Building with Nature in Indonesia

N°8

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Identity of the organisation

Organisation: "Building with Nature Indonesia" is a programme from Ecoshape, Wetlands International, the Ministry of Marine Affairs and Fisheries (MMAF), Ministry of Public Works and Human Settlement (MPWH), Witteveen+Bos, Deltares, Wageningen University & Research, UNESCO-IHE, Von Lieberman, Blue Forests, the Diponegoro University, and local communities.

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Site identity

Localisation: Demak district, Central Java, Indonesia

Specificities: In Northern Java, communities are suffering from coastal erosion along hundreds of kilometers of coastline. In the district of Demak, in some places, more than 3 km of land have already been swallowed by the sea, including entire villages.

Challenges : The Demak district, near the multi-million city of Semarang, has lost most of its protective mangrove forests as a result of the massive switch from rice production to aquaculture in the 1980's, which has caused severe coastal erosion. As a consequence of mangrove loss, biodiversity losses as well as GHG emissions are substantial.

Areas : coastal environment

Action type : people and goods, restauration or rehabilitation

Action framwork: Climate change adaptation, management of nature areas, risk management, land planning, spatial planning works

History and context

In Northern Java, the lives and livelihoods of 70,000 people are at risk of being engulfed by the sea if erosion is not put to a halt. Coastal floods are increasing and have destroyed infrastructure and productive land. Salt water intrusion pollutes drinking water, reduces aquaculture profits and affects agriculture. Over the last decade, income has decreased for shrimp farmers and fishermen respectively. This decline in well-being, security and self-reliance has been further exacerbated by the collapse of natural resources – timber, fuel, fish – which used to account for more than 50% of their income. Besides, sea level rise is projected to flood 6 kilometers inland by 2100In the long run, 30 million people may suffer from coastal erosion in Java.

The main causes of the erosion problems are the removal of mangrove belts for aquaculture development, coastal infrastructure which disturbs sediment build up from offshore, and groundwater extraction which causes land subsidence, and river canalization.

Mangrove belts play an important role in coastal safety along muddy coasts. They are dynamic systems, with sediment naturally eroding and accreting as a result of wave and tidal action. When a mangrove green belt is wide and self-maintaining, periods of erosion can be compensated for and the coastline restores naturally. They also protect against wave impacts and flooding indirectly by helping to accrete land and hence increase shore elevation and slope. Mangroves also contribute to sediment consolidation/compaction. Mangroves are also breeding grounds for fish, and rich sources of timber and non-timber forest products. In some places mangroves generate revenues from tourism and recreation.

Coastal managers typically use "hard" engineered solutions to combat erosion problems and related hazards which do provide important protection but are too expensive and complicated to design along muddy coasts. They do not address the root causes and fail to restore environmental conditions and ecosystem services that are crucial for a productive aquaculture and fisheries sector. Large scale mangrove planting efforts have failed, hampered by erosion and wave action. Protection measures are implemented ad hoc without coherent strategy.

Demak from outer space and evolution of the coastline © Wetlands Internationl

Instead of fighting nature with dams and dikes, Building with Nature solutions work with and along the dynamics of nature. For example, by restoring ecosystems so that they once more provide protection against extreme events and offer valuable 'natural capital' (shell-fish, timber or recreational opportunities for example). Different examples of Building with Nature solutions can be seen at : https://www.ecoshape.org/en/projects/

In Demak, the public private partnership "Building with Nature Indonesia" introduces this approach to address the root causes of erosion, integrating mangrove and river restoration, small-scale hydraulic engineering and sustainable land use (technical and socio-economic measures). Moreover, Building with Nature solutions are climate-adaptive, and often cheaper to construct and maintain, compared to static infrastructure solutions. The

environmental co-benefits enable more productive and multi-functional land-use. Local stakeholders – including communities – are involved in design, construction and maintenance of measures.

Presentation of the project

Issues and objectives

The project has different objectives:

- Rehabilitation of mangroves :

The principal objective is to build a stable coastline with reduced erosion by stimulating the rehabilitation of mangroves of the most vulnerable parts of 20 kilometers of affected coastline in Demak District.

For this purpose, permeable structures are constructed in front of the coastline, to dampen the waves and capture sediment (see next section).

Natural mangrove restoration supports the development of mangrove forests with different species. This is because not all species can equally withstand the submerged conditions, wave exposure and salinity occurring at the seafront. Natural mangrove succession starts with pioneer species that facilitate colonization by many other species and results in a great variety in root types, tree sizes, foliage and fruits, fulfilling different functions and attracting diverse (fish) fauna. This in turn results in the provisioning of multiple goods (timber, fodder, honey, fruits, and fish) and services (enhanced coastal protection, carbon storage, water purification, fisheries enhancement). Ecologically restored forests are also likely to be more resilient to change because of this. For more information see the brochure: 'Mangrove restoration: to plant or not to plant', which has been developed by the Building with Nature Indonesia consortium.

Where the coastline is not yet eroded the project stimulates pond conversion into mangroves in close participation with local communities.

• Develop a sustainable aquaculture:

Mangrove restoration will only sustain in the longer term if prosperity for local communities is created simultaneously. In the context of Demak, the project therefore revitalizes environmentally friendly aquaculture productivity and introduces mangrove based livelihoods, while restoring coastal safety. That way, prosperous communities are able to sustain the mangrove greenbelt that they rely on for their coastal safety. The project is putting in place a model for sustainable aquaculture that provides space for mangrove restoration. Measures include:

- the conversion of 50 ha of ponds into greenbelt
- setting back pond bunds along rivers to create space for mangroves in another 100 ha (so-called mixed mangrove aquaculture)
- revitalizing 300 ha of aquaculture ponds by adopting environmentally friendly practices such as decreased use of chemicals.

The introduction of the innovative mixed mangrove aquaculture system for the first time in Indonesia is exciting. This system is different from the silvofisheries system that is traditionally applied, because the mangroves and aquaculture ponds are separated. Due to this separation, aquaculture productivity is optimal, while the surrounding mangroves reduce the spread of disease agents, purify water and maintain their coastal safety and fisheries enhancement functions. In traditional silvofisheries systems, mangroves are planted on pond

bunds or inside ponds and as such are not connected to open water. Such enclosed mangroves cannot filter water nor provide food and shelter for fish species.

The aquaculture measures in the project will be governed under community bylaws and rooted in community development plans and government master planning for sustainable development.

- Address subsidence problems:

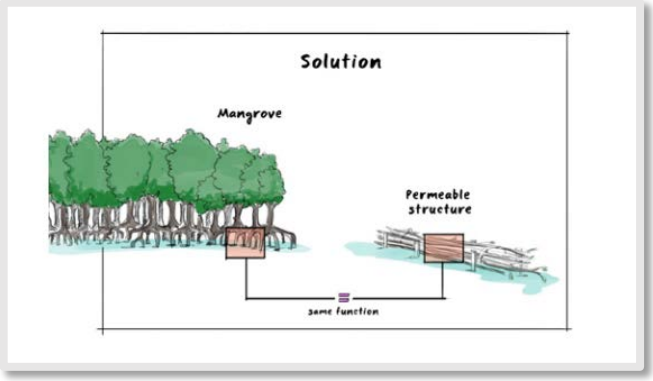
The project also stimulates policy dialogue on land subsidence problems. In 2017, the project Consortium observed that the problems with land subsidence in Demak affect the entire 20 km coastal stretch of the project. They warned that ultimately, sedimentation rates may not keep up with such high levels of subsidence. Uncontrolled groundwater abstraction is a global cause of soil subsidence in many areas of the world and is causing land subsidence in coastal areas throughout SE Asia. Informed decisions can only be made by mapping water demands, water availability, water safety and through dialogue. It ultimately calls for an integrated water management plan for Demak and Semarang. The Building with Nature Consortium therefore studied the potential to shift to surface water and severely reduce ground water extractions. The Consortium has presented a first preliminary evaluation of water availability and an exploration of possible solutions in Demak rivers to create dialogue among stakeholders and proposes that all the water demand is being mapped, because an Integrated Water Resources Management Plan is urgently needed to seize such opportunities. Download the summary of the IWRM study.

Creation, restoration methods:

- Technical measures:

The first step is to restore the sediment balance to stop the erosion process and regain a stable coastline. More sediment needs to be deposited on the coast than the amount being washed away.

To this end, permeable structures made of local materials such as bamboo, twigs or other brushwood are designed to function as sediment traps. These structures let the sea and river water pass through, attenuating the waves rather than reflecting them. As a result, waves lose height and energy before they reach the coastline. The permeable structures also let mud from the seaside pass through, while creating calm water conditions allowing net settling of fine sediments. This way the structures increase the amount of sediment trapped at or near the coast. The mangroves stabilize sediment, further build up the soil and reduce salt water intrusion and flooding extent landward.



Permeable dams mimic the structure of mangrove root systems to trap sediment and dampen waves © EcoShape

Permeable structures © Nanang Sujana

These poles must be durable for the entire lifetime of the permeable structure (5 years or longer). They will be removed when their function is not needed any more in

the project. Two materials are used for the vertical poles: bamboo betung and PVC filled with concrete. The bamboo poles are covered in the tidal zone with wrapping (carpet and tarpaulin) to protect against damage by shipworm. In the first years local wood was used, but more than half of the poles collapsed within one year due to damage by shipworm. PVC poles filled with concrete were then used. Concrete makes the poles more durable. However, PVC degrades due to sunlight and saline water (but it is difficult to monitor this deterioration, because the poles are difficult to reach). It should be investigated whether HDPE is a better alternative.3.33 poles are needed per meter as there are 2 rows of poles and every 0.6 m a pole is placed.

In 2017 the Building with Nature Consortium placed 1.7 kilometres of semi-permeable barriers, on top of the 3.5 kilometres that were built and maintained in 2015 and 2016. The Ministry of Marine Affairs and Fisheries has in total placed 11 kilometres of structures in 12 districts of Northern Java since the start of the project, worth 1.4 mln EUR.

Permeable dams should always be placed in the back of the area to be restored, advancing step by step in seaward direction. If not, too little sediment may be trapped, yielding the risks of water logging. Permeable dams are in particular effective during the stormy season (December – February), because the larger waves during the monsoon bring in more sediment to be trapped while the dams protect the hinterland from further wave attack. Once the erosion process has stopped and the shoreline has accreted to sufficient elevation, mangroves are expected to colonize naturally. The mangroves can then further break the waves and capture sediment and are intended to eventually take over the role of these dams. Hence, the permeable dams at least need to stay in place long enough for mangroves to take over, which is a sum of the sediment accretion rate (2 – 5 years) and rate of mangrove recovery (3 – 5 years). At the targeted front of the mangrove green belt, more permanent permeable structures are required, as these will form the primary sea-defence (means to dissipate wave energy) until also the muddy foreshore (mudflat) is restored.

Sediment accumulating inside the permeable dams © TONNEJICK F.

A technical guideline on permeable dams will be soon available.

Planting mangroves has often failed in this region, as the erosion process is in such an advanced stage that seedlings simply wash away because the water is too deep and waves are too strong. Still, mangroves are remarkably robust and opportunistic species, and they may recover even in eroding areas, as long as appropriate biophysical and social conditions are established. For successful restoration it is most effective to recreate the conditions for natural regeneration to take place rather than to do planting. Naturally recruited Avicennia grows faster than planted species or seedling.

- Socio-economic measures:

The project develops and introduces sustainable aquaculture and livelihoods diversification (crab & shrimp farming). 10 community groups are supported through farmer field schools and by providing resources (financial support) to initiate new aquaculture management practices and livelihood diversification. These improved practices will directly revitalize 300 ha of land for 300 households (based on a conservative estimate of 1 ha per household), increasing average aquaculture productivity with 50%, by adjusting pond lay-out and management, by reducing fertilizer and pesticide inputs, by making optimal use of mangrove services like water purification

and by diversifying livelihoods activities. Based on experiences in Indonesia and Vietnam, income derived from the ponds is expected to have risen to 5000 EUR ha by year.

Community funds will be established that:

- absorb savings from increased pond productivity (5%) in support of long-term coastal belt maintenance and up-scaling of sustainable land-use management measures beyond the project lifetime

- can absorb government support to local communities for coastal protection and sustainable land-use.

Communities have full ownership over enhanced aquaculture production systems and the hardware that will be put in place during and after the project. The reclaimed land will be managed as community-based protected areas (as agreed between communities and the local government), with opportunities for sustainable use of natural resources. The reclaimed mangrove belt will be formally owned by the government as per Indonesian law.

Enhanced capacity and awareness is required to enable and stimulate the target group and other actors to take an active role in planning and implementation of Building measures. Three different training curricula are developed and delivered, targeting government, private sector and communities. Trainings will address both technical, socio-economic and institutional (Integrated Coastal Zone Management, group organising etc.) matters.

Costal Field School © Boskalis

Human and material resources

The technical measures are implemented and maintained by community groups (20-30 each) from 10 villages, with support from Indonesian contractors and under general supervision by project partners. In return for active engagement in conservation and restoration measures, communities receive (financial) support to develop sustainable livelihoods that will generate income. The payments are conditional. This means that payments to communities will only be provided subject to successful restoration (*Biorights incentive mechanism*).

Community involvement in the construction work © Boskalis

Ownership and provisions for maintenance of the structures will be formalized during the project in co-management arrangements between communities and the local government. Communities will take full ownership over the structures ensuring their long-term maintenance. Maintenance costs will be covered via community-managed development funds.

Monitoring and evaluation methods

Different methods were used to monitor biophysical and socioeconomic effects, such as coastal risk reduction, land and water quality improvements, mangrove re-establishment and livelihood gains.

Different indicators and variables are monitored: restoration of the sediment balance, reduced salt water intrusion, decreased erosion rates, re-establishment of mangroves, recovery of pond fisheries production, improvements in income and livelihoods diversification.

Satellite imagery is used to assess coastline change and erosion/deposition areas, while drone images offer a means of assessing on-the-ground mangrove recovery.

Interviews and discussions provide also data about changes in local livelihood status and ecological conditions. Local communities are actively engaged in collecting and recording monitoring information (for example through taking part in regular dialogues, helping with the collection of field measurements, keeping logbooks and other records). The principle of stakeholder participation plays a key role in the technical monitoring protocol.

Monitoring is carried out on an ongoing basis, with data collection taking place at regular intervals. Monitoring allows to continuously update instructions for the design, construction, and supervision of the eco-engineering measures.

Description

The project will be completed by June 2019.

Facilitation

Regular reports are submitted to the donors, which include the Dutch Sustainable Water Fund, The International Climate Initiative (IKI) of the German Environment Ministry (BMUB) and Waterloo Foundation. The Indonesian Ministries are partners and contribute to the reporting.

Partners

The team is composed of project managers (Wetlands International and Ecoshape), private sector parties and specialists, both international and Indonesian. There is close collaboration with local communities.

Type of partner	Name	Role
Non-governmental organizations	Wetlands International	Manages the partnership, coordinates field-based and outreach activities, empowers local communities, facilitates stakeholder dialogue, give ecological expertise
	Blue Forests	Organizes coastal field schools to develop and implement aquaculture measures with communities.
Knowledge institutes	Deltares	Responsible for the design and monitoring of Building with Nature interventions
	Wageningen Marine research	
	Local University of Diponegoro	Contributes to the design and supports on the ground monitoring.
Consultancy and engineering firms	Witteveen+Bos	Manages the development of the guidelines and facilitates project replication.
	Boskalis	Global services provider operating in the dredging, maritime infrastructure and maritime services sectors
	Von Lieberman	Provides technical advice on the basis of experiences derived from a similar project
	Van Oord	Leading international contractor, specialized in dredging, marine engineering and offshore projects
Local stakeholders	Demak Communities	Are involved in the implementation and maintenance of technical measures.

The project shows that close engagement with local communities and other stakeholders, at all levels from design through to implementation, is vital to address root causes and to deliver community benefits.

Costal Field School © Boskalis

Costs and financing

Total funding volume: € 5.069.657 (own funds: 50,000€; external funding: 1.976.000€, BMUB (German Federal Ministry for the Environment, nature Conservation, Building and Nuclear Safety) funding 3.043.657€)

The programme is further supported by Waterloo Foundation, Otter Foundation, Top Consortia for Knowledge and Innovation, Mangroves for the Future, and with contributions by all partners.

Overall assessment

The progress and developments with regard to the Building with Nature pilot in Demak can be summarized as follows:

The Building with Nature measures implemented have in principle been successful.

Key successes that enhance coastal resilience and that have clear replication potential are:

- The Biorights incentive mechanism; as it has successfully engaged communities in mangrove restoration and aquaculture revitalization (community groups even giving up land for restoration).
- The Coastal Field Schools; as these have enhanced and diversified productivity and income of local communities by introducing best practices for aquaculture.

- The permeable structures; as they are effectively trapping sediment aiming to restore the conditions for mangrove restoration.

However, subsidence (having several causes, among which groundwater extraction) is much more severe than previously anticipated and stretching much further along the coast than previously thought. This may be exacerbated by further industrial/infrastructure development and population growth.

We may have reached a threshold where coastal restoration and aquaculture revitalisation may no longer be feasible at the landscape scale, unless subsidence is stopped. This requires further investigation as well as urgent action. Traditional infrastructural measures may also not be able to cope.

There is a shared responsibility by all stakeholders to address subsidence problems by stopping groundwater extraction, enhancing integrated water resources management and by joining forces to restore mangroves and revitalize aquaculture.

Although it is not clear whether the envisioned landscape scale coastal restoration and aquaculture revitalization is still feasible due to the severity of subsidence, the Building with Nature measures will still enhance the resilience of the coastal communities and ecosystem in the shorter term and at a smaller scale, thus softening and delaying the impact of hazards.

Hence, the project will continue the implementation and maintenance of measures as agreed in Biorights contracts with 10 community groups.

The project will also prioritize awareness raising among communities about subsidence and the need to address this, through integrated coastal zone and water resources management across Demak and Central Java, increase attention for disaster preparedness of communities (including e.g. adaptation or transformation of livelihoods) and will stimulate (policy) dialogue about subsidence at the national level.

The challenges in Demak emphasize the need for holistic solutions like Building with Nature, in combination with integrated water resources and coastal zone management.

Hence, the project will increase efforts with regard to mainstreaming Building with Nature across Indonesia, including through capacity building and training.

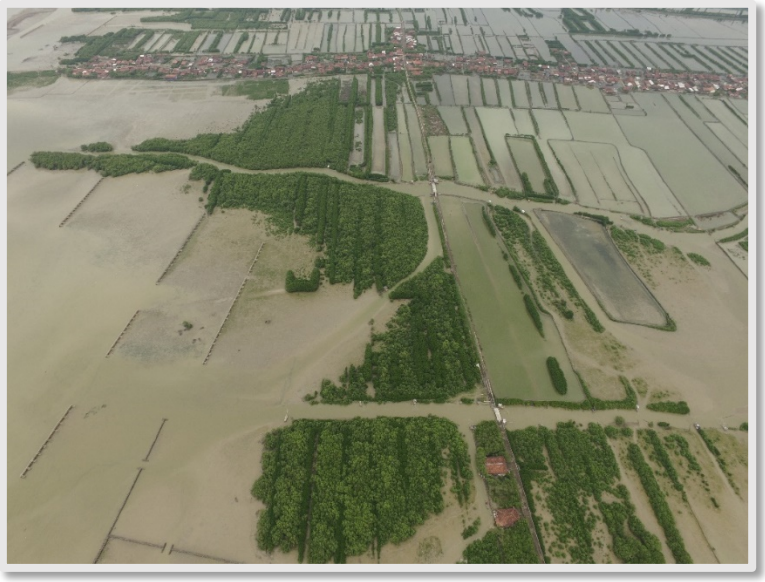
Tangible results policy embedding:

- Master plan for sustainable development of Demak district - including Building with Nature Indonesia measures developed with and endorsed by Taskforce Integrated Coastal Zone Management led by planning agency of Central Java and involving all relevant stakeholders.

- Master plan and Building with Nature approach embedded in Central Java Provincial policies (spatial plan and mid-term development plan 2019-2024 and provincial mangrove strategy).

- Village development plans and regulations on land use rights, protected areas and coastal zone management developed and adopted by 10 communities and formalised with local government.

STRONG POINTS	WEAK POINTS
Protection of a specific wetland type widely spread over coastal areas in the World	
Strong involvement of local communities including in the long term	
Identification of positive impact for local people (income and welfare) to promote the approach	
Integrated approach with involvement of all stakeholders/parties from national to local	Use of PVC filled with concrete(unnatural, heavier and more expensive than bamboo)
Use of local resources (bamboo, sediment…)	Solutions may not be able to cope with severity of subsidence
Helping communities to adapt to climate change and cope with disaster risk	The sediment balance is only monitored in the project area and not in other locations, where the process could have an impact.
embedded replication and scaling up of the approach	
building of a community of practice	
increased yields of aquaculture, reduce pressure on mangrove and ponds creation	
favouring natural recovering processes instead of targeted planting	



Mangrove recovery behind permeable dams © PT. Prospek Empat Dimensi

Perspectives

Continuation

The challenges in Demak emphasize the need for holistic solutions like Building with Nature, in combination with integrated water resources and coastal zone management. This year a Building with Nature secretariat was created in Indonesia, facilitated by the Ministry of Marine Affairs and Fisheries. It will disseminate the Building with Nature approach across Indonesia, by providing practical design guidelines, training and policy recommendations. A help desk facility will provide on-the-job guidance on all aspects of the project life cycle of existing and future Building with Nature projects. A high-level network of champions will be created to facilitate outreach in media, policy fora, and working groups for wider uptake of Building with Nature in Indonesia.

The consortium aims to turn this project secretariat into an independent platform to engage new members from government, private sector, knowledge institutes and civil society and initiate new pilots in different settings. In the future the Platform could become a Centre of Excellence in the South East Asia region providing advice on nature-based solutions.

Transposability

- Learning by doing:

Building with Nature is innovative and site specific, operating in areas with limited systems understanding and dynamic changes. Therefore the project applies a learning-by-doing strategy. It is therefore flexible and adaptive and is updated frequently with lessons learned. The project partners share their knowledge and lessons learnt widely to support sound replication of the approach.

- Replication and scaling up:

While specific designs for Building with Nature are highly site-specific, depending on local conditions, the general rationale behind the approach as well as the required process behind roll-out of the approach are readily replicable, provided that a conducive environment and sufficient stakeholder capacity are in place.

There is a “Building with Nature” solution in every setting, combining green and grey infrastructures in an optimal mix, alongside other measures of risk reduction. The project aims for replication and scaling up of the Building with Nature philosophy and approach to other rural and urban areas, in Indonesia and across the world. This is done through capacity building, knowledge exchange, exchange visits and embedding in policies and planning. The initiative is strongly supported by the Indonesian government and local communities.

Publications

ECOSHAPE. Brochure: Building with Nature Indonesia – meet the partners. 2p. Available at:

https://www.wetlands.org/publications/building-with-nature-indonesia-meet-the-partners/

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TONNEIJCK F., WINTERWERP H., VAN WEESENBEECK B., DEBROT D., RUSILA NOOR Y., WILMS T. Design and Engineering Plan. Building with Nature Indonesia – Securing Eroding coastlines. 65p. 2015

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