



Associated Mangrove Aquaculture (AMA) to build Nature-based coastal resilience and a blue economy in Indonesia

POLICY BRIEF

Context

In Indonesia, mangrove destruction along the coast has resulted in massive coastal erosion. More than 30 million people in Java alone are at risk of flooding and brackish water invading their ponds. Communities in Demak district, Central Java have already lost their income from aquaculture and some have been evacuated as several tidal lakes have emerged. Seawalls that were placed to protect the coastline were unstable and expensive and failed to prevent erosion thus protect the coast. Locally, land loss is aggravated by excessive ground-water use resulting in sinking land, faster than the rising sea level.

Blue economy and coastal resilience

- As mangrove removal for aquaculture is one of the main causes of coastal erosion, complementary mangrove and brackish water aquaculture land-use systems are an opportunity for Indonesia to adopt and invest in, particularly in rural settings.
- AMA's offer a sustainable aquaculture approach that provides a wide range of ecosystem functions to support Indonesia's efforts towards coastal resilience and a blue economy.
- AMA's are recommended to be integrated in Indonesia's mangrove restoration programmes and aquaculture management plans to contribute to implementation of its climate adaptation, disaster risk reduction, a Blue Economy, sustainable development and biodiversity conservation strategies.

Feature Picture : An AMA 6 months after construction, with the old dike with gate still intact. Natural mangroves already colonised the former pond. Photo: Blue Forests



*Creation of mudflats behind semi-permeable structures where mangroves naturally re-settle for coastal resilience.
Photo: Wetlands International*

Building with Nature solutions

Faced with this ongoing crisis, local authorities, communities and other stakeholders sought a new approach for coastal resilience. The Building with Nature Indonesia Consortium collaborated with local communities to construct semi-permeable structures to capture sediment and create coastal mudflats where mangrove can naturally resettle.

These coastal protection efforts were integrated with the introduction of aquaculture practices that support mangrove restoration instead of damaging the ecosystem and boosts the local economy. Among others, the programme introduced innovative Associated Mangrove Aquaculture (AMA) systems, which replace traditional sylvo-aquaculture systems that are often applied in Indonesia. Sylvo-fishery systems only have mangroves on dikes, produce some timber, but do not protect the land nor offer other ecosystems services. They may even have negative effects on aquaculture. In Demak we demonstrated that through AMA's aquaculture productivity and local incomes can be boosted while increasing hazard resilience. In AMA systems, part of the aquaculture pond is given up to make space for riverine mangroves. As such AMA's can restore mangrove greenbelts in the estuary along inland waterways and protect adjoining fishponds.

Towards sustainable and higher yields

Traditional farmers of milkfish and shrimp occupy 80% of Indonesian brackish aquaculture area, but produce only 10% of its shrimp. In Demak regency, Central Java, their yields of shrimp and milkfish were about 40 and 240 kg ha⁻¹ yr⁻¹, resp., and their gross margin 600 USD ha⁻¹ yr⁻¹, in 2015. With such margins, farmers can't contribute to mangrove recovery.

The Building with Nature Indonesia programme provided communities with technical and financial support to develop more sustainable aquaculture practices in return for their active engagement in the recovery and conservation of mangroves (Bio-rights mechanism).

The programme organised Coastal Aquaculture Field Schools (CAFS) in which 277 farmers were trained with LEISA (Low External Input Sustainable Aquaculture) practices during one milkfish crop season. They learned to manage pond bottom and water quality with a home-made liquid compost, among others and were trained on the importance of mangrove greenbelts. LEISA practices were adopted by 85% of the farmers which, compared to the baseline, tripled their shrimp yields, while milkfish yields slightly diminished. The gross margin of the adopters



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

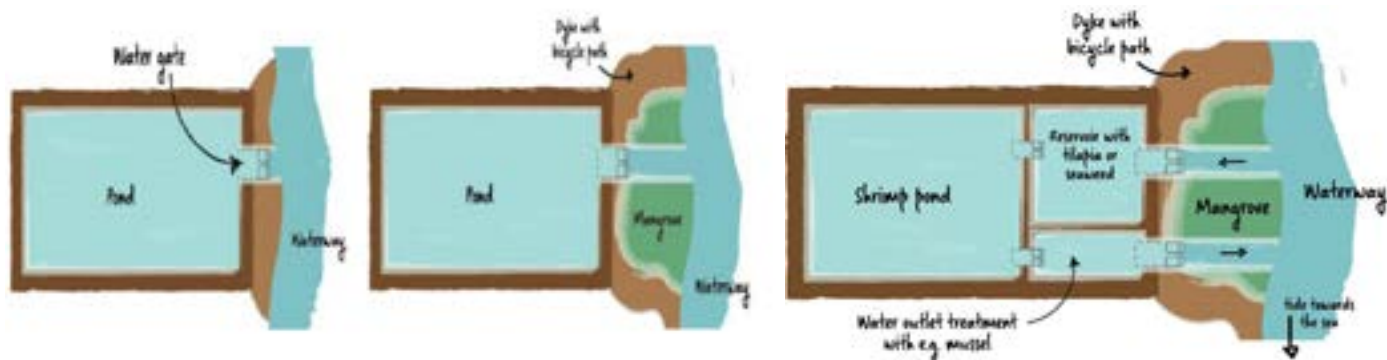
increased with an estimated 600 USD ha⁻¹ yr⁻¹. This motivated farmers to give up (part of their) ponds for mangroves while the 'Bio-rights' funds compensated for the forgone income and supported the required investment.

Associated Mangrove Aquaculture (AMA)

The project partners and community groups identified over 150 sites for AMA's. About 120 sites complied with suitable conditions, for which farmers received Bio-Rights funding for pond conversion.

While in the first year many ponds suffered losses from exceptionally high tides and incomes were low as before, the catches of fish, shrimp and crab in the gates of the mangrove component made-up for these losses. Now, farmers tell enthusiastic stories about their AMA's.

- Results of AMA's as piloted in Demak**
- AMA's 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 p/yr and more than 10,000 stems of mangroves were recruited naturally per average plot.
 - Farmers that built AMA's 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 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.



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



Farmer Abdul Ghofur showing his catch.
Photo: Blue Forests

Policy Recommendations

AMA's can contribute to the implementation of Indonesia's climate adaptation, disaster risk reduction, sustainable development and biodiversity conservation strategies. The following are actions that Indonesia could take to advance adoption of AMA's:

- Integrate sustainable aquaculture systems and training with reference to AMA's in Indonesia's coastal and marine ecosystem restoration programmes as part of Indonesia's NDC Roadmap, National Adaptation Plan, Climate Resilience Development Policy 2020-2045, Disaster Risk Reduction strategies and Biodiversity Strategy and Action Plan.
- Ensure uptake of the AMA approach in existing policies and programmes on Building Economic Resilience based on a Blue Economy principle, e.g. Ecosystem Approach for Aquaculture Management*.
- Enable the continued financing of projects and programmes aimed at strengthening coastal and marine ecosystem resilience, with dedicated funding for sustainable aquaculture systems to build a larger evidence base for AMA's.
- Include the AMA system in capacity building programmes among policy makers involved with coastal resilience building, extension agents and coastal zone managers.
- Include AMA's in government recommendations as an addition to the traditional silvo-fishery systems, using the guidelines developed by Building with Nature Indonesia.
- Build awareness among policy makers and practitioners of the right ecological and socio-economic conditions for successful mangrove recovery. The majority of mangrove planting efforts are failing. A more effective approach is Ecological Mangrove Restoration, which generally results in better survival, faster growth, and a more diverse and resilient mangrove forest. This includes investing in sustainable aquaculture solutions.

* Ecosystem Approach for Aquaculture Management (EAAM/ADPE) has been adopted as a basic principle for Indonesian Fisheries Management Plans (Rencana Pengelolaan Perikanan, RPP). EAAM has been endorsed through the regulation of the Director General for Aquaculture of MMAF No. 154/PER-DJPB/2019 which include Technical Guidelines for the Ecosystem Approach to Aquaculture Management¹ (petunjuk teknis pengelolaan kawasan akuakultur dengan pendekatan ekosistem). This regulation is one of the methods of managing aquaculture areas currently in the pilot stage in the field.

¹The technical guidelines refer to the Ecosystem approach to aquaculture (EAA) by FAO 2010: a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity and resilience of interlinked social-ecological systems.



More Information

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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. 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
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5. Wardani, I., Cado van der Lelij, A., Massa, Y. [Monitoring of Mixed Mangrove Aquaculture. New method for restoring aquaculture farms in Indonesia](#). Deltares. 2021
6. 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
7. [Associated Mangrove Aquaculture as a Solution on the PANORAMA - Solutions for a Healthy Planet platform](#)
8. [Mangrove restoration: to plant or not to plant?](#) Wetlands International. 2016

Wetlands International, other Ecoshape members and our Indonesian partners are working together to improve the way in which government agencies, the private sector (including smallholders) and civil society manage their ecosystems. We are pursuing this goal through collaboration and knowledge exchange and by encouraging innovative solutions such as Building with Nature. Join us and support our on-going initiatives by advocating sustainable coastal management, helping us with research, contributing to community-based conservation and restoration, and funding our activities on coastal resilience.

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