Q&A Building with Nature Phase II Indonesia:

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1. Who benefits from this project?

Through the large scale Building with Nature project in Demak district, we ultimately enhance coastal resilience for 70.000 vulnerable people by avoiding further flooding and erosion of the coast including 6000 ha of aquaculture ponds. The people in Demak, aquaculture farmers and fishermen, are desperate. In just 10 years' time their valuable lands have washed away by the sea. They lost their roads and schools. Entire villages disappeared into the water, as the sea encroached hundreds of meters up to a kilometer inland.

Without our project, coastal erosion will continue across the entire Demak district and land will be steadily lost. In this situation aquaculture production is not possible anymore and yields will become zero. Contrary, in the situation with our project, coastal erosion is stopped. We also support sustainable revitalization of 300 ha of aquaculture ponds along a 20 km shoreline. We do this by introducing best practice and innovative aquaculture measures through Coastal Field Schools and by providing incentives through the biorights approach. This enhances inclusive economic growth and self-reliance of the communities in the region.

2. Why and when did the erosion problems arise?

The erosion is largely caused by human interventions. Aquaculture farmers expanded their shrimp ponds substantially in the 1980s when the demand for shrimp increased. In the 1990s, frequent losses of shrimp harvests due to diseases pushed farmers to open new ponds close to the waterline for which they removed the mangrove forests. This has initiated a self-accelerating erosion process, because waves get bigger when they reflect on the aquaculture pond dykes. Erosion was then aggravated by the establishment of traditional hard structures for coastal protection that block sediment input and enhance erosion. Ground water extraction for aquaculture and industry is causing severe subsidence that further exacerbates the situation. More information: Article Science

Direct: Aquaculture induced erosion of tropical coastlines throws coastal communities back into poverty; Brochure: Building with Nature for Coastal Resilience

3. Why not using hard structures for coastal defence in muddy coasts?

Coastal managers often try to fight coastal erosion and flooding with conventional hard solutions, such as dikes and seawalls, fighting the symptoms rather than addressing the root causes of these problems. This traditional response is also witnessed in Demak. However, this approach is unsuitable for soft muddy coastlines in rural areas as they deteriorate the stability of the coast by blocking sediment transport towards the coast and by enhancing the eroding force of waves.

Hard engineering solutions can be a good solution in some areas, but are too expensive for Java's extensive rural coastline. They are only affordable for urban areas with high economic revenue and high population densities. Moreover, hard-infrastructure solutions fail to restore environmental conditions that are crucial for a productive aquaculture and fisheries sector.

4. Why is Building with Nature a more suitable approach?

Building with Nature combines smart engineering and ecological rehabilitation, while introducing sustainable land use practice. Instead of fighting nature with dams and dikes only, Building with Nature solutions work with and along the dynamics of nature.

For example by allowing river flows and sea currents to reinforce the coastline with sediment. Or by restoring ecosystems so that they once more provide protection against extreme events and offer valuable 'natural capital' in the form of shell-fish, timber and recreational opportunities. Building with Nature solutions are furthermore climate-adaptive, and typically 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 disadvantaged communities – are involved in design, construction and maintenance of measures. This renders the approach financially, institutionally, environmentally, technically as well as socially highly sustainable.

5. What is your vision for Demak?

We envision a safe and prosperous Demak district, in which a mangrove greenbelt provides the coastal safety and resilience needed for the communities to thrive such that in turn they can sustain the mangrove greenbelt they rely on.

This long-term vision is shared among the Indonesian and Dutch project partners and is based on discussions with multiple local, provincial and national stakeholders since 2012. A shared long-term, landscape level vision will help the multiple stakeholders – including the project partners – to align the implementation of coastal safety as well as socio-economic measures, and set priorities in these. We are working together with stakeholders to refine this vision, and to embed it in policies and planning.

6. What technical coastal safety measures will be taken in Demak?

The main solution we propose to achieve coastal safety in Demak is to bring back a healthy mangrove ecosystem. In severely eroding settings, this requires restoration of the sediment balance using permeable dams and mud nourishments. 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.
In the areas where erosion is still limited, the hydrology is severely disturbed by aquaculture bunds, channelization and degraded tidal creeks. This hampers mangrove recovery and functioning and the hydrology will be need to be restored along with the sediment balance.

These measures will prevent a 100 m/yr erosion, ultimately preventing the loss of 6000 ha of aquaculture ponds in Demak district, predicted to be flooded by 2100 due to sea level rise.

7. Isn't the situation too severe to restore the area?

Some researchers are concerned that the Demak area has already crossed several thresholds, so that mangrove restoration is no longer possible for reasonable costs. We agree that the situation in Demak is very severe, especially in the areas closest to Semarang (e.g. Bedono) where subsidence due to groundwater extraction is worst. However, in partnership with the Indonesian government, local communities and Dutch water experts we agreed that we should not yet give up and try the innovative Building with Nature solution.

Ironically, an advantage of the severity of the current situation is that stakeholders truly understand that business as usual is destructive and that a paradigm shift is needed. Moreover, if this solution works, it can trigger change and bring hope in similar areas that are suffering from erosion and flooding across the tropics. The success of our approach largely depends on whether stakeholders will take due responsibility for the situation and act accordingly. For example by reducing and ultimately halting ground water extraction to reduce subsidence and by protecting restored mangrove instead of converting them to ponds again. We try to facilitate stakeholders by together developing viable alternatives, such as improved surface water management and by supporting aquaculture revitalization to reduce pressure on the mangrove greenbelt. Also, we work in the entire Demak district, also in areas where the erosion is less severe so that at least in those areas we can demonstrate success. In the areas closest to Semarang we do not implement measures, but rather stimulate a dialogue with stakeholders to come up with urban Building with Nature solutions that require a different approach.

8. Why don't you just replant mangroves?

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. Furthermore, trials to protect eroding shorelines have usually been implemented in an ad hoc manner without coherent strategy.

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. This often involves restoration of the hydrology and of the sediment balance to ensure the right soil elevation. Naturally recruited *Avicennia* grows faster than planted species or seedlings, but unfortunately planting efforts sometimes damage natural recruitment and awareness raising is needed.

In some cases, 'enrichment planting' may be needed to enhance biodiversity. Mangrove planting along dams and bunds may be considered as a temporary measure to avoid erosion in the short term, but in the longer term a continuous greenbelt is needed to avoid erosion and flooding.

More information: Ecological Mangrove Restoration Manual, manual on community based mangrove restoration, manual on mangrove reversion of abandoned and illegal brackish fish ponds.

9. Don't you need a more holistic approach, for instance by changing the land use in the area?

Some people think our approach is too technocratic, by focusing only on coastal protection and engineering. In fact our approach is holistic and also involves master planning, education and implementing socio-economic measures such as the set-up of financial mechanisms to support aquaculture revitalization linked with mangrove restoration. However, the small scale experiment that led to the development of our district-wide Building with Nature project has received a lot of attention and is more visible than our other measures. In the coming years there will be more balance. Our design and engineering plan describes both technical and socio-economic measures and is available online

10. How is the community involved in this project?

The project involves and trains local communities in planning, implementation and maintenance of coastal safety measures. The project furthermore promotes sustainable land-use including the development and introduction of sustainable aquaculture and livelihoods diversification. Capacities of the community will be built through coastal field schools. The measures in Demak will be rooted in community development plans and integral government master planning, and governed under community bylaws and funding mechanisms.

11. How will you revitalise aquaculture?

The ponds will be located behind the restored mangrove belt, instead of right in front of the coast or directly bordering the rivers where they induce erosion. In this way the ponds can make optimal use of mangrove services like water purification. Also the pond lay-out and management will be adjusted to enhance water quality. The ponds will include a filter pond, and fertilizer and pesticide inputs will be decreased. Further, poly-culture systems will be introduced, in which farmers stock multiple species which stimulates nutrient recycling, limits pollution and enhances resilience.

Altogether productivity of the ponds is expected to go up with at least 50% as a result. In the next five years the project will directly support sustainable revitalization of 300 ha of aquaculture ponds along a 20 km shoreline. With this, we hope to inspire further revitalization in Demak through capacity building and the set-up of community funds. Lastly, aquaculture measures will be linked to mangrove restoration measures through the coastal field schools and biorights mechanism to emphasise their interdependence. How is the long term sustainability of the project ensured?

Together with the community groups and local government, community funds will be established which we aim to get filled by savings from increased pond productivity and by the government in support of long-term coastal greenbelt maintenance and up-scaling of sustainable land-use management measures beyond the project lifetime.

The project partners aim for embedding Building with Nature solutions in policies and plans for mangrove management, sustainable development and coastal zone management at the level of community, Demak district, Central Java Province and national government.

The project partners will train communities, engineers and government officials from local to national level on the design, implementation and maintenance of Building with Nature measures.

We believe there are many advantages for coastal zone engineers to apply the BwN approach, as it is socially and environmentally much more sustainable, which may help them comply with ICSR policies and substantially shorten permitting procedures, rendering important cost savings

12. How long do the permeable dams need to stay in place?

The function of permeable dams is to stabilize the sediment so that mangroves can recover to then provide coastal safety. Hence, 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). The front of the mangrove belt, which will function as primary sea defense, needs more permanent permeable structures until also the muddy foreshore is restored.

Currently, we are optimizing and testing the design of the permeable dams in line with this requirement. Poles may be damaged by shipworms and either need to be replaced regularly or made of durable materials like PVC (which will eventually need to be removed). The brushwood needs to be refilled regularly, and needs to be kept in place with e.g. nets with a wide mesh size to avoid unintended trapping of species. Lastly, we train contractors and communities to properly construct and actively maintain the dams. The costs of permeable dams need to be calculated over their required lifetime, including maintenance.

13. What are the chances that the dams collapse or will be damaged, for instance by the monsoon?

In general, the monsoon is an opportunity rather than a threat, as the currents during the monsoon mobilize the sediment to be captured behind the permeable dams. However, the brushwood dams are built from natural materials as much as possible and therefore will collapse (and be lost) at some point in time (see Q 12). The time window in which these dams will collapse will depend on quality of materials, dam construction and maintenance effort. Presently we are performing tests in Demak with different materials and construction variants to obtain more insight in how lifetime of permeable dams can be optimized in a cost effective way.

We distinguish between short life dams and long life dams, where short life dams, built of natural materials (e.g. bamboo + brushwood), trap sediment for a about two to five years. When sufficient sediment has been trapped these dams may collapse, since new grid cells are constructed in front of the permeable dams. Primary dams form the seaward transition from the restored mangrove greenbelt towards the sea and need to remain in place for a much longer term (such that the mangrove greenbelt can mature, which takes about 10 years at least). Presently tests for primary dams are executed with PVC poles filled with concrete in combination with brushwood. Continued maintenance will be an important factor for primary dams.

So far dam collapse was mainly caused by natural degradation by benthos organisms (as shipworms) rather than extreme weather conditions. The effects of this natural degradation typically become visible during the more severe monsoon conditions. We address this issue by regularly checking and replacing poles and by testing different types of poles.

14. How do you make sure that the new mangrove is not replaced by fisheries/shrimp farms?

In all our activities we emphasise how a healthy aquaculture sector depends on the coastal safety provided by mangroves and that the mangroves in turn need to be sustained by it. Parallel to our mangrove restoration activities we revitalise aquaculture, so that the same amount of profit can be reaped from a smaller area, leaving space available for mangroves. We set up community groups and

introduce the bio-rights mechanism, a micro-credit system that supports those community groups financially to develop sustainable aquaculture and other livelihoods in return for their active engagement in environmental conservation and restoration.

Once the mangrove belt is restored, vital ecosystem services that the mangrove forests provide, such as fisheries enhancement, carbon storage, and water purification, will be revived. The recovered mangrove ecosystem itself will also provide many ecosystem services that can enhance livelihoods. See more information on how the community is involved in question 8.

15. How do mangroves enhance coastal protection?

Mangrove belts can severely lessen wave damage and even reduce the impacts from major storms (also called cyclones, typhoons or hurricanes) by reducing wave height and wind speed and by reducing flood extents in low lying areas. Healthy and mature mangroves can further reduce tsunami heights, reduce erosion and they are able to moderate or even fully negate the effects of sea level rise over long periods provided that enough sediment is available. See mangroves for coastal defence for more information. The wider the mangrove belt (ideally thousands of kilometesr), the more effective in acting as a line of defense against waves and surges. Allowing mangroves space to retreat landwards will help to ensure their survival.

Mangroves rarely provide a stand-alone solution; they need to be combined with other risk reduction measures to achieve a desired level of protection. If they are integrated appropriately, mangroves can contribute to risk reduction in almost every coastal setting, ranging from rural to urban and from natural to heavily degraded landscapes. In urban areas mangroves may need to be combined with hard infrastructure solutions and in that case they can lower maintenance costs of that infrastructure while providing additional benefits.

16. How do mangroves keep up with sea level rise?

Mangrove soils are actively growing in many places by capturing riverine or coastal sediments that pass through, as well as adding their own organic matter in the form of roots, leaves and woody material. The fine mangrove roots also help to trap and bind the particles. Due to a lack of oxygen in the waterlogged soil, organic matter is not broken down by soil organisms. This allows the organic matter to build up over time, producing the deep peaty soils that underlie mangroves in some areas. Mangrove root growth also pushes the soil upward, resulting in a higher soil level. These processes can allow mangroves to keep pace with rising sea levels in some areas. While not all mangroves may be able to fully “keep up” with rising seas, even a small increase in soil surface height over time may help to reduce the impact of sea level rise on coastal areas.

17. Does ongoing subsidence affect the project?

Subsidence is caused by ground water extraction from deep wells for industry, aquaculture and household use. Other activities that can cause subsidence are oil extraction and the drainage of peatlands which causes its oxidation. Subsidence adds to climate change induced sea level rise and can be much larger. In Semarang, subsidence is estimated to be up to 8 cm per year while sea level rise is a few mm per year. . Subsidence can be addressed by halting ground water extraction, which requires improving surface water management. Integrated water management is one of the key elements of our activities to revitalise aquaculture.

18. Have the project partners been active in the past in advising the Indonesia or Javanese government how best to manage mangrove ecosystems moving forward?

Yes, we provided input into the National Mangrove Strategy, the Aquaculture rehabilitation program of the Ministry of Marine Affairs and Fisheries and the Essential Ecosystem program of the Ministry of Forestry.We organized stakeholder platforms in Banyuwangi (East Java) and Banten (West Java) leading to the adoption of management plans that specifically aim to enhance management of mangroves for provisioning of ecosystem services. In all cases we try to enhance decision making by providing access to the latest scientific knowledge and by showing that management choices have a big impact on ecosystem services delivery. That way we hope that stakeholders start recognizing the multiple values of a healthy mangrove ecosystem, stop converting mangroves and start restoring them.

19. Are there other coasts with similar problems that can benefit from this BwN approach?

There is a different Building with Nature solution for every setting, combining green and grey in an optimal mix. In natural and rural settings more space can be made available for ecosystems to provide coastal and water safety, while in urban settings ecosystems can be combined with conventional infrastructure to introduce multiple benefits. Key to success is to use an inclusive and holistic approach and this implies that the solution needs to be tailor made for each situation. We will use our project in Demak to inform and inspire coastal zone managers from government and private sector and help them include and adjust the approach in their urban (Jakarta, Semarang) and rural development programmes. Though we aim for replication and up-scaling of Building with Nature across Indonesia and beyond, it is vital that critical lessons are learnt from this project.
As part of the present project scope we therefore test and use different materials and techniques, depending on the circumstances of different sites. We share these lessons through trainings, and via constant interaction and tuning of activities with Indonesian partners and stakeholders. Although the construction of permeable dams itself is low tech, their geospatial design is actually high tech, since it requires a solid system understanding. Replication therefore requires a proper feasibility study and baseline assessment.

20. Can we already responsibly promote replication elsewhere or not?

Permeable dams have been applied (and researched) for centuries in the Netherlands and Germany (called salt marsh works), and in that sense the approach is not new. In the tropics, the approach is also being tested and researched in Vietnam and more recently a pilot started in Surinam. We are in close contact with these projects so that we can learn from each other. Our first pilots in Indonesia (Demak) demonstrated that the approach is at least technically feasible and our first monitoring results confirm this.

However, the permeable dams should be part of a broader set of technical and socio-economic measures at the landscape scale, and need to be implemented with multiple stakeholders and embedded in policy to be successful in the longer run. Rather than promoting permeable dams as a single issue measure we are therefore promoting the Building with Nature approach. This approach is based on system understanding/problem analysis and develops landscape scale solutions with stakeholders.

There are many different types of Building with Nature solutions for many different settings. There is a risk that others replicate the permeable dams as a stand-alone measure in the wrong place. This cannot be entirely avoided. To address this risk we are e.g. setting up a Building with Nature training program (initially aimed at Indonesia), developing guidelines and sharing knowledge and lessons learned.

21. Is there sufficient scientific evidence for the approach?

The original Building with Nature Indonesia project is not a research project and as such scientific monitoring is relatively basic and aimed at demonstrating performance of our coastal safety measures (e.g. sedimentation rates, mangrove recruitment) and aquaculture measures (e.g. enhanced productivity and income). We complement this through student research to enhance our wider system understanding. Monitoring is done by Deltares, Wageningen University and Imares in collaboration with the local University in Semarang and a local NGO. The first results are becoming available, and we will share the results once possible. In addition, we do more practical monitoring during implementation, to allow for adaptive management along the way, with the community (e.g. as part of the Coastal Field Schools). Since we wished to further enhance system understanding in Demak and enhance our measures, we developed two (applied) research proposals that were granted last year: 1) on bio-morphodynamic modeling of mangrove-mud coasts and 2) on the development of innovative sustainable aquaculture systems to support mangrove forest restoration.