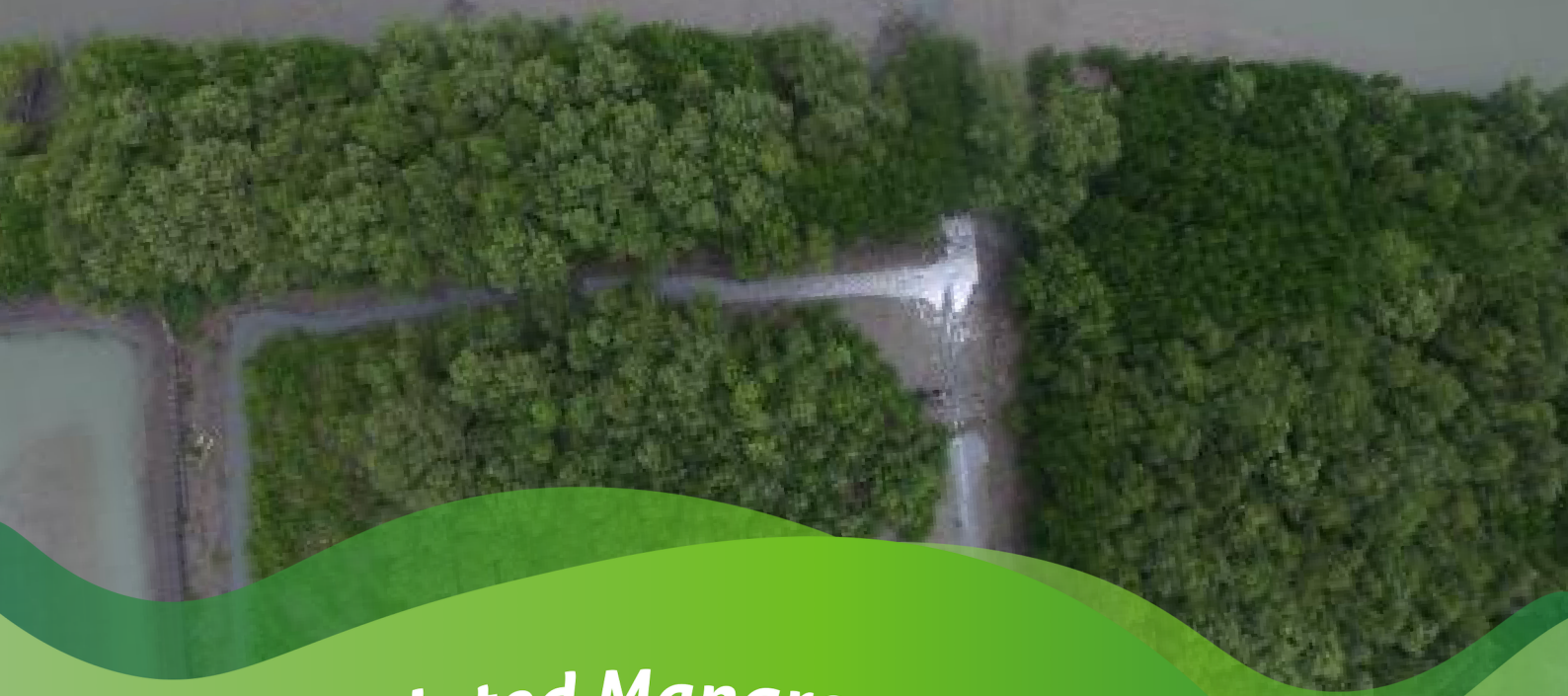


Associated Mangrove Aquaculture

Fact Sheet

Aquaculture and other coastal development as drivers of loss in the Philippines

- Expanding aquaculture has been one of the main drivers of mangrove loss in the Philippines. Coastlines have become vulnerable to severe erosion and extreme coastal flooding, increasing the likelihood of displacing coastal dwellers from their homes and land, as well as losing their livelihood and income from aquaculture.
- Building hard seawalls and dikes to protect aquaculture and households against erosion and flooding is too costly. It is also not advisable in eroding and subsiding coastlines.
- There is a need for more sustainable and cost-effective alternatives to protect aquaculture and households against erosion and flooding.
- Using nature-based solutions such as restoring coastal greenbelts (mangroves) is one of the solutions that can be done.
- Full reversion of abandoned, undeveloped and underutilized (AUU) ponds is a challenge due to various reasons such as institutional and policy support, costs, lack of guidelines on fishpond lease agreement (FLA) cancellation, political and tenure issues surrounding FLAs, poor monitoring and recording of FLAs, and limited government resources to enforce FLA regulatory mechanisms.

Nature-Based Solutions

Wetlands International advances Nature-Based Solutions (NBS) to create mangrove-based economy integrating the revitalization of aquaculture productivity with mangrove restoration for coastal protection.

One of the NBS promoted by Wetlands International is the Associated Mangrove Aquaculture (AMA) which offers a sustainable aquaculture approach that provides a wide range of ecosystem functions that can support efforts geared towards coastal resilience and a blue economy.

Feature Picture : An AMA 6 months after construction in Timbulsloko Village, Demak, Indonesia, with the old dike with gate still intact. Natural mangroves already colonised the former pond. (Blue Forests)

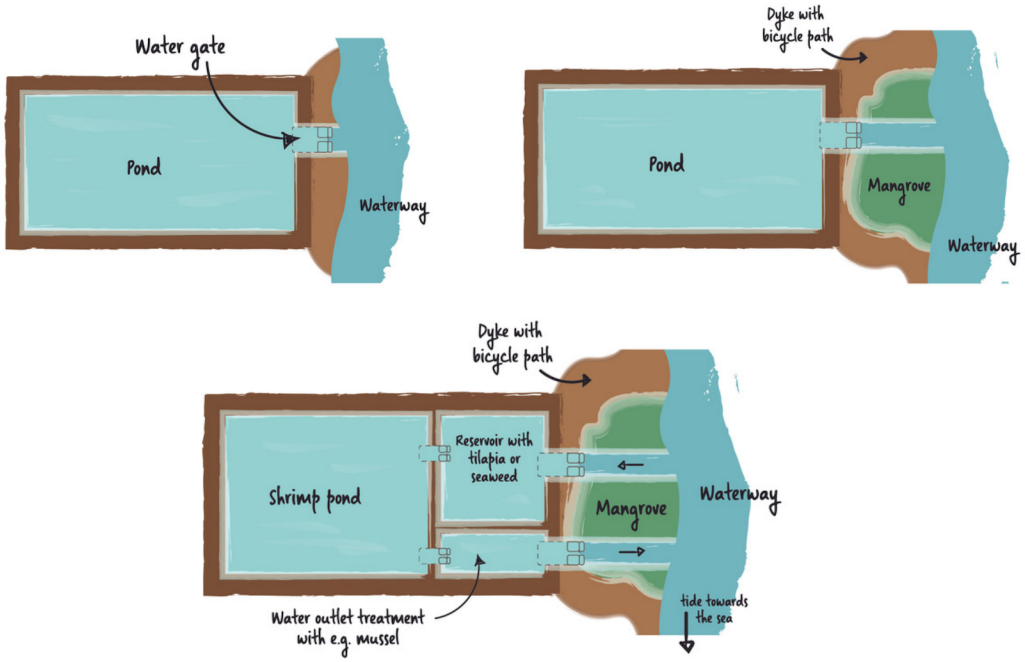
Creation of mudflats behind semi-permeable structures where mangroves naturally re-settle for coastal resilience in Bogorame Timbulsloko village. (Kuswantoro, Wetlands International)

Why Practice Associated Mangrove Aquaculture (AMA)?

- Associated Mangrove Aquaculture, or AMA, is a concept for combining aquaculture with forestry by establishing a greenbelt of mangroves along shorelines of waterways in estuaries. This contrasts with existing ponds that have too little or no mangrove left on the shorelines.
- AMA is a type of silvo-aquaculture and is sometimes called mixed-mangrove-aquaculture.
- However, in contrast to the usual silvo-aquaculture systems where the mangroves are planted on dikes and in ponds, the mangroves of AMA are located outside the pond.
- In AMA systems, part of the aquaculture pond is given up to make space for riverine mangroves. As such, AMA can restore mangrove greenbelts in the estuary along inland waterways and protect adjoining fishponds.
- Complex AMA farms have additional ponds for storage (water preparation) and sedimentation which allows better water quality management.

Benefits in Practicing Associated Mangrove Aquaculture

- The mangrove greenbelt protects the pond dike from the impact of waves and chronic erosion. It can also compensate for soil subsidence.
- The mangrove greenbelt acts as a biofilter, reducing the levels of toxic materials, e.g. heavy metals, hydrogen sulfide and shrimp pathogens.
- The mangrove greenbelt provides additional benefits not directly associated with the ponds:
    - Products, such as firewood and timber.
    - Fertilizer is made by composting leaf material from some species. After composting, these leaves do not produce ammonia, nor do they reduce oxygen levels.
    - Human food from some *Avicennia (api-api / miapi)*, *Rhizophora (bakhaw / bakawan)*, *Bruguiera (pototan-lalaki)* and *Sonneratia (pagatpat)* species, which also has market potential.
    - Nursery grounds and feeding grounds for aquatic organisms; and thus, an increased potential catch for estuarine and offshore fisheries.



Overview of a common pond without mangrove (top left) a standard AMA for a single farm (top right) and a complex AMA for better water management (bottom center). @Dr. Ir. Roel Bosma

Which ponds are suitable for AMA?

The goal of AMA is to create an estuary or coasts with mangrove greenbelts of at least 20m wide (ideally 50m). If mangroves are already present, only a smaller part of the pond may need to be converted. Dimensions depend on the specific conditions.

The remaining pond should always have a width of 20m or more. Narrow ponds with their long side adjacent to the waterway are either more costly to transform, or would become economically unviable, so complete transformation to mangrove greenbelt is advised.

Certain sites are not suitable for conversion to AMA:

- Ponds with dikes bearing a large road, or heavy protection dikes along larger rivers or canals. When the road is large or the dike is a heavy protection dike, moving the dike needs district planning and major investment.
- Single ponds with dike(s) carrying paved/non-paved/mud roads suitable for carts.

AMA works: The experience in Demak, North Java, Indonesia

Demak is a coastal district in Central Java province that has been plagued by erosion, flooding and devastating land loss that in places has extended for several kilometers inland.

The Building with Nature (BwN) approach was undertaken by a unique public-private partnership under the leadership of the Indonesian government, Wetlands International and Ecoshape after the construction of "hard" infrastructure (such as sea walls) and the planting of mangroves failed to stop the loss of land.

These coastal protection efforts were integrated with the introduction of aquaculture practices that support mangrove restoration instead of damaging the ecosystem and boosting the local economy. Among others, the program introduced innovative Associated Mangrove Aquaculture (AMA) systems, which replaced traditional silvo-aquaculture systems that are often applied in Indonesia.

In Demak, it was demonstrated that through AMA, aquaculture productivity and local incomes can be boosted while increasing hazard resilience. In an AMA system, part of the aquaculture pond is given up to make space for mangroves.

AMA shortly after construction in Tambakbulusan (Suhadi, Blue Forests)

FINANCIAL BENEFITS OF ASSOCIATED MANGROVE AQUACULTURE

A mono-culture shrimp farm earns between 1,000 to 30,000 USD/ha/yr, and the shrimp yield varies between 40 and 6,000 kg/ha/yr. The Total Economic Value (TEV) of mangroves forest varies according to the contribution to ecosystem services (ESS).

In South Minahassa this TEV was 36,000 USD per ha (Mankay et al, 2012, cited by [3]). The ESS include, among others, harvested timber and fruits (provision services), the catches of fish that were nursed there (habitat services) and flood protection (regulation services) (Russi et al, 2013, cited by [3]).

While a well managed average tiger shrimp farm produces 6,000 kg/ha/yr, a classical silvo-aquaculture system can yield at maximum about 400 kg/ha/yr.

THE MINIMA AND MAXIMA OF THE TEV OF MANGROVE'S FOUR ESS (USD/HA./YR.)		
	MIN	MAX
Provision services	44	8,300
Habitat services	27	68,800
Regulation services	1,900	135,400
Cultural services	10	2900

Table 1: The minima and maxima of the TEV of mangrove's four ESS (USD/ha/yr).

PRODUCTION FOR FARM OF 12 HA.	EXTENSIVE	INTENSIVE	AMA (7 HA. MANGROVE)
Approximate shrimp yield (*1,000 kg)	4.8	70	30
Farm revenues TEV of ESS	30 0	432 0	180 252
Total economic values	29	432	432

(Amounts in 1,000 USD/yr.)

Table 2: Production for farm of 12 ha.

In an AMA system, the pond can be managed more intensively because the water quality is not limited by leaves falling in the pond. Thus, in AMA, the shrimp yield can be identical as the normal intensive farms. Thus, together with the TEV of the ESS (accounting the value found for South Minahassa), the economic value of an AMA is equal to a monoculture intensive shrimp farm if the area of mangrove is about 60%. Moreover, due to lower ecological qualities, the financial risks of the intensive system are higher. The proportion of mangroves in the AMA stimulated by Building with Nature is about 20%. Hence, the total economic value is much higher.

Results of AMA as piloted in Demak

- AMAs in the estuary can protect the land, while providing almost all ecosystem functions.
- Over 100 farmers gave up ~0.174 ha of their pond by building a new dike, preferably with two gates.
- Project monitoring data show that smaller ponds gave higher yields (r=-0.2).
- Soil sedimentation was ~10cm per year and more than 10,000 stems of mangroves were recruited naturally per average plot.
- Farmers who used AMA maintained their baseline income in the first year, despite severe flooding events, as their catch from fishing in the gate increased.
- Most AMA farmers were trained through Coastal Aquaculture Field Schools (CAFS).
- The rate-of-return of CAFS training (cost about 1,100 USD/farmer) was more than 1.2, meaning that cost was recovered within one year. Few projects reach such rates.

Demak Farmer Abdul Ghofur showing his catch. (Blue Forests)

Cost-Benefit Analysis (CBA) on improving aquaculture and restoring mangroves in Demak, Indonesia

The investments and profits including those for fisheries, the cost of destroyed houses and ponds, and of forgone benefits were accounted due to new mangrove forest and loss of land.

The baseline scenario used assumes subsidence and abrasion similar to villages closer to Semarang, where most lands were gradually engulfed in the last 25 years. For such a period, a no-intervention scenario would cost close to 3 million USD due to loss of land, infrastructure, and livelihoods.

Investing USD 88,000 on solely recovering mangroves or on solely improving aquaculture would generate benefits of USD 7.8 and 1.0 million, respectively.

Concurrently, investing in both mangrove recovery (climate change mitigation) and aquaculture improvement (adaptation) would yield almost double: USD 15 million.

Promoting AMA in the Philippines

In the Philippines, Wetlands International is working with aquaculture farmers, governments, funders, communities, and other stakeholders to

1. restore mangrove ecosystems;
2. encourage innovative solutions to mangrove restoration;
3. increase productivity, profitability, and resilience on aquaculture farms; and
4. catalyze opportunities for funding for mangrove restoration and conservation.

Wetlands International Philippines is advocating for AMA to BFAR and DENR to accelerate the rehabilitation of mangrove forests in the Philippines for sustainable food production in fishponds and coastal waters, and for the protection of coastlines and river banks from erosion. We champion this in support of the relevant policies of the Philippine Government.

Join us and support our on-going initiatives by promoting sustainable coastal management, helping us with research, contributing to community-based conservation and restoration, and funding our activities on coastal resilience.

Pneumatophores of Avicennia mangroves in Bedono Village, Demak District, Central Java Province. (Cynthia Boll)

More Information

1. Bosma, R.H, Debrot, D., Rejeki, S., Tonneijck, F., Yuniati, A., W. & Sihombing, W. *Associated Mangrove Aquaculture Farms; Building with Nature to restore eroding tropical muddy coasts.* Wetlands International and Ecoshape. 2021

2. Bosma, R.H., Rejeki, S., Ariyati, R.W., Widowati, L.L., Fadila, R., Yuniati, W. *Building Sustainable Aquaculture through Coastal Field Schools Building with Nature to restore eroding tropical muddy coasts.* Wetlands International and Ecoshape. 2021

3. Van Oudenhoven et al (2015). Effects of different management regimes on mangrove ecosystem services in Java, Indonesia. Ocean & Coastal Management. http://dx.doi.org/10.1016/j.ocecoaman.2015.08.003.

4. Rejeki, Sri, Ariyati, R.W., Widowati, L.L., & Bosma, R.H. (2020). Associated Mangrove Aquaculture: Farmers' Yields and Income and Pond Water Quality. Monitoring report for Building with Nature Indonesia, Wetlands International. Project WI-NL 1354_019

5. Yuniati, W., Fadilah, R., Rejeki, S., Widowati, L., Ariyati, R.W., Astra, A., Bosma, R. *Aquaculture field schools supporting mangroves for climate change adaptation of Indonesian milkfish-shrimp farmers.* Aquaculture Asia. 2021

6. Wardani, I., Cado van der Lelij, A., Massa, Y. *Monitoring of Mixed Mangrove Aquaculture. New method for restoring aquaculture farms in Indonesia.* Deltares. 2021

7. Widowati, L., Rejeki, S., Ariyati, R., Bosma, R. The impact of aquaculture field school on the shrimp and milkfish yield and income of farmers in Demak, Central Java. World Aquaculture Society 52: 362-377. 2021

8. *Associated Mangrove Aquaculture as a Solution on the PANORAMA - Solutions for a Healthy Planet platform*

9. *Mangrove restoration: to plant or not to plant?* Wetlands International. 2016

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