fish production can be treated and reused much easier than for the land counterparts. Just as any other food production, aquaculture does have environmental impacts that must be considered, but as demonstrated above, seafood has a smaller footprint.

¹⁰ Mimako Kobayashi and Randall Brummett, *Disease Management in Aquaculture*, <http://www.agriskmanagementforum.org/content/disease-management-aquaculture>.

Economic

The economics surrounding sustainable aquaculture have the fundamental goal that it can be practical and have long-term profitable results. Often, governments cannot see past the necessity for jobs and food security with the current problems of water scarcity, degraded land, and fluctuating climates, and will overlook the long-term end goal of sustainability. That is why investments from other governments, private interests, and nongovernmental organizations (NGOs) are needed. The additional investments introduce parties that are focused on the future generations that will be dependent on the sustainable aquaculture. While this can be seen as biased against the people who rely on the seafood industry currently, a balance must be found in which the future of the environment and economies are accounted for, just as in environmental sector. Aquaculture must be developed so the benefits that are created today will be able to be maintained into the future. In order to support the economic sector of sustainable aquaculture, there must be government and international regulation, and compliance to this regulation. While the compliance to regulation must start with the farmers, the companies that are buying from the farmers must ensure that the regulatory procedures and standards are being met. Sustainable aquaculture depends on an effective enforcement of the regulations, from the production of the fish feed, through the processing and transport of the end product. One final part of economic sustainability is that the aquaculture business is both profitable, and can maintain itself, while also be accessible to the domestic economy.

Social

The social aspects of sustainable aquaculture are just as important as the environmental and economic sectors and include both having aquaculture that is socially responsible and

contribute to community well being.¹¹ There are a variety of standards that aquaculture must follow in order to be determined socially sustainable. The first involve the working force of the supply chain of aquaculture. Worker safety, decent labor conditions, such as hygiene standards, and equitable compensation for work are necessary for the social sustainability. This ensures that workers are all treated equally, regardless of gender and income levels. Also, there should be domestic food security that is developed from the sustainable aquaculture. With the addition of many international interests, such as private companies, there is the potential that the improved aquaculture product becomes too expensive for the domestic producers to sell to their own people

Current State of Myanmar and its Fishing Industry

The country of Myanmar has a history of being politically unstable. Just recently has the civil war between the military government and insurgent populations finally ended, and a representative democracy has taken over. With democratic elections foreign relations improved, allowing for the foreign assistance the country needs. It is one of the poorest nations in Southeast Asia, and dependent on the production of their natural resources to boost its economy. Figure 1 shows the economic status of the country in relation to the rest of the world. However the lack of technology and adequate infrastructure, as result of the many years spent in civil war, has limited its ability to both effectively develop their resources, and recover from environmental hazards. In 2008, Myanmar was hit by Cyclone Nargis which killed over 138,000 people and caused \$10 billion in damages. A majority of these damages were experienced by coastal communities in which many fishers died and villages destroyed. Socially, the civil war had resulted in many human rights violations, and the fact that it remained a developing country resulted in both the

¹¹ *Sustainable Aquaculture*, <http://www.worldbank.org/en/topic/environment/brief/sustainable-aquaculture>.

lack of education, and women's rights. Furthermore, 2009 numbers demonstrate that 30 percent of the 50 million people in the country live in poverty, in addition to life expectancy 10 years before the average for the surrounding countries.¹²

As there are abundant fishing resources in Myanmar, it has become a major source of protein and as one of the highest per capita consumption in the world.¹³ In addition, the fishing industry represents a primary portion of the country's economy, important for both income and employment. Myanmar is dependent on capture and aquaculture methods. The capture methods are primarily used for marine species, while aquaculture methods target the production of freshwater species. Figure 2 and Figure 3 demonstrate these trends, how the marine species are more prevalent in capture production and how the freshwater species are more prevalent in aquaculture production, respectively. However with the increasing amount of environmental disasters that will be caused by climate change, such as Cyclone Nargis, the coastal ecosystems such as the mangrove forests and wetlands are at risk of being destroyed. These coastal areas are vital for the fishing industry and many villages that depend on fishing for subsistence, and that destruction can put those two in jeopardy. The stress of both severe environmental events and the excessive dependence on fishing will not allow the ecosystems to sustain the use of the resources through the future generations. The following sections will discuss both marine and freshwater fishing in the country, including techniques, environmental impacts, and management.

Marine

The fishing of marine species in Myanmar generally consists of commercial techniques such as trawl nets, purse seines, driftnets and gill nets. There are traditional fishing techniques

¹² *Fishery and Aquaculture Country Profiles: The Republic of the Union of Myanmar*, <http://www.fao.org/fishery/facp/MMR/en>.

¹³ *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

that are sometimes used, but the commercial techniques capture the majority of the landing, or amount of fish harvested.¹⁴ The commercial techniques, such as trawl nets and driftnets, are very detrimental to the environment, as they can damage the sea beds, aquatic plants, and coral, and they contribute large amounts of by-catch. The damage to the ecosystems that result from these techniques have led the country to ban them within 5 nautical miles of the shore, in hope to protect the coastal communities and juvenile fish. Additionally, the country has banned many other fishing techniques completely, under their Fisheries Law and Foreign Investment Law of 1995.¹⁵ Still the maximum sustainable yield determined by Food and Agriculture Organization (FAO) of the United Nations for Myanmar has been exceeded by at least 50%. This demonstrates the need for long-term management of fishing, and adaptation to the changing climate.

Freshwater

The inland fishing of freshwater species occurs in the 8.2 million hectares of water systems, including lakes, reservoirs, rivers, and ponds.¹⁶ The principal fishing techniques that are used are stow nets, gillnets, and traps for prawn, crab and eel. Stow nets are the most widely used, but similar to the commercial marine techniques, have environmental impacts that include catching many juvenile fish. Due to the overfishing that also occurs in the freshwater bodies of the country, the Myanmar Department of Fisheries has restocked the reservoirs, lakes and rivers, in hopes to maintain the production levels and a balanced ecosystem. The country's already installed aquaculture is a bulk of the production of the inland fishing industry. The species that are farmed are Rohu carp, additional species of carp, tilapia and silver barb. Recently, the farming of soft-shell crabs, seaweed, and shellfish is shifting towards seawater, as the pressure

¹⁴ *Fishery and Aquaculture Country Profiles: The Republic of the Union of Myanmar*, <http://www.fao.org/fishery/facp/MMR/en>.

¹⁵ Ibid.

¹⁶ Ibid.

from the farming of these species in freshwater is putting excessive pressure on the stocks. There are 200 aquaculture farms that are currently active in Kayan, an area east of Yangon, the former capital of the country and largest city. However, with the changing environment and continuing dependence on the fishing industry, Myanmar must look towards both expanding its aquaculture and move towards a sustainable system. There are advantages and disadvantages of implementing it in Myanmar must be discussed. To start, benefits are that there are many resources in the country, such as land and water, in addition to the labor force committed to the seafood industry. The improved international relations, the recent more favorable tax structure, and the established feedmills and available markets are also advantageous.¹⁷ On the other hand, challenges that arise are market problems, high import and export taxes, high production costs, and the recent environmental disaster, Cyclone Nargis.¹⁸ In addition, there must be a switch from the current procedures of feedmills, farms, and hatcheries.

Myanmar Sustainable Aquaculture Plan

The World Bank instituted the Global Partnership for Oceans (GPO) in 2012, which is “a global, public-private partnership, with the aim to address three key ocean challenges: (1) increase sustainable seafood and livelihoods from fisheries and aquaculture, (2) reverse habitat loss, and (3) reduce pollution.”¹⁹ This partnership was designed to provide investments in projects created to protect oceans and encourage sustainable uses of marine resources, and it designated five guiding principles in assessing the projects seeking investment. It is important to mention that the GPO is both not a party involved in the sustainable aquaculture project in Myanmar and not focused on freshwater projects, but the principles it outlines provide a

¹⁷ Kevin Fitzsimmons, *Where are the Needs and Opportunities for Investment in Myanmar's Aquaculture Sector?* (2015).

¹⁸ Ibid.

¹⁹ Ove Hoegh-Guldberg et al., *Indispensable Ocean*, 7.

comparison for the desired goals for Myanmar. Both the GPO and the collaborators in Myanmar have the same purposes in mind, to protect the aquatic ecosystems, and improve the livelihoods of the people that depend on them. The principles are as follows.

The first principle is to ensure sustainable livelihoods, social equity, and food security to many impoverished and vulnerable populations. It emphasizes that ecosystem management must be done with approaches that consider environmental, economic, and social aspects, which are the three main parts that embody sustainability. Myanmar has many populations that are in poverty and depend on fishing and aquaculture to survive, so ecosystem management must consider their economic situation, which relates to their social well-being. The next is to maintain a healthy ocean and sustainable use of marine and coastal resources, which means that the vital ecosystems must be identified and protected, as well as locations that are important spawning and nursery areas for juvenile fish. For example, Myanmar has already taken steps to protect the coastal areas and has protected up to five nautical miles from the shores from damaging fishing techniques. However, the damaging techniques, such as trawling, are still allowed outside that point, which can damage ocean resources. The third principle is installing effective governance systems. The GPO is looking for regulatory procedures and initiatives that produce a shift towards more sustainable use of natural resources and ecosystems. The governance systems should not only target the producers of the supply chain, but cover all areas. In terms of an aquaculture project, such as the one desired in Myanmar, the governance would have to apply starting at the feedmills, continuing all the way to the processing plants. The two final principles the GPO is focused on is the long-term viability and the capacity building and innovation of the project. Long-term viability means that the project is “socio-ecologically

sustainable and promote[s] positive self-sustaining outcomes.”²⁰ This is vital, because once the aid from investors in a specific project ends, the project must be able to continue on its own. This relates directly to the following principle, capacity building and innovation, because without these two aspects, the projects are more at risk of failure. Capacity building relates to developing the workforce, primarily through education and resources, and developing infrastructure. Innovation in these sustainable projects means to take solutions that have already been successful in other areas, and apply them with new ideas and strategies. Every ecosystem is different, thus the success of a project depends on designing it strictly to the situation of the area or country. The overall plan will be described below, and how it intersects with the principles highlighted by the GPO.

Overview

Through a collaboration between USAID, the University of Arizona, Yangon University (YU), Patheingyi University (PU), five multi-national private partners which include Ripple Fish, Regal Springs, Handy Seafoods, DuPont, and the Tiran Group, the Burmese private and public sector, which include the Myanmar Department of Fisheries (MDoF) and Myanmar Fisheries Federation (MFF) and several NGOs, a plan for sustainable seafood infrastructure was developed and is being implemented in Myanmar. The project seeks to help the Myanmar seafood industry move “towards an industry that that mixes capture fisheries and aquaculture along with improved processing, and the market capabilities to meet global standards of sustainability, equitability, profitability and food safety.”²¹ Currently the Myanmar seafood industry and aquaculture is behind the international standards, and one of the corporate partners

²⁰ Ove Hoegh-Guldberg et al., *Indispensable Ocean*, 16.

²¹ *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

that has worked with Myanmar producers has experienced issues with failed water quality inspections and Salmonella contamination. In addition, only 13 of the 80 cold-storage factories in Yangon have the ability to export to the European Union (EU) because they do not have Good Management Practice (GMP) or Hazard Analysis at Critical Control Points (HACCCP) plans, which are necessary to sell in the international markets. Finally, the Association of Southeast Asian Nations (ASEAN) has just opened its Common Market, which forces Myanmar into full competition with the rest of the association, which includes countries with more sophisticated seafood industries. There are over two million people in Myanmar that are employed within the supply chain of the supply chain of the seafood industry, and they are at risk if the infrastructure of the industry is improved to match the competitors. This project is vital to ensuring that Myanmar does improve its infrastructure to increase their exports, but also focuses on incorporating the three sectors of sustainability. The following sections highlight the desired results and methods of the plan in the environmental, economic and social sectors, with a primary focus on aquaculture.

Environmental Sector

The plan has highlighted that conserving the aquatic ecosystems and resources as the primary goal. This includes restoring overfished and overharvested wildlife populations, such as fish, eels, and crabs. In turn, this will restore the balance in the ecosystems as biodiversity is important for environmental health. To address the issue of overharvesting, there are many methods that the plan hopes to introduce. Environmental education of the industry workforce is among the most important. The workforce and management must understand what the significance of environmental protection is, and that only through the conservation of their available resources will their industry be able to thrive for future generations. Through their

current overfishing of both marine and freshwater species, they have also endangered other species as a result of by-catch. Improved aquaculture would be able to alleviate the overfishing problem, for multiple reasons. Specifically with the eels and soft-shell crabs that are drastically overfished, the recirculation system that were previously mentioned would allow for the production of the profitable species while allowing the wild populations to recover. In addition to eel and crab, the plan focuses on *Macrobachium* prawns and tilapia. Through the aquaculture of these species, the pressures on the overfished species such as groupers and pomfret will be reduced. The restoration and maintenance of the natural resources directly align with a GPO principle, and is important for developing a sustainable industry.

Also addressing this GPO principle is the project's emphasis on the necessity to conserve and restore the endangered habitats such as the mangrove forests. Mangroves have many important ecological effects, which include improving water quality, protecting the banks of bodies of water, providing habitat to many juvenile species, and naturally remediating damaged ecosystems.²² These forests have been endangered by many unsustainable uses of their resources, including using the trees for firewood, urbanization, building larger ports, and converting the forests into shrimp farms. The people of Myanmar do not understand that when removing the mangrove forests, they put the health of their ecosystems at risk. Aquaculture that both prevents the destruction of mangroves, as well as encourages replanting the trees around the farms, will improve the water quality of the farms and maintain the health of the aquaculture product. The goal of the project is to replant 73,000 mangroves at three farm sites, with the expectation that the partners will invest more to expand this part of the project. The GPO discusses the requirement for stakeholder investment in restoring the vulnerable ecosystems in its principles,

²² *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

as the people with economic interests have to share the common goal for a sustainable use of resources for the end goal to be accomplished.

Another environmental aspect that will be managed through the project is maintaining water quality. The destruction of the mangroves and wetlands has already been discussed as a contributor to the decreasing water quality, however the current aquaculture farms play a large role as well. First, as the seafood infrastructure is not as sophisticated as other countries, the techniques used do not manage the effluent leaving the aquaculture farms. Methods such as cage and open-net pen aquaculture that are used in the common water are the contributing problems. There is no way to prevent exchange between these aquaculture systems and the surrounding environment, which allows waste, chemicals, and other pollutants from the farms to escape and decrease water quality. This has a compounding effect, as it can then damage the stock populations in the wild. Other factors that damage water quality is the lack of farm sanitation, such as toilets, septic tanks and sinks for hand washing, which the project is planning to install at six farms. This will be beneficial to the water quality, and will reduce the chance for introducing disease into the farms. Water quality is vital to the aquaculture operation, as it determines whether or not a product can be sold in the international market. Environmental standards must be met, which is a problem that many of the farms in Myanmar are experiencing. However the environmental standards must not only be met at the producer level, but also in the feedmill, transport, and packaging and processing levels, to ensure that the product void of contamination and disease. This is also important because there are many people that depend on the fishing for their food security, which is addressed by the first GPO principle. This is not only the people who are employed by the seafood industry, but also the subsistence fishers. If aquaculture is not shifted towards a more sustainable system, there are many impoverished people at risk.

One of other environmental aspects of the project is to shift away from the dependence on fishmeal as a source of feed for aquaculture. The US Soybean Export Council has been consulted in order to begin using vegetable based pellets to make aquaculture more sustainable. While reducing the environmental pressure, the pellets are floating feeds which will last longer and be the most cost effective option over time. While shifting towards the pelleted feed has proven benefits, it cannot be overlooked that that this shift makes crop production a major factor in the environmental footprint of aquaculture.²³ While these are not necessarily effects that will be seen in Myanmar, they will happen on the global level. Land use for the agriculture of soybean has ecological costs as there are important rainforests in Brazil and Argentina that are being cleared for over 50% of soybean agriculture.²⁴ Another issue from soybean agriculture is the nitrogen and phosphorus fertilizer, as the crop accounts for roughly 8% of the excess nitrogen and phosphorus globally.²⁵ While these are not environmental effects that are going to be experienced in Myanmar, its effects of its footprint is being felt in other nations. This is why it is difficult to develop a fully sustainable system, as keeping the entire supply chain sustainable is a challenge. Even though the aquaculture moves away from using fishmeal and reduces the stress on their stocks, it just places the stress towards environments of other countries.

Economic Sector

In order to achieve a more economically sustainable seafood industry, the project is focusing on capacity building and long-term viability, main principles designated by the GPO. Capacity building is fundamental to economic sustainability, especially in a country as undeveloped as Myanmar. The infrastructure throughout the country is very limited, not only in

²³ Jillian P. Fry et al., “Environmental health impacts of feeding crops to farmed fish,” *Elsevier Environmental International* 91 (2016), 205.

²⁴ *Ibid*, 205.

²⁵ *Ibid*, 205.

the aquaculture sector, but also in the entire supply chain, including the feedmills and processing plants. Feedmills must be developed to produce the large amounts of pellets that are needed to meet the demand of the growing aquaculture system in the country. Hatcheries must also be changed in order to meet demands as well. The hatcheries are needed to both provide healthy stocks in farms and in the wild. The hatcheries will be changed through shifting to mono-sex hatcheries and through using only native species. Mono-sex hatcheries allow for male fish, which grow much quicker and larger than female fish, to be raised solitarily, yielding a uniform harvest. The tilapia and *Macrobrachium* prawns both exhibit this behavior and thus will be the fish species used in these mono-sex hatcheries. These forms of hatcheries will allow the industry to provide more regular harvests, with fish optimal for the market. Furthermore, by switching to the native species, especially in the case of shrimp, the introduction of new diseases is reduced. Some private sector aquaculture farms are making attempts to bring in a white shrimp species from Vietnam, which will only introduce new diseases that will pose major risks to the ecosystems of Myanmar. It has been recommended that the private sector instead use native species that have already adjusted to the environment and will provide a more sustainable production. Other capacity building of the infrastructure will occur at Yangon University, in which a “fully functioning microbiology, food safety, and water quality lab,” will be installed.²⁶ This will ensure that the country will have a lab to ensure the quality of their products, and help them remain capable of selling on the international market. Also, capacity building will occur in the form of training of the associations of the MFF, and other supply chain sectors, such as the processors. This involves human capacity building, in which 300 people will be trained as future educators in certification programs such as GMP and HACCP, best management practices,

²⁶ *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

fisheries and aquaculture regulations and seafood business English, and 1,650 farmers, and business owners and managers will be directly trained in the same subjects.²⁷ The training will ensure that the seafood industry meets the necessary global standards.

Finally, the success of the economic sustainability will be determined by what happens when the international aid ends. The aquaculture and seafood industry must have long-term viability. The predictions of the future of the product will certainly depend on the increased revenues from both domestic and international sales. However, the improved quality and quantity of the product and supply chain, such as processors that meet international standards, will ensure this needed increase in revenues. Once the private sector does increase their sales, it will be up to them to reinvest funding to continue the training of more professionals, as well as support new innovation and improvements in the infrastructure. In addition, the government of Myanmar will benefit from the increased exports and imports, which will provide tax revenue that can also be reinvested into the seafood industry. A possible result from the continued improvement would be for the country to mimic its competition, such as China and Vietnam, and hire international contractors to provide additional research and innovation in their industry.²⁸

It is also important that governance systems are instilled into the seafood industry, and that there is compliance with the domestic and international regulations. The GPO highlights governance systems as a main principle in its criteria for determining which sustainability projects to invest in. Without compliance by all sectors, not just the aquaculture farmers or capture fisheries, the seafood industry function as a sustainable system. Management mechanisms must be installed at all levels, whether local or national, and the success of these

²⁷ *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

²⁸ *Ibid.*

mechanisms depends on the public and private sector partnerships. The GPO recommends that incentives are provided for both the public and private sector in order to encourage the involvement in institutionalizing sustainability in the given area. Finally, the success of the aquaculture also depends on stakeholders and fishers and farmers maintaining civic responsibility. This includes the governance systems being equitably applied to the fishers and the farmers, but also the same fishers and farmers following standards and regulations, reporting accurate harvest amounts and paying their appropriate taxes. Overall, the Myanmar project goals have extensive support in both the public and private sector, which is vital for the project's success in the country.

Social Sector

The social improvements that will be made through the project are focused on building the educational opportunities at the universities of Myanmar, gender equity, and a domestic, nutritious seafood product for the impoverished population. In previous sections, environmental and business education has been discussed as vital pieces in the project. In addition, the education of the students that will be joining the workforce is equally important. The aquaculture program will not only depend on the incoming workforce, but also on these students who will need to find employment and provide for themselves and their families. The proposed plan will provide 20 scholarships at YU and PU, while also providing 50 internships to students to become directly involved in the developing sustainable seafood industry. Providing these opportunities to domestic students is important for social sustainability as it works to improve the lives of the population. The GPO determined that promoting sustainable livelihoods, social equity and food security are important impacts of sustainable projects. In terms of social equity, the Myanmar project is focused on improving the opportunities of women in the seafood industry. This

includes equal opportunity for jobs, as well as fair labor practices and compensation. In addition, the men and women will both be educated regarding the rights guaranteed to women under the Myanmar constitution. The University of Arizona Southwest Institute for Research on Women is being consulted to ensure that the project represents the views of women in decision-making and any workshops or trainings will be gender informed.²⁹

A final aspect in the social sustainability sector addresses food security, especially as the country as one of the highest consumption rates of seafood in the world. This does not only mean that the population has access to food, but also has access to the necessary nutrition that they require. The project will ensure that there will be higher nutrition in the seafood that is available to the population, as the aquaculture will be producing larger fish, using a healthier fish feed. Also, the improved aquaculture will reduce the amounts of disease and contamination that the fish are exposed to, increasing the quality of the product for the dependent people.

Aquaculture in Vietnam

The above sections have examined the effects of sustainable aquaculture on the environmental, economic, and social aspects. In the following sections, the importance of the goals of the Myanmar project will be supported through the case of Vietnam in which aquaculture has already been invested in.

Vietnam is also part of ASEAN, and one of the main competitors of Myanmar. It has become largely dependent on its quickly growing fisheries sector as well, and provides a good comparison for where the Myanmar industry could be in the future. The aquaculture of Vietnam has especially grown rapidly, and Figure 4 demonstrates the high rate of increase from the mid 1990s to 2010. This growth has been attributed to its “environmental and aquatic resource

²⁹ *Executive Summary*, USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar.

protection, effectiveness and sustainability.”³⁰ The work that has gone into the Vietnam aquaculture program mirrors much of what the Myanmar project hopes to accomplish. In the environmental sector, Vietnam has pushed for hygienic aquaculture operations, and the improvement of their fish feeds. In terms of capacity building, Vietnam has also encouraged a community approach to the management of aquaculture, just as the project is bringing together the private and public sectors to collaborate in Myanmar. In addition, Vietnam has demonstrated the importance of research, education and training in promoting the sustainable and effective development of the seafood industry and aquaculture, a main part of the Myanmar project.

However, the Vietnam seafood industry has encountered recent challenges that are important to consider for the Myanmar project. A majority of these issues have been caused by the high demand from their export markets, which have caused the Vietnam industry to grow much more rapidly than the country could manage.³¹ The country has been unable to continue to effectively maintain their goal of resource protection and sustainability, and is beginning to encounter the effects from rapid growth. The first of these problems are the high rates of diseases that are present in the aquaculture farms, especially the shrimp farming. The size of the farms have increased, which have allowed disease outbreaks to occur more easily and devastate the harvest. Another problem that the increase in aquaculture farms has caused is the stress on the infrastructure and canal systems that were originally designed.³² In addition to the problems with the infrastructure is the stress being put on the environments surrounding the farms, as the environmental protection has not been sufficiently addressed to account for the increased size and production from aquaculture. The expansion has directly caused environmental damage and

³⁰ *National Aquaculture Sector Overview: Viet Nam*, http://www.fao.org/fishery/countrysector/naso_vietnam/en.

³¹ Ibid.

³² Ibid.

water pollution. The environmental issues are not only around aquaculture but also in coastal resources. This is because the growth caused the marine harvests to be unsustainable, and the overfishing has resulted in the increasing amounts of lesser value fish to be landed.³³ This is being seen in the fishing stocks close to the shore, where many impoverished fishing communities are now unable to depend on their primary source of food and money. While the Vietnam fishing sector did increase rapidly and promote economic growth of the country, it has now left the country with many challenges as its ecosystems and natural resources were unable to handle the pressure of the rapid growth and demand. It demonstrates that without the proper environmental management, the economic and social sectors will eventually face similar problems.

The Myanmar project must use the Vietnam project as warning to the potential detrimental effects of rapid growth. While it is much needed in the country, there must be effective management of growth, which the project does address. It emphasizes the need for the private sector and the government to reinvest revenues from sales and taxes into continuing to improve its aquaculture and seafood industry. If the growth is not managed properly, Myanmar could face the same fate as the country of Vietnam.

Conclusion

The country of Myanmar is currently in a fragile state, and the introduction of sustainable aquaculture could be the answer to improving the economy, conserving the environment, and providing social stability through the means of food security. However, as discussed above, the three sectors of sustainability, environmental, economic, and social, must be equally pursued or it could have detrimental risks, as seen in the country of Vietnam. The environmental goals of

³³ “Viet Nam: Coastal Resources for Sustainable Development Project,” (The World Bank, 2012), 1.

the project are to restore stock populations of eels and crabs, and to reduce the stress on the same stock populations through aquaculture. There will also be restoration of the mangrove forests, which are vital to the ecosystem and restoring the populations of aquatic species. The economic aspects of the project will be to work on capacity building throughout the supply chain, making the feedmills, hatcheries, farms, and processors more sustainable, as well as establish effective governance system to ensure that the regulations and standards are met. Socially, the project hopes to ensure food security across the nation, increase educational opportunities for students at the universities, and achieve gender equity in the seafood industry. The goals of the project align with the principles of the Global Partnership for Oceans, which the organization uses to determine which sustainable projects to invest in. This provides basis for the claim that the desired results of the Myanmar project will ensure the sustainability of the seafood industry.

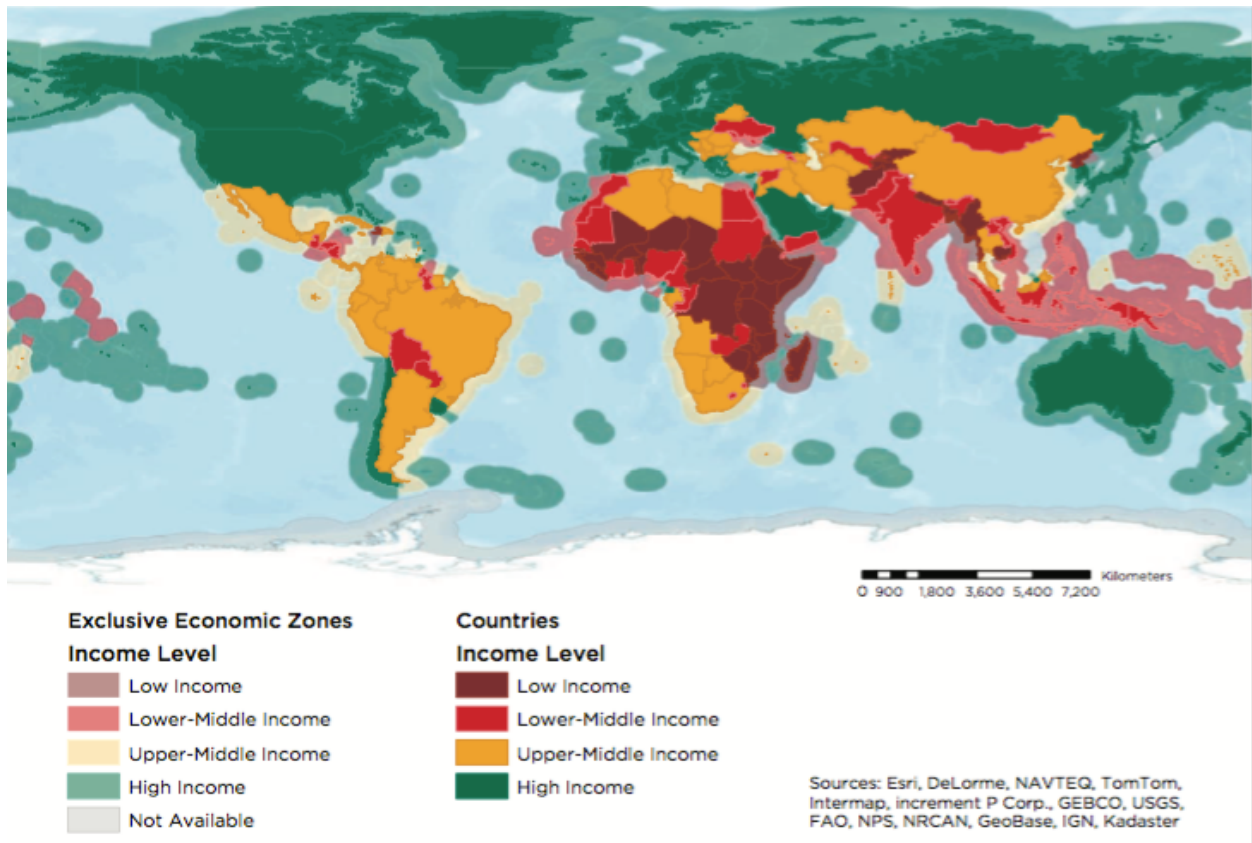


Figure 1: World map showing income levels, with the largest amounts of red zones in Africa and Southeast Asia.³⁴

³⁴ Ove Hoegh-Guldberg et al., *Indispensable Ocean*, 5.

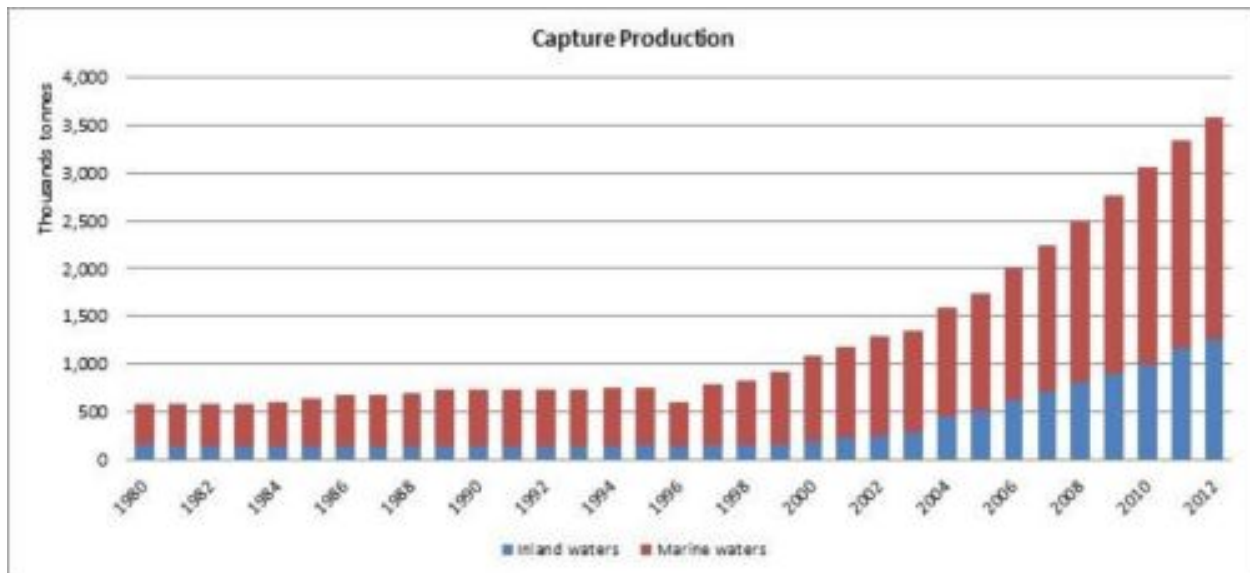


Figure 2: Capture Production in Myanmar. Red shows the marine landings, and blue shows the inland landings, in thousands of tons.³⁵

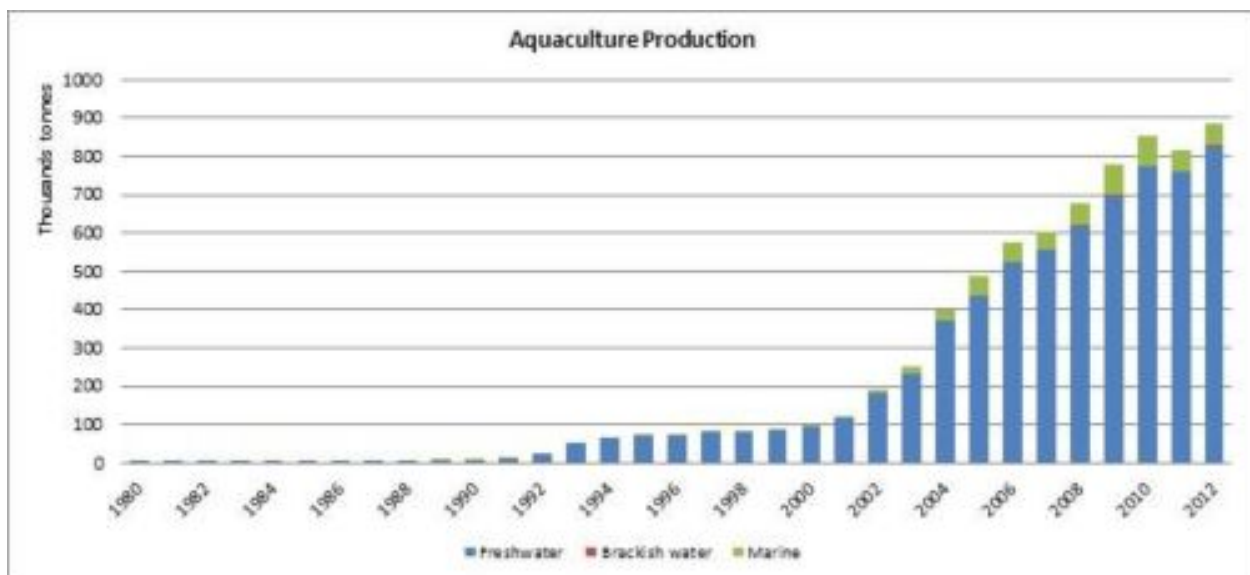


Figure 3: Aquaculture production in Myanmar. Blue shows freshwater aquaculture production, red shows brackish water, and green shows marine, in thousands of tons.³⁶

³⁵ *Fishery and Aquaculture Country Profiles: The Republic of the Union of Myanmar*, <http://www.fao.org/fishery/facp/MMR/en>.

³⁶ Ibid.

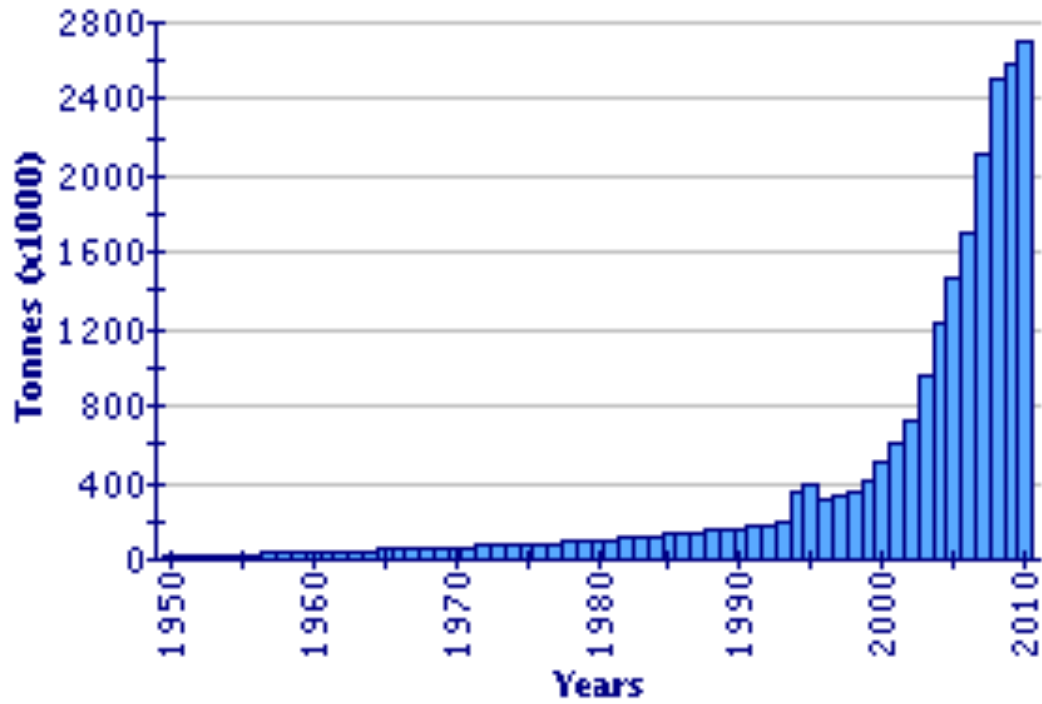


Figure 4: Aquaculture production in Vietnam. Shows the rapid increase in production from 1990s until today.³⁷

³⁷ National Aquaculture Sector Overview: Viet Nam, http://www.fao.org/fishery/countrysector/naso_vietnam/en.

References

- "Aquaculture Methods." *Seachoice.org*. Accessed May 03, 2016. <http://www.seachoice.org/state-of-our-oceans-2/aquaculture-issues/aquaculture-methods/>.
- Brummett Randall. "Growing Aquaculture in Sustainable Ecosystems." *Agriculture and Environmental Sciences Department Notes*. Issue 5, 2013.
- "Executive Summary." *USAID Developing a Sustainable Seafood Industry Infrastructure in Myanmar*.
- "Fishery and Aquaculture Country Profiles: The Republic of the Union of Myanmar." *Fisheries and Agriculture Department*. <http://www.fao.org/fishery/facp/MMR/en>.
- Fitzsimmons, Kevin. *Where are the Needs and Opportunities for Investment in Myanmar's Aquaculture Sector?* 2015.
- Fry, Jillian P. et al. "Environmental health impacts of feeding crops to farmed fish." *Elsevier Environmental International*. Vol 91. 2016.
- Hoegh-Guldberg, Ove et al. *Indispensable Ocean: Aligning Ocean Health and Human Well-Being - Guidance From the Blue Ribbon Panel to the Global Partnerships for Oceans*. Washington, D.C.: The World Bank, 2013.
- Kobayashi, Mimako and Randall Brummett. "Disease Management in Aquaculture." *Forum for Agricultural Risk Management in Development*. <http://www.agriskmanagementforum.org/content/disease-management-aquaculture>.
- "National Aquaculture Sector Overview: Viet Nam." *Fisheries and Agriculture Department*. http://www.fao.org/fishery/countrysector/naso_vietnam/en.
- "Sustainable Aquaculture." *The World Bank*. 2014. <http://www.worldbank.org/en/topic/environment/brief/sustainable-aquaculture>

“Viet Nam: Coastal Resources for Sustainable Development Project.” *The World Bank*. 2012.