

# Improving livelihoods and increasing coastal resilience: A look at integrated mangrove-shrimp aquaculture in Vietnam

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## Climate change in broader context: Southeast Asia and Vietnam

Shrimp aquaculture has been practiced in Asia for centuries but has seen significant expansion in Vietnam since the 1970s. Over the past forty years, shrimp aquaculture has become the most valuable seafood export in Vietnam. In 2017, shrimp accounted for 46% of seafood exports. Traditionally, shrimp aquaculture has been conducted through extensive farming methods. This is to say that farmers use large areas of land, generally on rice paddies, to rear fewer, high value shrimp. Recently, there has been a shift from extensive farms rearing black tiger shrimp (*Penaeus monodon*), to intensive farms rearing white-legged shrimp (*Penaeus vannamei*). Intensive farming occurs on much smaller plots of land and shrimp are grown in much higher concentrations— this, in theory, yields much higher returns per unit area.

Both of these practices are however not without fault from environmental and social standpoints. Both have come under fire for the deforestation of immense areas of mangrove forest. Between 1976 and 1992, shrimp aquaculture saw a massive boom (of ~3500%) which saw the largely unsustainable development of the industry. With this development came a significant loss of mangrove area. Between defoliants that were used in the American War, and the expansion of agriculture and aquaculture, mangrove forest area was decimated and reduced to only a fraction of what it had been. This was particularly notable in the Mekong Delta, which is home to approximately 70% of the mangrove stocks in Vietnam. The clearcutting of mangrove forest for shrimp farms is often a positive feedback cycle: Shrimp farms often become unusable after a period of time, forcing farmers to move on and clear cut more mangrove forest. While government regulations have improved the situation, the clearcutting of mangroves to make room for intensive shrimp farms remains a very real concern.

## Pathways to improved livelihoods

One of the main social concerns surrounding shrimp farming in Vietnam is the ability to maintain a livelihood. Income from shrimp farms, particularly intensive farms, is often characterised by boom and bust cycles. When everything goes according to plan, shrimp farming can be a very lucrative career. However, epidemics, such as early mortality syndrome, and whitespot syndrome are extremely feared by farmers and can wipe out entire harvests in almost the blink of an eye. Higher stocking densities, ineffective wastewater management, and overuse of antibiotics due to the expansion

of the shrimp aquaculture sector have only made these diseases more commonplace. If the right precautions aren't taken intensive shrimp aquaculture can be more comparable to gambling than farming as high input costs paired with very high risk can lead to loss of capital and bankruptcy. To make matters worse, in recent times, shipments of shrimp from Vietnam have been rejected by the FDA in the United States and the European Union due to trace amounts of illegal antibiotics.

Evidently, environmental and social sustainability is an issue when it comes to shrimp aquaculture in Vietnam. Recently, integrated mangrove-shrimp (IMS) aquaculture has emerged as a possible means of reaching both of those goals. IMS is an aquaculture practice that involves rearing shrimp in plots of land where mangroves are also grown. Standards are often set by the government or forestry companies, generally requiring 50-70% of the plot to be mangrove forest, while ponds and housing make up the other 30-50%. Generally plots may be set up such that mangroves are either separated or mixed within the shrimp farms. Some farms have even begun using mangroves as a means of filtering wastewater, ultimately diminishing the farms environmental impact. IMS farms more closely resemble extensive shrimp farming in the sense that *P. monodon* are reared at low stocking densities. While a fairly rudimentary practice, integrated mangrove-shrimp aquaculture has the potential to provide a more stable income than other forms of shrimp aquaculture practice— all while delivering tangible environmental benefits at near and far fields.

It goes without saying that sustainable livelihoods are of primary concern for farmers when deciding what type of aquaculture to engage themselves in. As mentioned, intensive shrimp farming may offer the opportunity for highly profitable returns on investment. However, the reality is that it is an extremely risky form of aquaculture to engage in, requiring a substantial investment in infrastructure alone. Furthermore, of the 2.4 million individuals involved in aquaculture in Vietnam, 75% of them are small scale farmers with farms smaller than 2 hectares; Evidently a large proportion of the farming population does not have the capital to invest in the technology or large quantities of feed needed for intensive aquaculture. There are a few ways by which IMS aquaculture has the potential to provide more stable livelihoods to farmers. First, IMS farming provides the opportunity for a more diversified income. While shrimp continue to be the primary species for income, IMS farmers can stock their ponds with crabs, clams, wild shrimp, wild fish and more. Furthermore, mangrove wood may be harvested at regular intervals to be sold. This diversification inherently allows for less reliance on shrimp and creates more protection from shrimp market downturns that otherwise can have huge effects on shrimp farmers.

Regulations set by forestry companies generally permit farmers to harvest mangrove wood after a 12 year growth cycle. This wood can then be sold for up to USD\$310/hectare/year and is a way for farmers to diversify their income.

There have been several ways that the government and non-governmental organisations have been encouraging a transition from other forms of aquaculture to IMS. One such incentive is the implementation of Paid (Forestry) Ecosystem Services, a program that pays farmers for good environmental practice. In this case, because farmers are growing mangroves which are good for the environment, they are rewarded with additional income. For farmers that are contracted for 20 ha of land by forestry companies, this results in ~USD\$500/year of income. Eco-certification is another means of receiving additional income as an IMS farmer. Eco-certifications are services generally indicating that a given product has attained a certain standard of sustainability. In the case of IMS systems, shrimp farmers can apply to be eco-certified—in the Mekong Delta, farmers usually apply as a group of farmers and as such reduce expenses. Shrimp that are reared and sold under eco-certifications will fetch a premium on the open market, creating incentive for farmers to become eco-certified. There are currently NGOs working with small-scale farmers in the Mekong Delta to increase the frequency of eco-certification.

## Contextualising mangrove-shrimp aquaculture in climate change

### Near field benefits

As previously mentioned, sea level rise is expected to be one of the biggest threats of climate change facing Vietnam. According to a recent report by the Norwegian Institute of International Affairs, Vietnam is one of the top ten countries expected to be the most impacted by climate change. This is due to the fact that Vietnam has large populations concentrated in low-lying areas. The Mekong Delta is one such area, lying at sea level with over 20 million inhabitants largely dependent on the land for subsistence. While there is much uncertainty surrounding the degree of sea level rise, models suggest that there will be at least 40 cm within the century depending on the degree of global warming. Even 30 cm of sea level rise would have huge implications for the low lying delta, likely displacing millions and having a huge impact on the livelihoods of many more; Vietnam is in need of a multi-faceted plan to combat this looming problem. Although political discussion has taken place regarding action required for sea level rise, IMS aquaculture has the potential to provide an innovative and sustainable soft option to combat the effects of climate change through processes inherent to mangrove forests.

Mangrove trees occupy the intertidal zone, and beneath every mangrove, there is a theoretical area called the 'accommodation space'. The accommodation space can be defined as the space between the current soil level and the area in which soil can grow vertically and laterally. The accommodation space can gradually be occupied through the processes of sedimentation and accretion. Sedimentation is the process by which sediment is deposited onto the soil and accretion is the process by which that sediment is bound into the soil. Together, they ultimately increase the surface elevation of a

given area. Sediment may be deposited in a variety of ways: Brought in during high tide, deposited from upstream river discharge, and even from the leaves from the mangrove trees themselves. Sea level rise is a very gradual process, occurring over many years and as such can be combated with another slow process in accretion. Studies have shown that in some cases, the rate of accretion can match the relative rate of sea level rise—particularly in delta areas where there is considerable sediment discharge from upstream. Reforestation of mangroves in the coastal provinces of the Mekong Delta by encouraging IMS aquaculture would be a means to combat the effects of SLR expected in the coming decades.

### Far field benefits

IMS also has the potential to provide environmental benefits that extend beyond Vietnam. The primary driver of climate change is carbon dioxide emissions into the atmosphere. This creates the greenhouse effect whereby heat is effectively trapped in the atmosphere leading to increased temperatures over time. Like SLR, the degree of warming expected within the next century is uncertain, but appears to be between 1-4°C. A warmer climate may have huge implications for farmers, some effects are already being seen: an increased risk of disease, lower survivorship, and increased chances of extreme weather events such as typhoons. All of these will ultimately decrease the profitability of the farm and put livelihoods at risk. Carbon is removed from the atmosphere, or sequestered, through naturally occurring processes like respiration in plants, and passive absorption into the ocean. To reduce the rate of climate change, it is logical to try and increase the rate that carbon may be sequestered from the atmosphere. Reforestation of areas previously occupied by mangrove forest is one such way to increase sequestration.

Mangroves are among the best carbon sequesterers in the world. In fact, mangroves generally sequester over two times more carbon than boreal, temperate, or tropical forests. This is largely because of the tremendous amounts of carbon the mangroves store deep below ground. Even within our lifetime, reforested mangrove forests can sequester amounts of carbon comparable to forests that have existed for long time periods. A recent study conducted in Can Gio Mangrove Forest Park showed just that. Can Gio's mangrove forests had been completely decimated during the Vietnam War due to the use of defoliants, but have recovered after reforestation efforts. If this concept is applied to a broader scale, reforestation efforts through much of the coastal Mekong Delta could help combat climate change through carbon sequestration.

## Moving forward

In a period of time where industry rushes forward with little regard given to people or the planet, it is important to take sustainability into serious consideration. IMS aquaculture provides small scale farmers with an alternative to more risky forms of aquaculture by providing a steady, diversified income stream. Mangroves allow shrimp to be reared in a healthy and natural environment ultimately increasing survivorship and decreasing the risk of large losses through die-offs. Currently, IMS aquaculture is seeing expansion in Ca Mau province with support from international NGOs. The Government of Vietnam has encouraged the reforestation of land previously occupied by mangroves, but further support is needed to

implement IMS farming at a larger scale. While some issues remain, such inequality in benefit sharing with the timber industry, things are steadily improving.

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