



BUILDING WITH NATURE ON JAVA

Weaving dams to defend mangroves



On Java alone, 30 million people are at risk from flooding because the mangrove forests along the coast are damaged and no longer hold back the sea. To restore them, researchers are resorting to a mediaeval technique using simple little dams behind which the floating tree seeds can germinate.

**TEXT RENÉ DIDDE PHOTO NANANG SUJANA / WETLANDS INTERNATIONAL
ILLUSTRATION INFOGRAPHICSLAB**

On his laptop, Dolfi Debrot shows photos of a muddy field full of stalks pushing up at random angles. These very young plants are the germinated seed of the *api*, the local name for the mangrove *Avicennia marina*. Debrot, who works for Wageningen Marine Research, sees this field of seedlings as an indication of the successful comeback of mangrove forest.

Worldwide, and in Indonesia particularly, these forests, which protect coasts, are suffering badly.

Mangrove forests form natural coastal defences. The forests trap sediment both from the sea and from the rivers flowing into it. The forests spread seawards like a resilient wall of sea defences which fends off high

winds and big waves. These wet forests also spread inland, providing nurseries for young fish in the many lagoons and creeks.

'Right off the coast of Java here, we are creating a good nutrient base for the large quantities of seed floating around,' says Debrot. On the next photo the mangrove specialist points out a series of disarmingly rickety-looking dams. 'They were woven by local people with bits of wood from pruning within a strong frame of bamboo poles.'

The little dams catch sediment that the waves carry in from the sea. The water streams back through the semi-porous dams, while the sediment stays behind. This leaves a muddy nutrient base for mangrove recovery along the coast. The technique

comes from the Netherlands. Not from scientists with high-tech equipment but from mediaeval monks who used similar rickety dams to turn parts of the Dutch delta into slow-growing salt marshes, making the coast habitable.

SALT MARSH WORKS

Near the city of Semarang on the north coast of Central Java, history is repeating itself 1000 years later, as new salt marsh works get under way. 'We have copied the measurements of the dams directly from the salt marsh works as standardized by the Dutch national water board in 1900,' says Han Winterwerp of research institute Deltares. It is hands-on work, says the water specialist.



PHOTO PT. PROSPEK EMPAT DIMENSIS / WITTEVEEN+BOS.

A drone photo of the mangrove restoration project on the north coast of Java near the city of Semarang. The semi-porous dams are visible in the water. They trap sediment, in which mangrove seeds can germinate.

‘The technique is simple but we have done a thorough study of the wave patterns, the tides and the sediment balance.’

There were setbacks too. The naval shipworm, a mollusc that bores through wood, had damaged the first set of hardwood poles within seven months. ‘We replaced them with bamboo, and now they will last a year but we are keen to find more durable material, because they need to last at least three years. Only then will the young mangrove forest be ready to take over their task,’ says Winterwerp. So the driving force here is ‘building with nature’. ‘We are just giving nature a helping hand by building little dams to trap the sediment,’ says Debrot. Debrot and Winterwerp collaborate on the Java mangrove restoration project, which is costing nine millions euros for five years. Most of this funding comes from the Dutch government, the Netherlands Organization for Scientific Research (NWO) and various research and advisory institutes in Ecoshape, a consortium which propagates ‘building with nature’ (see text box). The Indonesian government contributes too, to the dam-building among other things.

Mangrove is not a tree family but a collective noun for 50 species including palms such as the Nipa palm, which thrive with their roots in water.

All around the world, mangrove forests along tens of thousands of kilometres of

coastline are suffering serious damage or have even disappeared. Sometimes this is due to the demand for firewood and construction wood; more often the forests make way for farming for ever-expanding cities. The first people to chop down these forests on Java, from 1850, were rice farmers wanting to farm on the fertile river-fed coastal plains. ‘When rice-farming became less lucrative from the late 1980s, shrimp farming started to take off,’ says Debrot. ‘Driven by investors from the cities – wood and shrimp traders – the farmers cut down trees and dug ponds in the forest.’

Shrimp-farming went well for a number of years, until it became impossible to clean the ponds, which were full of manure, pesticides and antibiotics. ‘The farmers lacked knowledge and capital to make improvements, and the aquaculture moved on to another part of Java.’ The farmers who stayed behind struggled on and got themselves into

a negative spiral, says Debrot.

To make matters worse, canalization of rivers inland caused their sediment to be dumped out at sea rather than along the coast. This meant less of a nutrient base for mangrove.

SWALLOWED UP

Rising sea levels and severe storms are taking their toll as well. Several villages have been swallowed up by the sea because the mangrove forests no longer hold back the water. On Java alone, where the coast has sometimes been eroded up to several kilometres inland, 30 million people are in danger, says Femke Tonneijck of the Netherlands-based NGO Wetlands International.

The dam project on Java, which started in the autumn of 2013, aims to prove on a small scale that it is possible to turn the tide, says Tonneijck. Already, four kilometres of ➤

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BUILDING WITH NATURE

In the first decade of this century a working method was developed in the Netherlands for enlisting the help of nature in defending coasts against the sea. One of the first projects was the construction of a reef in the Oosterschelde estuary in the south of the Netherlands. This was made of oyster waste, which new oysters clamped onto, says Fokko van der Goot of Ecoshape, a consortium of dredging companies, NGOs, consultancy firms and research institutes – including Wageningen University & Research. ‘The reef prevented the coast from eroding and sandbanks from disappearing,’ says Van der Goot. The same concept was applied in Bangladesh in 2012. And projects have been started recently in Surinam and Vietnam in which porous dams are used in efforts to protect

the coast and restore mangrove forest.

Another success story is the Sand Motor: in 2011, instead of replenishing sand to protect the coast every five years as usual, a huge amount of sand was deposited in one go to form a hook-shaped sandbar along the coast near The Hague. ‘The sand is slowly moved northwards along 20 kilometres of coast by waves, tidal currents and the wind. The concept has benefits not just for coastal reinforcement but also for recreation and nature. And it costs less than the total cost of all the repeated deposits of sand.’ A similar approach has now been adopted in Friesland. ‘When sludge from Harlingen harbour is dumped at a strategic spot in the Wadden Sea, currents carry it off and the salt marshes get reinforced.’



Clockwise from left: fishing in the mangroves, germinated seeds of the mangrove *Avicennia marina*, and the roots of the mangrove *Rhizophora mucronata*.

dams have been constructed, each of them 100 metres long. The first results are impressive, according to the water expert. ‘Within one and a half years the most badly damaged strip of coast has been raised 40 to 50 centimetres,’ says Tonneijck, who coordinates the collaboration between Dutch and Indonesian partners. While elsewhere in the world governments

and local people set to work to plant out cuttings and seedlings, those taking part in the Java project are waiting until the naturally floating seeds germinate of their own accord on the newly formed soil. ‘The means that the first to get established is the api api mangrove, and that is the best one,’ says Tonneijck. ‘It forms a mat with its root system, trapping even more sediment. As a re-

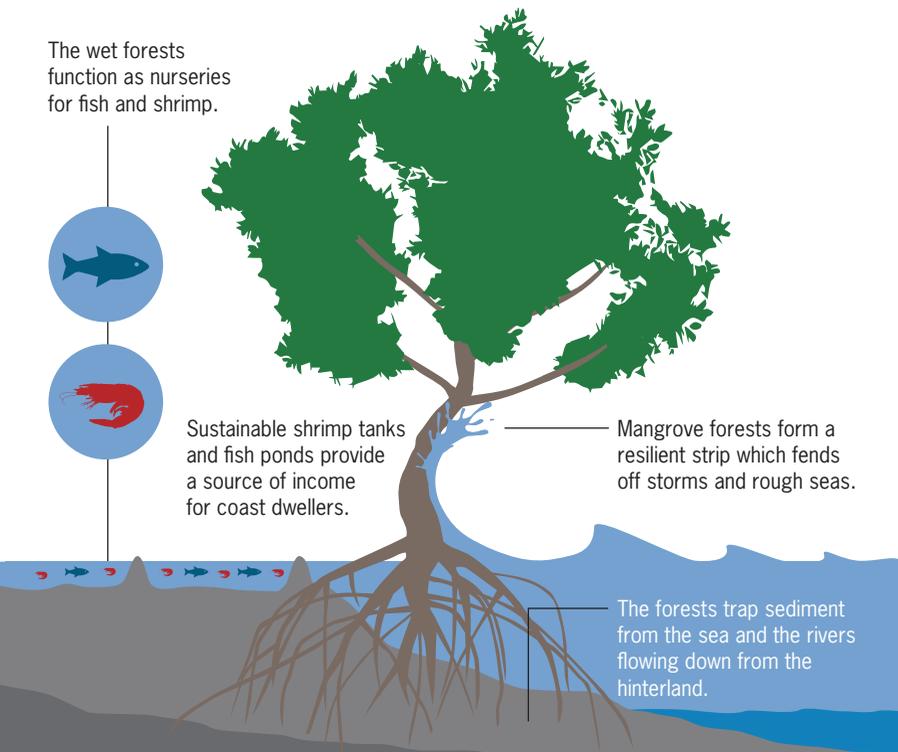
sult, the bakau mangrove (*Rhizophora mucronata*) gets the chance to establish itself closer to land, and then things can change fast,’ she explains.

In many mangrove restoration programmes species are planted in the wrong places, Tonneijck has concluded. ‘Thanks to a well-intentioned “tree-planting day feeling” they start randomly planting out the bakau mangrove. However, without a protective front-line of api api mangroves seawards, restoration will not be very successful, as comparative studies have shown.’

The project’s objectives include not just restoring the mangrove forest but also making aquaculture more sustainable. Interested owners of the remaining shrimp ponds are

‘Mussels in the tanks help with purifying the water’

MANGROVE FOREST PROVIDES COASTAL DEFENCE AND SHRIMP FARMING



more strictly, too, and enforce existing laws better,' says Bosma.

NEW SYSTEM

There are a total of ten partners involved in the project. 'One of them is the Blue Forest group, a young Indonesian NGO which is trying to establish the new approach to coastal conservation and sustainable aquaculture through a practice-based teaching method called the coastal field school,' says Femke Tonnejck. 'Training is now going on in ten villages, with 20 people in each village. Afterwards they can take part in the Biorights mechanism, in which they get money to invest in sustainable aquaculture and fisheries, in exchange for protecting and restoring mangrove.'

The aim is to demonstrate on 300 of the 6000 hectares of aquaculture in the district that the land can be protected while at the same time doubling earnings from aquaculture. After one year, improvements have already been made on 116 hectares, says Tonnejck.

According to mangrove specialist Debrot, building with nature is the big new business model for coastal protection. 'When the forests are a bit more mature, they will also offer opportunities for beekeeping and farmers can keep goats in the higher areas.' Debrot expects ecotourism to provide another source of income. 'Already city people from Semarang are coming to walk on boardwalks in the area. And if predatory fish return to the mangrove forests, perhaps there will be new opportunities for sports fishing.' ■

www.wur.eu/buildingwithnature

CDI COURSE

Wageningen Centre for Development Innovation will be running a course in June called *Wetlands, integrated water resources management and food security*.
www.wur.eu/cdi/shortcourses2017

being encouraged to adopt sustainable shrimp-farming practices and better management of the ponds, says Roel Bosma of the Aquaculture and Fisheries chair group in Wageningen. 'Nowadays the farmers fertilize the ponds with homemade compost. Previously they would also throw leftover food into the tanks, but breaking that down took a lot of oxygen. That is not a good idea in aquaculture,' says Bosma. 'Now they are learning to drain their ponds once a year, and clean them out.'

Bosma works with Diponegoro University on an integrated fish farming system with species such as milkfish, as well as shrimps. Mussels and oysters could be of interest for boosting the farmers' incomes too, says

Bosma. 'Mussels in the tanks also help with purifying the water. And if the soil is suitable, oyster banks can promote the recovery of mangrove, in combination with the dams.'

There is still a need to develop a market in Indonesia for new products such as mussels and oysters. 'With a city like Semarang nearby, that can't be a big problem,' expects Bosma. A trickier issue is that the shrimp farmers are expected to give up 15 to 20 per cent of their production area in the form of ponds for the restoration of mangrove forests, along both the coast and the rivers. 'Mangrove restoration is needed along the riverbeds as well. The Indonesian government needs to supervise mangrove felling