

THE WIOMSA MAGAZINE

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# people & the environment

ISSUE NO.11 | SEPTEMBER 2020



inside...

Issue 11 is inspired by the **2021-2030 UN decade of Ecosystem Restoration** to support and scale up efforts to prevent, halt and reverse the degradation of ecosystems worldwide and raise awareness of the importance of successful ecosystem restoration.





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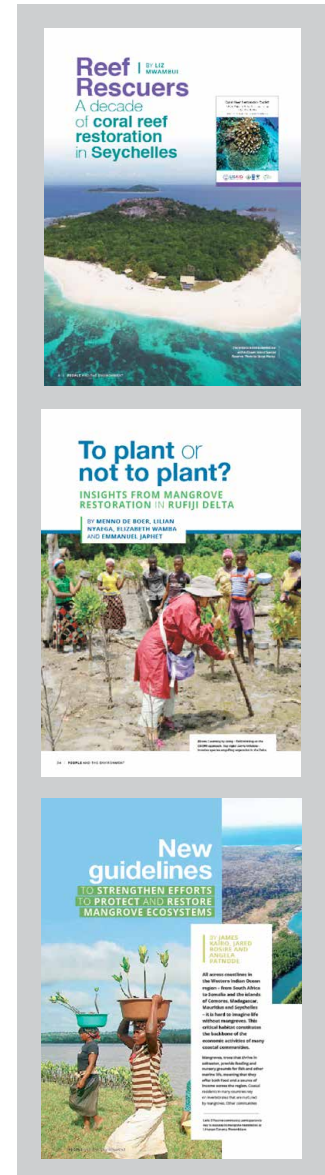
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**Cover photo:** Coral farmer cleaning “baby corals”, © *marinecultures.org* and *Adobe Stock*, *James White/Danita Delimont*.

**Back photo:** Reef rescuer Athina Antoine cleaning corals at a nursery, © *Camila Marino*

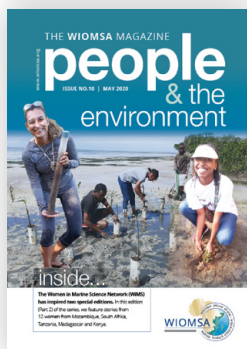
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# people & the environment

## Restoring damaged WIO Coastal Ecosystems:

**The restoration of coastal ecosystems is regarded as a viable nature-based solution in achieving a wide range of global development goals.** Indeed,

the United Nations has proclaimed 2021–2030 as the decade of Ecosystem Restoration, to support and scale up efforts to prevent, halt

and reverse the degradation of ecosystems worldwide and raise awareness of the importance of successful ecosystem restoration. Over the years, restoration of critical coastal habitats such as mangroves, seagrasses, estuaries, dunes and coral reefs has been undertaken in the WIO region with some restoration initiatives remaining at an experimental level while others have gone on to be implemented at a large scale. In the process, a wealth of experience has been accumulated from different restoration processes. The dissemination of the lessons learnt from these initiatives provides a great opportunity for shared learning across the region. **WIOMSA and the “Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities” (WIOSAP) Project of the Nairobi Convention have jointly produced two issues of the WIOMSA Magazine focusing on restoring damaged coastal ecosystems.** The first part of this series features stories from projects implemented in the Seychelles, Kenya, Mozambique, South Africa, Tanzania and Madagascar. The stories focus on successes, failures, challenges, lessons learnt and also outline the opportunities that exist in ecosystem restoration. They highlight community participation in restoration efforts, how restoration fits within the wider ecosystem management realm, the costs and economics of restoration activities and compare different restoration techniques.

# A unique opportunity to “build back better”

BY JARED BOSIRE

**W**hat a remarkable moment to have an issue of the WIOMSA magazine dedicated to the restoration of ecosystems across the Western Indian Ocean (WIO) region. Firstly, we have all experienced the impacts of Covid-19, an unprecedented global pandemic which has disrupted life as we have known it, and the concept of restoration will definitely be one of the approaches by which we may address the global clarion call to “*build back better*”. Secondly, the publication of this issue of the magazine in 2020 is quite timely, coming on the eve of the start of the Decade on Ecosystem Restoration for which the United Nations has unequivocally reaffirmed that

“restoring damaged ecosystems is an efficient and cost-effective way people can work with nature to address the most pressing challenges humanity is facing today, i.e. the Coronavirus disease 2019 (COVID-19) global pandemic, especially in the context of the build back better approach”.

**The build back better approach is particularly fitting in the context of the WIO region because the livelihoods of local communities, and even national economies, are closely tied to the integrity of coastal resources.** With increasing human population, compounded with the increasing pace and scope of coastal developments/urbanization, and natural challenges like climate change, coastal resources have never been under more



Jared Bosire at a restored mangrove stand at Gazi Bay, Kenya.

intense pressure. Inevitably, this has led to widespread resource degradation which requires restoration to bring back lost ecosystem goods and services.

**Reading through the various case studies documented in this magazine, it is amazing to learn how much restoration work has been undertaken across the region** in both the mainland and island states. Restoration activities cover a diversity of ecosystems, ranging from sand-dunes and coral reefs to mangroves and saltmarshes. From many of these case studies, bold lessons have been learnt for sharing within and even outside the region. These lessons include the adoption of innovative technologies. For example, in Seychelles the coral gardening technique is being applied at a scale not attempted anywhere else in the world; in Mozambique, hydrological restoration has been found to be more successful than the direct planting of mangroves, with Mother Nature helping with the restoration effort. The role of Mother Nature is also promoted by the so-called Community Based Ecological Mangrove Restoration (CBEMR) approach being promoted at the Rufiji Delta in Tanzania. The approach focuses on creating the enabling environmental conditions for natural recovery in sites that have been disturbed by human interference. This is achieved by

implementing measures that restore hydrology, sediment dynamics and soil conditions. The role of local communities in most of these restoration projects has been remarkable because it has blended traditional and scientific knowledge for better outcomes, including sustainability.

**Some of the benefits of the restoration projects are very inspiring and include:** an increase in fish abundance and the income of people living in a village in Kenya; an increase in tourist numbers at a restored coral lagoon in Zanzibar; and carbon credits that generate a combined income of USD 45 000 per year for communities involved in the world pioneering Mikoko Pamoja mangrove project on the southern coast of Kenya. These outcomes and more underscore the importance of successful initiatives in restoring environmental benefits, but more significantly, community livelihoods and local economies. This has huge potential to enhance the resilience of local communities in building back better after disruptions precipitated by natural catastrophies like the cyclones in Mozambique and the COVID-19 pandemic.

**Recently, the UNEP-Nairobi Convention, WIOMSA, USAID and the WIO Mangrove Network launched [Guidelines on Mangrove Restoration](#)** for the WIO region which provide a step-by-step guide to successful mangrove restoration and help to address some of the pitfalls that may impede positive outcomes. Guidelines on Seagrass Restoration, soon to be launched by the Nairobi Convention and WIOMSA, have also been supported by the UNEP-Nairobi Convention and WIOMSA and are ready for adoption across the region.

From the experiences shared, it is clear that there is need to have exchange programmes on restoration interventions within the region, and even support for the sharing and promotion of best practices which have been tested and proved to overcome the failures that are so costly and common place.

# Reef | BY LIZ MWAMBUI Rescuers

A decade  
of **coral reef**  
**restoration**  
in **Seychelles**

## Coral Reef Restoration Toolkit

A Field-Oriented Guide Developed in the  
Seychelles Islands

EDITED BY SARAH FRIG TORRES, PHANOR H. MOKOTYA-MINA, AND NIRMAL SHAIH



The project is being carried out  
within Cousin Island Special  
Reserve. Photo by Serge Marizy.



Climate change has been identified as the single most profound threat to marine ecosystems and its impact on coral reefs has been devastating in Seychelles.

Watching, nurturing and documenting the growth and development of corals in a nursery – from a 5 cm fragment to a colony as big as a football – is truly rewarding for Nature Seychelles’ Reef Rescuers team. The nursery and all the work that goes into it is an essential part of the coral reef restoration process, helping prepare coral fragments for the reef. The nursery holds the team’s stock of precious coral fragments in mid-water on ropes, in perfect conditions for growth, until they are ready for transplanting to the reef. It takes between 10 and 12 months for corals to reach a suitable size for transplantation and so coral nursing is a continuous task.



**“It is a job I am proud to do,” says Athina Antoine, a member of the Reef Rescuers team. “It is satisfying to see the little piece of coral I put on a rope grow to transplantation size. As a Seychellois, I feel happy to be part of this huge effort to restore corals damaged by coral bleaching in Seychelles.”**

Athina is part of Nature Seychelles’ Reef Rescuers, a coral reef restoration project, which is celebrating exactly 10 years in 2020. It was started to combat climate change-induced coral bleaching around the Cousin Island Special Reserve, a 50+ year old nature reserve and marine protected area that is managed by Nature Seychelles

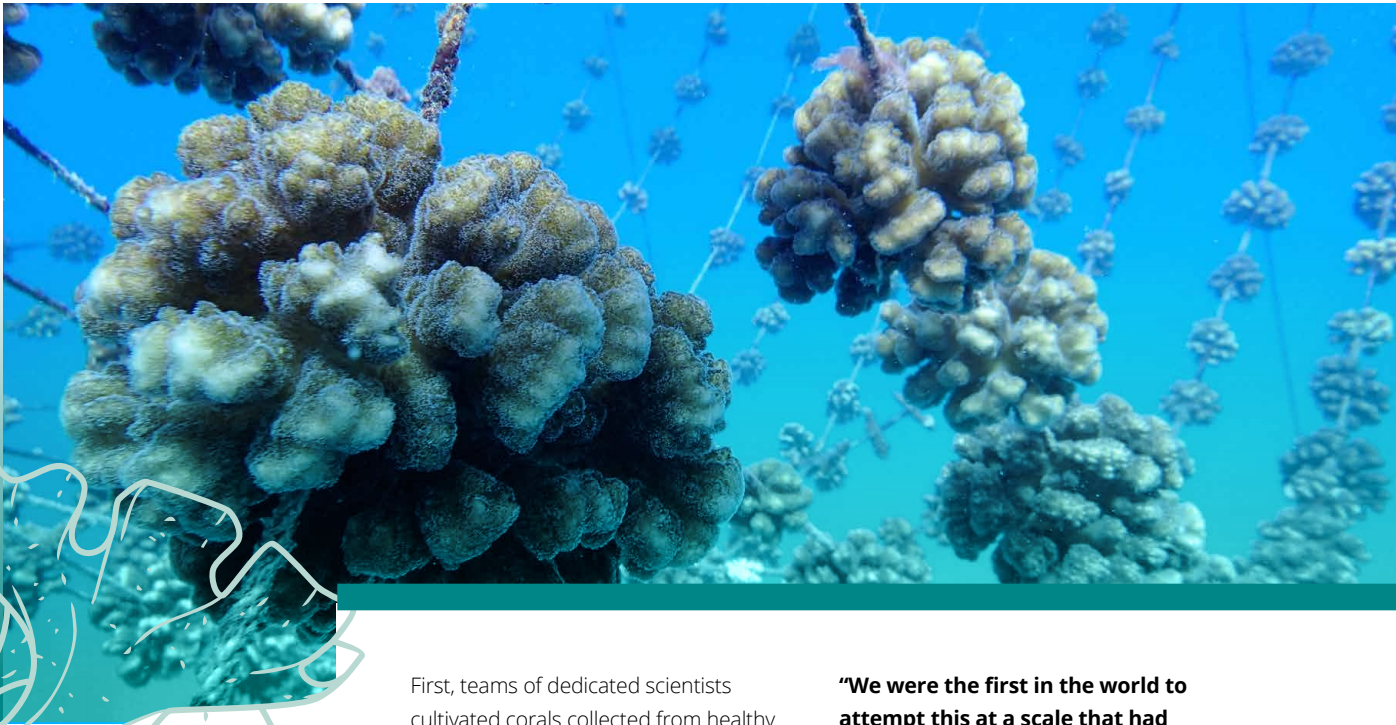
**Climate change has been identified as the single most profound threat to marine ecosystems** and its impact on coral reefs has been devastating in Seychelles. Coral reef ecosystems are extremely important for the country because its primary economic pillars – tourism and fisheries – depend on healthy coral reefs, the most

important habitats and spawning grounds for fish, which constitutes the daily diet for most people in the country. Reefs also provide coastal protection from rising sea levels, which have affected the islands in recent times and taken a toll on infrastructure such as roads. **The loss of coral hinders the ability of reefs to provide coastal protection** and sustain white sandy beaches that are a central part of the islands’ tourism attraction.

In order to ensure that coral reefs continue to provide local populations with vital biological, ecological and socio-economic goods and services, and to maintain resilience capacities, the Reef Rescuers project was conceived in 2010. Funded by the United States Agency for International Development for the last 10 years, with additional funding from the Global Environment Facility and the Indian Ocean Commission, the project’s aim is to use large-scale coral reef restoration to enhance natural recovery, biodiversity and ecosystem services within the Cousin Island Special Reserve.

Above: Reef rescuer Athina Antoine cleaning corals at a nursery. Photo by Camila Marino.





“  
**An ambitious project, and well ahead of its time, the Reef Rescuers project used the “coral gardening” concept to attempt large-scale coral reef restoration.**

First, teams of dedicated scientists cultivated corals collected from healthy sites in underwater nurseries. The project built and cultivated 12 midwater nurseries (nine rope nurseries and three net nurseries), filled initially with up to 40 000 coral fragments or nubbins (from donor corals and corals of opportunity) of 34 coral species (branching, massive and encrusting). Then, after approximately 10 to 12 months, the corals are transplanted onto degraded reefs. A total of 24 431 corals were transplanted in an area of 5 225 m2 within the no-take marine reserve of Cousin Island Special Reserve in the initial phase of the project.

**“We were the first in the world to attempt this at a scale that had never been seen before, using the coral gardening technique invented by scientists from Israel.** The project was designed to investigate if direct intervention enhances natural recovery of coral reefs. Through this science-based restoration, Nature Seychelles significantly scaled up experimental technology and at the same time achieved the necessary research and development for the next phase of coral culture and restoration,” says Dr Nirmal Shah, chief executive of Nature Seychelles.

**Above:** Corals growing in underwater nurseries at the Nature Seychelles Coral Reef Restoration Project. Cousin Island. 2017 Photo by Louise Malaisé.

**Right:** from the WIO region received training on restoration techniques.



“  
The project has received global attention but, most importantly, crucial buy-in from stakeholders in Seychelles.

**Below:** Nature Seychelles Coral Reef Restoration project with Pocillopora coral and fish in the foreground. Cousin Island. 2018. Photo by Chloe Shute.

Over 60 scientists and volunteer scientific divers from around the world have been involved in the Reef Rescuers project. Through two international training courses, including one for the Western Indian Ocean region, the project has equipped personnel to carry restoration methodologies and tools to areas across the globe which are likewise prone to reef degradation. A toolkit has been developed to provide information on challenges and lessons learnt to help others who might want to carry out similar work. [The toolkit is free and available for download.](#) The Centre for Ocean Restoration Awareness and Learning (CORAL), a physical facility on Praslin Island, was also launched under the project to serve as a national and regional hub for research, conservation and knowledge sharing on coral reef conservation and restoration.

Among those who have partnered with Nature Seychelles to restore reefs are two luxury hotels: the Constance Lemuria Resort on Praslin Island and Six Senses Zil Pasyon on Félicité Island. The partnerships ensure sustainability.

“We are now leapfrogging into the third and next level of our coral reef restoration program, called ‘Reef Rescuers 3.0;’” says Shah. “We started out in the first instance with methods from the scientific literature, secondly, improved on those with our own discoveries and techniques and now we are moving into an exciting and very large regional project with Mauritius so we can use the latest breakthrough science developed in the United States and Australia.”

**The next phase will entail construction of large land-based nurseries to facilitate full-scale coral mariculture.**

“We will need overseas expertise in the form of top scientists and practitioners who have been developing new techniques in coral genetics and reproduction and in growing corals and planting, so there is a very exciting component of international cooperation and knowledge sharing as well,” Shah explains.



# Low-tech methods and community support

BY JELVAS MWAURA,  
DISHON MURAGE,  
JACQUELINE UKU,  
STEPHEN MWANGI  
AND AHMED  
ABUBAKAR

## SECURE CORAL REWARDS AT WASINI ISLAND

Below: Collection  
of coral fragments.



“  
For generations, these coral reefs have supported the economic, social and cultural well-being of people of Wasini Village.

A nearly three-fold increase in fish abundance and an increase of between 80 and 100 percent in the weekly income of people living in Wasini Village are just two of the impressive gains made by a low-tech, community-based coral reef rehabilitation project on Wasini Island in Kenya.



“ The project has produced a trained workforce on coral reef restoration, with at least 40 local people being certified in restoration work and 25 youths being certified as SCUBA divers.

**Left:** A view of one of the restored reef areas showing transplanted corals and abundant fish.

**Top right:** Community members holding discussions on the feasibility of reef.

**Wasini Island is located at the southern end of the Kenyan coast, near the Tanzania border.** On the island is the small, idyllic village of Wasini which is home to approximately 3 000 people. The island is well endowed with an extensive mangrove forest and nearby shallow coral reefs. **For generations, these coral reefs have supported the economic, social and cultural well-being of the people of Wasini Village.** Nearly 90 percent of the households depend on small-scale fishing and tourism-related activities such as snorkeling, SCUBA diving and hotel employment as a source of food security, livelihoods and jobs. But, just like other reefs in the Western Indian Ocean (WIO), the coral reefs of Wasini Island are under significant threat from over-fishing, eutrophication and coral mining, as well as changes in the global climate. For example, in 1998 and 2010, an increase in ocean temperature of 1.0 °C resulted in large-scale bleaching and the mortality of between 50 percent and 70 percent of corals. Branching corals were worst affected.

Realizing the consequences of degraded reefs, including poor fish catches, the Wasini Beach Management Unit (BMU), in consultation with local researchers, government officers and civil society organizations, developed and designated a community conservation area (CCA) in 2008. The site chosen for the CCA is adjacent to the village. Here, community members in the BMU agreed to stop fishing and purposely protect and

conserve the CCA in order to enhance local fisheries production. However, after almost five years of establishing the CCA, research conducted by the Kenya Marine and Fisheries Research Institute (KMFRI) showed that there was still a low presence of reef fish, especially the commercially important fishes such as groupers, snappers and sweetlips, as well as lobsters and octopus. In spite of this setback, the Wasini CCA was seen as a potential site for fish breeding, facilitated by a coral reef restoration project.

The process of community-based, low-tech reef restoration started in 2013 in Wasini, with funding from World Bank/ Government of Kenya and executed through the Kenya Coastal Development Project. **The project actively engaged the involvement of the local fisher community**, with technical support provided by KMFRI in partnership with the Africa Nature Organization (a local non-governmental organization), Kenya Wildlife Service (KWS) and the State Department of Fisheries.

**The primary goal of the Wasini community-based reef restoration programme was to rehabilitate degraded reef sites using corals that survived previous bleaching events and to restore the ecological environment while creating alternative livelihood opportunities.** During the three-year project period, a number of activities were implemented. These included training local people

on coral culture and reef restoration techniques, setting up mid-water nurseries, transplanting nursery-grown corals on denuded reefs and artificial reef structures, and facilitating boat and SCUBA diving certification as a means of promoting tourism and alternative incomes for the people of Wasini Village.

### Community-based reef restoration

**At the three sites of the designated Wasini CCA, the “coral gardening” concept was adopted and centered on a two-step process** – the nursery growing of hundreds of coral fragments (nubbins) for six to eight months and, later, the transplantation of nursery-grown corals on recipient reef sites, either on denuded reef substrates or on artificial reef structures made with concrete blocks or coral boulders.

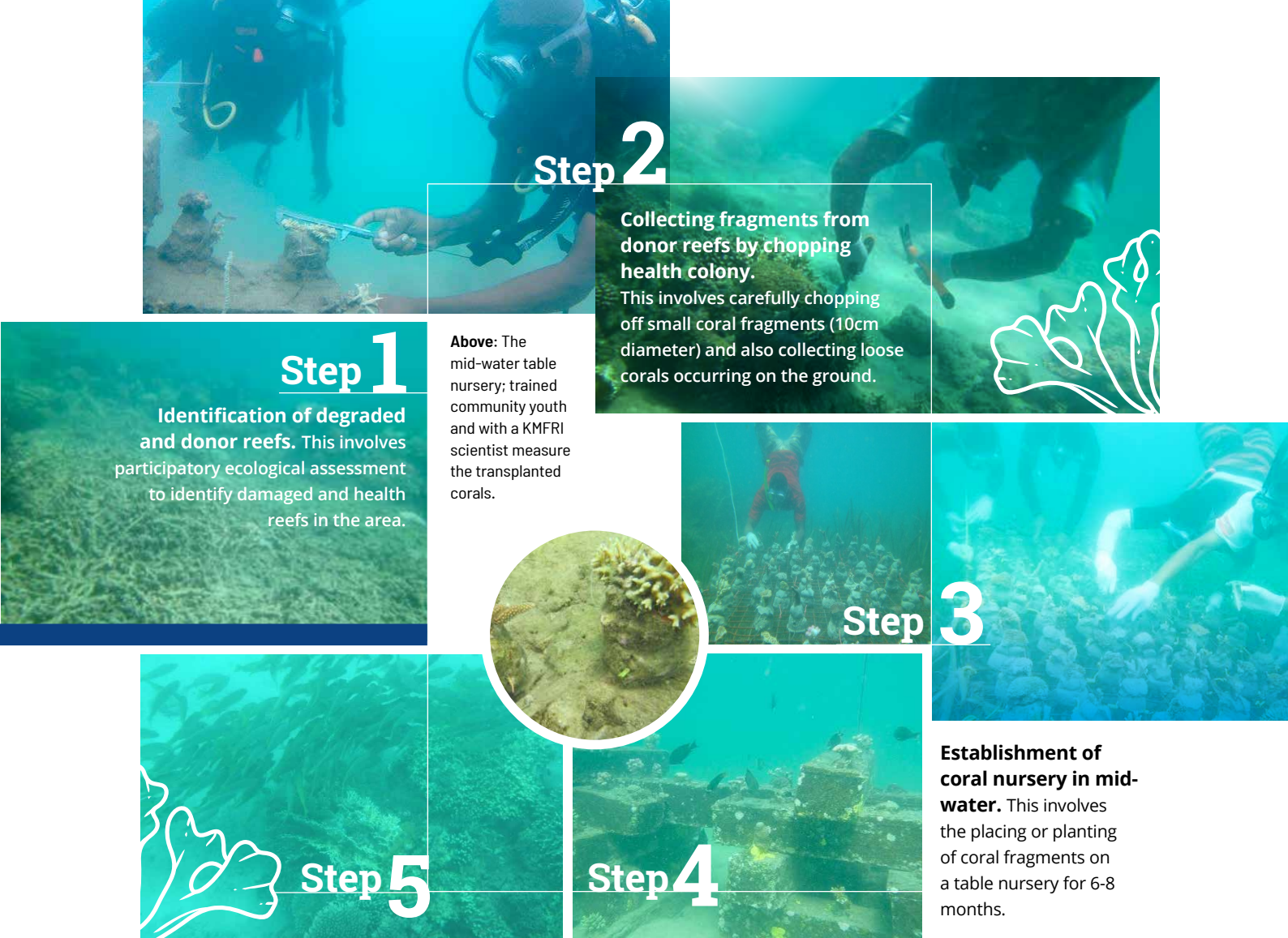
Approximately 8300 small coral fragments were raised in the midwater table nurseries. Materials used for nursery construction and artificial reef modules were sourced locally, coral fragments were raised in situ and extensive community participation rendered the whole project inexpensive and easy to replicate.

Monitoring the success of coral transplantation involved tagging coral fragments using numbered labels, periodic measuring of their linear growth and survival at intervals of six months and storing this data in a database. **After three years of reef rehabilitation, most of the corals had grown well and high coral survival rates were recorded (68 percent and 75 percent at natural substrate and artificial reef sites respectively).** The cost of implementing the two techniques was relatively low, with the total cost of restoring one hectare with over 8000 corals estimated to be USD 9300.00. Extensive community involvement helped to keep costs down.



**From Top:** Project leader Jelvas Mwaura with the Director of KMFRI Prof. Njiru and the Cabinet Secretary, Fisheries, Kenya, Prof Ntiba. Community members showcasing the project to the Cabinet Secretary, Fisheries. Wasini Women displaying nursery and artificial reef models.

**Left:** hands-on construction of table nursery using wire mesh and iron rods.



**Monitoring, maintenance and evaluation of restoration progress.** This involves periodic monitoring of growth and survival of transplanted corals, new coral recruits, and fish abundance.

**Transplanting nursery-grown corals.** This involves outplanting corals onto degraded bare and artificial reefs substrates.

Above is a schematic diagram showing the five important phases of the adapted community-based restoration protocol

**Key project results and impacts**

**One of the key outcomes of the project was a nearly three-fold increase in fish abundance when compared with the baseline levels.**

The deployment of artificial reef structures and the subsequent attaching of corals has created a new habitat for fish breeding and an observable increase in fish populations has become an attraction for visiting tourists, thereby creating an alternative source of income for Wasini villagers. On average, there has been an 80 to 100 percent increase in their weekly income, from USD 60 to USD 220 for the BMU during high tourism seasons.

The transplant of over 8000 small corals on both denuded and artificial reefs has facilitated the expansion of the marine area under community conservation from 2 ha to 3 ha. But perhaps the most important outcome is that the project has produced a trained workforce on coral reef restoration, with at least 40 local people being certified in restoration work and 25 youths being certified as SCUBA divers. This will fundamentally contribute towards ecotourism development and upscaling restoration efforts at the sites.

Additionally, the community participation in the project has increased awareness and capacity regarding reef conservation, leading to increased enforcement of fishing regulations.

The project has produced a draft national reef restoration tool kit for future use in community-based restoration projects in other parts of Kenya, or elsewhere in the WIO.

**Wasini CCA has over the years become a role model for reef restoration, where other communities are invited to learn about their experience.**

The Small Grant Programme of the Global Environment Facility has recently launched two projects for the community to expand the current area under restoration, in addition to supporting the take-up of these innovative actions in other CCAs in the Shimoni-Vanga seascape.

# Corals of opportunity

REFORESTATION OF  
DAMAGED CORAL REEFS  
ON UNGUJA, ZANZIBAR

BY CHRISTIAN  
VATERLAUS AND  
FABIAN BUMBAK

“

The procedure allows our team of three coral farmers to transplant about 8 000 to 10 000 corals per year.

A coral farm and reforested reef structures in Jambiani Lagoon are among the most visited tourist spots in Jambiani in Unguja, Zanzibar, but the coral restoration effort has been lengthy and difficult.



In 2014, marinecultures.org initiated a coral farm in the lagoon of Jambiani. **The aim was to produce sustainably farmed corals** for the aquarium trade, thus meeting the demand for corals with a known pedigree that have not been taken from the wild. The primary focus was to provide local fishers with an alternative to fishing, and to generate improved incomes.

Initially, a team of three local coral farmers received training from Simon Ellis, a coral farming specialist from The Marine and Environmental Institute of Pohnpei in Micronesia. Within a year, the trio managed

It became clear that commercial coral farming is not feasible in the context of climate change and rising water temperatures. Rather than abandoning the project altogether, we decided to transform it into a programme to reforest damaged reefs. This transition was made possible with the financial support of our partner, coralreefcare.com.

The repositioning required us to adapt our workflows and introduce new methods. Primarily this meant giving up on our brood stock. **A brood stock refers to “mother corals” from which fragments are**

The non-governmental organization, [marinecultures.org](http://marinecultures.org), is well known for introducing sponge farming as an alternative means of income on the east coast of Unguja, Zanzibar. **Farming sponges provides a sustainable alternative to fishing and reduces the pressure on natural resources in coastal waters.** The sponge farms benefit many families in the coastal village of Jambiani, enabling farmers, mostly single women, to provide for their children and improve their quality of life. The sustainably farmed sponges have become a popular souvenir and are sold in numerous shops and hotels on Unguja.



to build up a sizable brood stock of local corals and to fully adapt the methods taught by Simon to local conditions.

However, the project received a serious blow when El-niño hit the region in 2016. Raised water temperatures caused shallow reefs around Unguja to lose more than 50 percent of their corals and the entire coral rearing project was destroyed. The farmers restocked the farm but as water temperatures rose again in 2017, the coral bleaching returned, and their efforts were shattered once more.

**taken in order to clone baby corals.**

While suitable for an aquarium, clones are less likely to survive environmental change compared to sexually reproduced corals, because while they all have the same genetic background inherited from the mother coral. Sexual reproduction promotes genetic variability which may help a species to adapt to challenging conditions. **While sexual reproduction of corals for reforestation is technically feasible, it is too complex and expensive for small organizations like marinecultures.org.**

Left: Coral farmer cleaning “baby corals”.

Above: Bleached brood stock.



“ The procedure allows our team of three coral farmers to transplant about 8 000 to 10 000 corals per year.

**However, there is an alternative approach with the potential to generate significant genetic diversity at low cost.**

Such fragments may attach to loose rocks but have a low chance of further growth. We exclusively collect corals of opportunity and record the exact GPS location of where they were found. Back at the farm, the fragments are glued onto small cement discs and placed in a marked sector on a coral table that represents fragments from the same coral species and location. For example, the *Galaxea* fragments collected at location XY are to be found on table D in sector 3. All fragments in a sector such as D3 are assumed to be genetically identical since

they were collected at the same location and may originate from the same coral.

Good care and maintenance (i.e. regular cleaning and removal of predators) allows the baby corals to grow large enough to be transplanted onto damaged or dead reef structures. This takes about 25 to 40 weeks, depending on the species.

**Once the corals are ready for reforestation, we drill holes into dead coral structures which enables secure fixation of farmed corals with cement.** We generally transplant clusters of 4 to 5 corals from the same sector (e.g. D3) because this increases the chance that one of them will survive. The next cluster of D3 corals will be



**Top:** Current stock of approximately 7 500 corals on 40 tables.

**Below:** Sector D3 with fragmented *Galaxea* from reef XY.





**From Top:** A cluster of *Astreopora* sp. Bleached coral. Coral transplants after two years on our house reef.



placed at least 50 m away from the first cluster. Baby corals from other sectors representing the same species but a different collection site (and hence a different genetic background) are placed in a cluster within 3 m to 5 m of the D3 cluster to promote sexual reproduction between genetically distinct clusters. The described procedure allows our team of three coral farmers to transplant about 8 000 to 10 000 corals per year.

In April 2020, another wave of elevated water temperatures hit Zanzibar. This time, only certain species died while others experienced various degrees of bleaching but recovered.

**Overall, more than 50 percent of our transplants on damaged reef structures survived.** This underlines the effectiveness of cultivating multiple species which also promotes biodiversity.

**Today, our coral farm and some of the reforested reef structures are among the most visited tourist spots in the Jambiani lagoon because they exhibit a higher variety and density of marine life, compared to many other spots.** Our organization also runs local events to raise awareness about the vulnerability of marine ecosystems and how to sustainably utilize them.

We recognize the importance of exchange with researchers and coral reforestation experts around the world, especially the Coral Reef Initiative (<https://www.icriforum.org>).

We constantly re-evaluate our methods but in principle follow the reforestation guidelines issued by the Coral Restoration Consortium (<https://www.coralrestoration.org>), particularly Baums et al., 2019 (doi:10.1002/eap.1978).

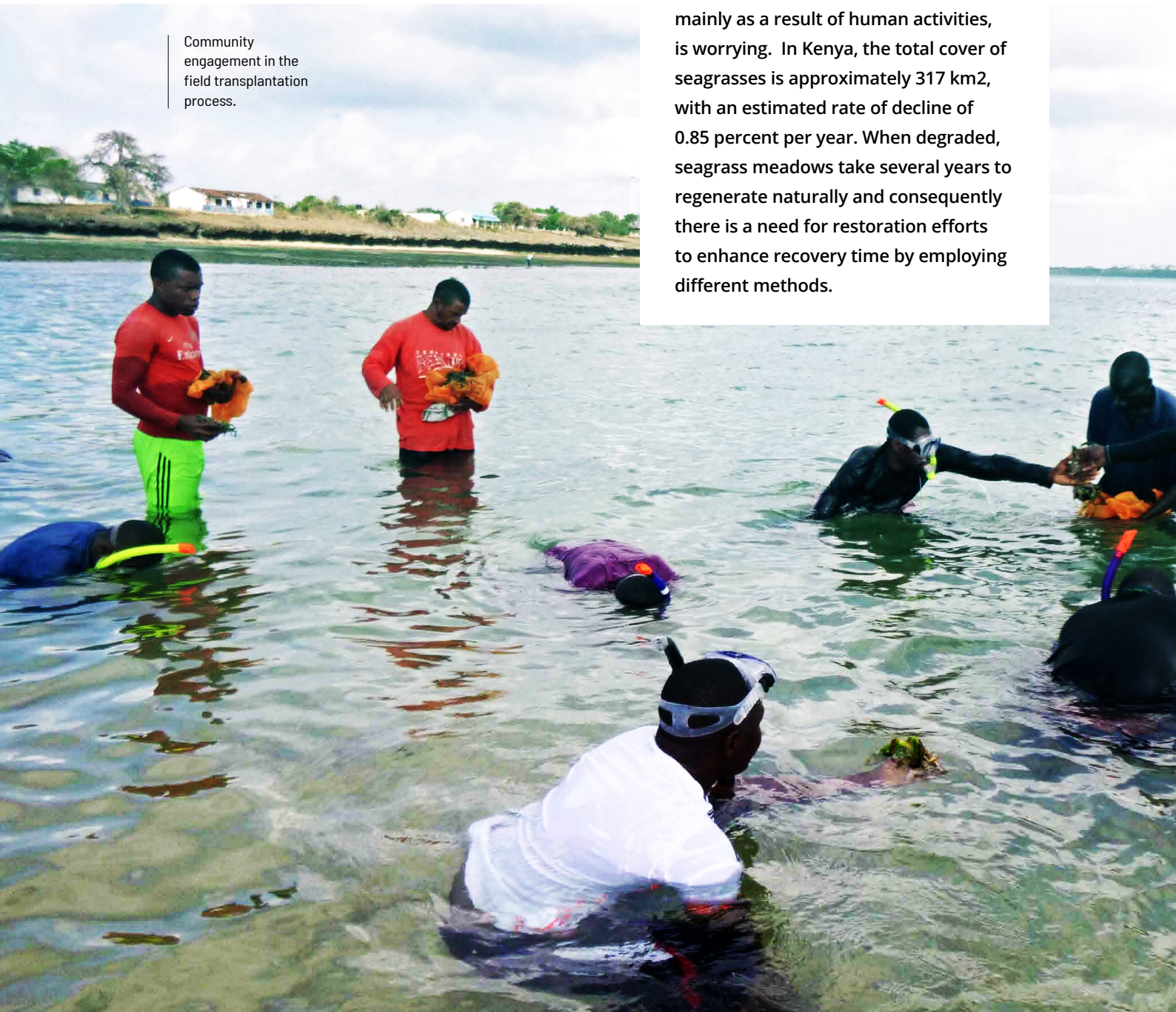
[www.marinecultures.org](http://www.marinecultures.org)

# Learning from failure

BY THE KMFRI  
SEAGRASS TEAM

Community engagement in the field transplantation process.

Seagrass is a crucial ecosystem that is vital to the overall health of the ocean. Sadly, the global rate of seagrass decline, mainly as a result of human activities, is worrying. In Kenya, the total cover of seagrasses is approximately 317 km<sup>2</sup>, with an estimated rate of decline of 0.85 percent per year. When degraded, seagrass meadows take several years to regenerate naturally and consequently there is a need for restoration efforts to enhance recovery time by employing different methods.



The article was prepared by the following members of the KMFRI seagrass team who participated in the restoration efforts: Jacqueline Uku, Lillian Daudi, Charles Muthama, Victor Alati, Alex Kimathi, Samuel Ndirangu and Susana Kihia. Paul Kimanzi, of the KMFRI PR team, assisted with the preparation of this article.

“ We waited with much anticipation to see the spread of our clumps but by the end of 2008, much of what we had planted had been dislodged and washed away by the wave action during the southeast monsoon.



**Top right:** Using sods or clumps of seagrasses as a rehabilitation method.



**From as early as 2004, we began to notice the loss of seagrasses**

in several lagoons in Kenya and our field surveys showed that there was an extensive decline of the dominant species, known as *Thalassodendron ciliatum*, because of a proliferation of the sea urchin, *Tripneustes gratilla*. In some areas, seagrass cover declined by as much as 90 percent. The urchin numbers rose from the normal density of two urchins per square metre to eight urchins per square metre, and more. Soon, we noticed that the degradation was highest in the Diani-Chale Lagoon, on the south coast of Kenya. This area is a tourist hub and the seagrass beds, which support unique biodiversity, also form part of the fishing grounds of artisanal fishers.

Because of a paucity of environmental data and irregular monitoring, it was not easy to diagnose the cause of the proliferation of this particular sea urchin species. **Many researchers attributed it to the overfishing of the sea urchin's predators, while others attributed it to climate change and eutrophication.** With the loss of seagrass increasing we knew that we, as a team of seagrass scientists, had to respond with a restoration effort. Experimental trials began in Diani, with tryouts expanding over time to Wasini, using different methods with varying degrees of success.

**Restoration using the sod method**

Literature scans revealed there was a variety of restoration work that had been done, using several methods including the use of underwater planting machines. **Eventually, we settled on the sod method for our experiment in Diani.** In this first trial, which ran from 2007 to 2008, we used two species of seagrass *Thalassodendron ciliatum* and *Thalassia hemprichii*. We selected these species because of their dominance at this site. We worked hard to design our experimental planting and to plant sods (clumps) of the selected seagrasses into our experimental plots. We covered an area of approximately 0.03 ha.

We waited with much anticipation to see the spread of our clumps but by the end of 2008, much of what we had planted had been dislodged and washed away by the wave action during the southeast monsoon. The only encouraging result we recorded was that one plot that was planted with *T. hemprichii* sods seemed to have survived the storms and was well established in the area, compared with the plots planted with *T. ciliatum*. We believed that we had failed because our results did not meet our expectations. We felt that we had been short-changed by the forces of nature.

“ In our trials, we were not able to restore the seagrass areas completely or to re-establish the beds to their previous state, but we were able to rehabilitate the experimental areas with new seagrasses and re-establish a functional and self-sustaining habitat.



**From Left:** Seagrass mimics at the onset of the experiment, and the area colonized by *H. ovalis* when the mimics were being collected, the hessian bag established with shoots of *T. hemprichii* anchored on the bag; and freshly planted *T. hemprichii* seedlings and Health growing: Four years after restoration.

### Restoration using mimics

At the same time that we were running the sod experiment, we also conducted a three-week study using seagrass mimics (artificial seagrasses) to understand the colonization of degraded areas by tiny animals that live on marine plants (*epiphytic meiofauna/epiphytes*). We set the mimics into experimental plots, similar to those we used for the sod restoration experiment.

At the end of the experimental period, when we extracted the mimics for the analysis of the epiphytes, **we were surprised to find that the mimics were surrounded by the pioneer seagrass species *Halophila ovalis***. We learned a key lesson from this – mimics were important for stabilizing the sediments around them, thus allowing colonization by pioneer species such as *H. ovalis*. Although the seagrass mimics were set up to assess the colonization by *epiphytic meiofauna*, they yielded results that enhanced our understanding of the potential for the use of artificial seagrasses in the restoration of seagrass beds.

### Restoration using the hessian bag technique

The third learning experience came from the Wasini Community Managed Area (CMA) in 2015. Members of the Beach Management Unit (BMU) requested support to restore corals and seagrasses in the CMA. **For the seagrasses, the major cause of degradation was damage from boat anchors** and as part of the restoration process we provided buoys for boats so that the sites would be saved from damage caused by anchoring. We also invested time in training the community and undertook the restoration work with them.

### This time we changed tack and opted to use a modified hessian bag technique.

From the lessons we learned in Diani, we focused on using shoots from healthy *T. hemprichii*, harvested from nearby meadows in Mkwiro, approximately 8 km from the restoration site. We punched holes in the hessian bags and planted *T. hemprichii* shoots in an area of approximately 0.012 ha.

The planted seedlings of *T. hemprichii* did survive, although the survival rate was not quantified because funding limitations

The authors wish to thank WIOMSA for the MARG I grant to Charles Muthama, which supported the experimental trials using the sod methodology in 2008. The seagrass mimic work formed part of a MSc thesis by Lillian Daudi under the Flemish Inter-university Council scholarship program of Master of Science in Ecological Marine Management (ECOMAMA, Free University of Brussels). The work using the Hessian bag was supported through the World Bank-funded Kenya Coastal Development Project (2010–2017). We are also grateful to the community members, led by the Mvuleni and Wasini BMUs that participated in these experimental studies.

**Below:** Community training on the technical aspects of the seagrass restoration work



constrained monitoring. However, trained community members from the BMU observed recolonization by pioneer seagrass species and associated epiphytes six months after replanting.

An assessment conducted three years later in 2018, revealed colonization by other seagrass species other than the replanted species and seagrass cover was recorded as approximately 75 percent in the area that was previously bare of seagrasses. The new colonizing species included *Halodule uninervis*, *Syringodium isoetifolium*, *Halophila stipulacea*, *Cymodocea rotundata* and *Cymodocea serrulata*, with the former two species dominating although coverage was not estimated, the species had spread more widely than the restored area.

### **This time round our efforts were successful!**

We picked up valuable lessons on this journey and these will help us to move forward with renewed energy to propel this work from the experimental phase to more concrete actions in the rehabilitation of seagrass beds in Kenya.

## **LESSONS LEARNT AND OPPORTUNITIES FOR REPLICATION**

Often only successes are documented and we have learned that it is important to also share the failures, which is why we chose to tell our story. Failure helped us to learn and to keep on trying.

One thing that is very clear to us, after all this work, is that we cannot talk about seagrass bed restoration. In our trials we were not able to restore the seagrass areas completely or to re-establish the beds to their previous state, but we were able to rehabilitate the experimental areas with new seagrasses and re-establish a functional and self-sustaining habitat. We suggest that restoration of seagrass habitats to their original state may not occur, but rehabilitation does occur when a different composition of species colonizes a previously degraded area.

### **Some of the other lessons that we wish to share are:**

- Seasonal stressors are important to consider, as demonstrated by the loss we experienced during the southeast monsoon. More success was achieved using the sod establishment method during the calmer northeast monsoon.
- Site selection is also critical. It is important to select sites that are sheltered from high wave action in order to provide the transplanted seagrass with an opportunity to settle and spread.
- Identification of the stressors caused by human activities is important. The removal of the stressor is crucial in providing for natural re-establishment of seagrass areas that have been stabilized, as demonstrated through the provision of mooring buoys in Wasini.
- Continued conservation and preservation of seagrass meadows is critical to ensure that there are donor communities from which to obtain seed materials.
- Field observations are a key component of documenting recovery. If we had not been keen observers we would have easily missed the colonization that took place around the seagrass mimics.
- There is need to monitor the restored areas over long time periods and to share costs with communities. This can be done by the community matching monetary support with effort in monitoring and securing the sites.
- There is a need to have an inclusive (participatory) restoration method that can be adopted by communities. Therefore, community engagement through training and involvement in the restoration process is crucial. This cuts down monitoring costs and ensures that there is knowledge transfer between technical teams and community members.
- There are great expectations when working with communities and often communities will not dedicate sufficient time to such efforts because the work is time consuming. Consequently, there is a need for supervision and constant training from the technical team.
- It is important to identify hotspots of seagrass degradation and implement regular monitoring of environmental attributes and habitat change to be able to decipher the change agent.
- Restoration efforts should be long-term (over five years) to measure the complete cycle of ecosystem recovery, and document recovery trajectories. This includes a variety of metrics such as micro and macro invertebrate recovery, changes in sediment characteristics, fish recovery and seagrass-related parameters. This requires core government support, rather than reliance on limited short-term project-based support.

One other lesson we learnt, was that there is a need to evaluate whether a site requires rehabilitation because in many cases natural recovery may occur with time.



COMMUNITY AND  
GOVERNANCE  
CONSIDERATIONS PLAY AN  
IMPORTANT ROLE IN THE

# Restoration of estuaries and blue carbon habitats

BY JANINE  
ADAMS,  
VUSUMZI  
TSIPA AND  
JOHAN  
WASSERMAN



“ Salt marshes, seagrass and mangrove habitats all require greater protection.

Blue carbon habitats, such as salt marshes, seagrasses and mangroves, provide a multitude of ecosystem services such as raw materials, nursery habitats for juvenile fish, coastal protection, carbon storage, nutrient retention and water quality enhancement. Sadly, in many regions of the world, the health of these blue carbon habitats is rapidly deteriorating because of increasing pressure from human beings. Unless



Globally some progress is being made on mangrove restoration, but other habitats such as salt marshes and seagrass beds are neglected. The United Nations' Decade of Ecosystem Restoration (2021 to 2030) provides an opportunity to focus on the restoration of blue carbon habitats.

“ South Africa's long history of research and understanding of estuary health, conservation and management provides direction for a future restoration programme.

**policy-makers and managers intervene in a timely manner, valuable natural capital will be lost.**

**In South Africa, blue carbon habitats occur in approximately 290 estuaries.**

These are complex, dynamic and productive ecosystems that form the interface between marine and freshwater environments. They are focal points for development, tourism and recreation, and are also important for supporting biodiversity, livelihoods and marine fisheries. **More than 60 percent of these estuaries are modified or degraded in some way by human activities caused by urbanization** and, to a lesser extent, agriculture and mining. Increased demand for fresh water has reduced river flows in nearly 20 percent of South African estuaries and this has affected river mouth dynamics, water quality, biological productivity and the way that estuarine ecosystems function as nurseries for juvenile fish and invertebrates.

In 2018, the National Biodiversity Assessment quantified the status, including the extent of loss, of Blue Carbon habitats.

**An important conclusion of the Assessment was that salt marshes, seagrass and mangrove habitats all require greater protection.** Specific estuaries were identified for the protection and restoration of seagrass, salt marsh and mangrove habitats (see Table 1).

Although some restoration activities have taken place in South African estuaries, they have mostly met with limited success (see Table 2) and we suggest that a socio-ecological systems (SES) approach, as illustrated in the diagram, is the way forward for successful restoration. This is because there is a need to align legislation,

governance, implementation and social commitment. A SES approach is in line with the One World–One Health concept, which recognizes that no-one lives in isolation, that the actions of one affect all, and that health security requires a global crosscutting perspective that integrates humans, ecosystem health and biodiversity.

With a SES approach, restoration takes place in an adaptive management cycle where objectives are set, actions are implemented and then monitored. The diagram illustrates how outcomes are analyzed and objectives are adapted, if necessary, in a learn-by-doing approach. The success of restoration interventions is measured against the restoration objectives which should include ecosystem and social targets. Estuary state can be measured using the estuarine health index used in South Africa, while the state of the social system can be measured through uses and values that contribute towards human wellbeing.

South Africa's long history of research and understanding of estuary health, conservation and management provides direction for a future restoration programme. Estuary health assessments (2011 and 2018) for each estuary clearly indicate the areas where restorative action is needed. **Success is possible because estuaries are resilient ecosystems that can recover once the pressures acting on them have been modified or removed.** The UN Decade of Ecosystem Restoration (2021 to 2030) provides an opportunity to scale up activities and to pursue a National Estuary Restoration and Research Programme that will secure funding and co-ordinate efforts.

Table 1:

## THE STATUS OF BLUE CARBON HABITATS IN SOUTH AFRICAN ESTUARIES AND PRIORITY ESTUARIES FOR PROTECTION AND RESTORATION

HABITAT TYPE	CURRENT STATUS	RESTORATION OBJECTIVE
<b>Seagrass</b>	The dominant species <i>Zostera capensis</i> is endangered. It is sensitive to human disturbance and populations fluctuate naturally in response to floods. Impacts are eutrophication, sediment input from destructive land use practices, bait digging and disturbance by boats.	Restore habitat and Kwa-Zulu Natal (east coast) populations in the Mhlathuze and Mlalazi estuaries. Maintain integrity of south and west coast populations, particularly the largest area of <i>Zostera capensis</i> in the Knysna Estuary (316 ha).
<b>Salt marsh</b>	Nearly 30% of salt marsh habitat has been lost as a result of poor land-use practices, flow reduction, agricultural encroachment and development. Supratidal salt marsh currently covers 10 169 ha and intertidal salt marsh 4 786 ha.	Restore intertidal saline habitats along the east coast. The Berg River Estuary, with its expansive floodplain marshes is unique and must be prioritized for rehabilitation and protection. The Orange River mouth salt marsh provides a restoration option through the removal of the causeway to link the desert marsh with freshwater inflow and tidal exchange.
<b>Mangroves</b>	Mangroves no longer occur in 10 subtropical estuaries. Nationally, mangroves have been lost to development and related estuary mouth closure, direct harvesting and cattle grazing.	Maintain habitat area in the 32 estuaries where they occur. Protect the largest stand of <i>Rhizophora mucronata</i> in the Mngazana Estuary and the unique diversity in the Kosi Estuary where five species occur.

### A SOCIO-ECOLOGICAL SYSTEMS APPROACH FOR THE RESTORATION OF ESTUARIES

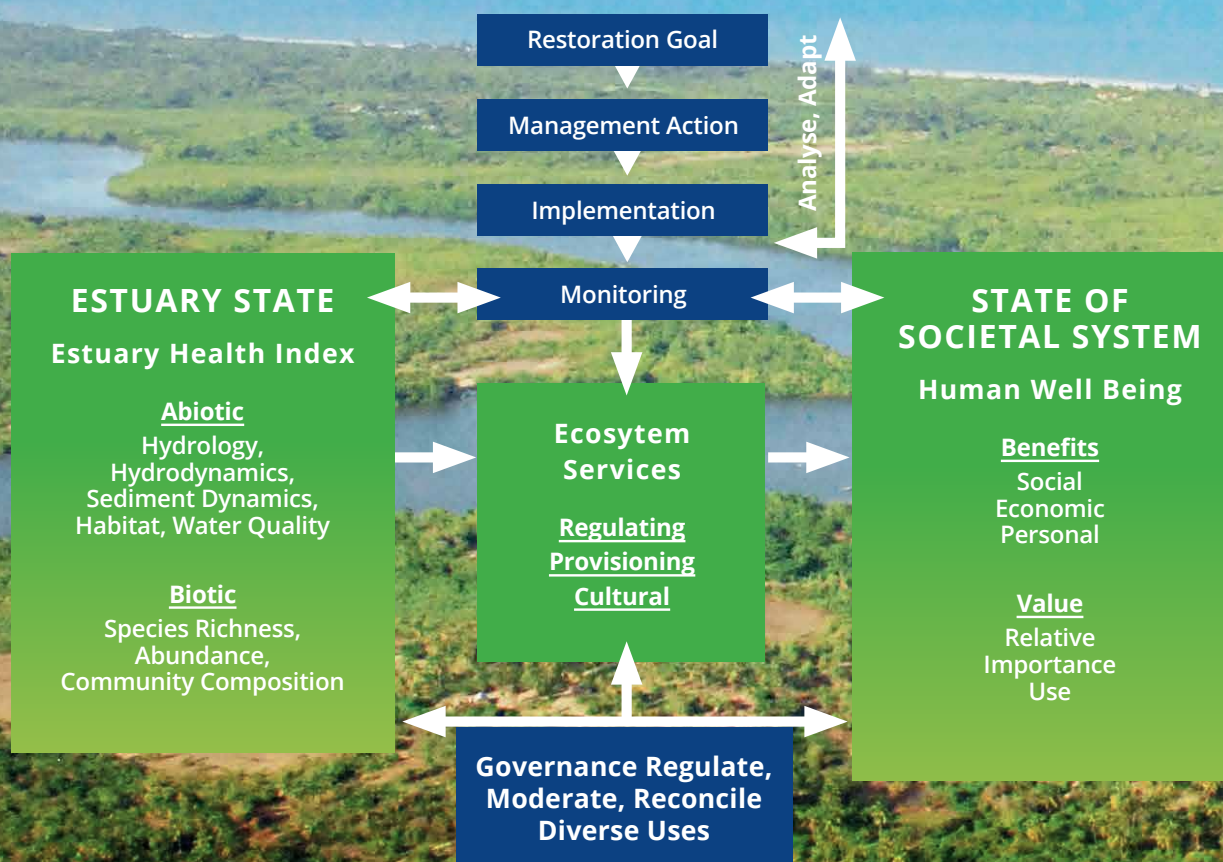


Table 2:

## SUMMARY OF RESTORATION ACTIVITIES AND THEIR SUCCESS OR FAILURE IN SOUTH AFRICAN EAST COAST ESTUARIES


Anthropogenic driver	Anthropogenic pressure	Resultant state	Ecological impact	Restoration activity	Degree of success
<b>ST LUCIA ESTUARY</b>					
Agriculture dredging & mouth manipulation	Reduced fresh-water inflow related to river flow diversions and restrictions	Mouth closure to sea, lake desiccation and hypersalinity	Biodiversity loss, compromised nursery function and fish kills	Reconnection of the Mfolozi River to the St Lucia Estuary	<b>Medium success</b> Normal water levels restored but system has shifted into an alternate oligohaline, silt laden state
<b>NHLABANE ESTUARY</b>					
Mining, crossing of a dredger and water storage	Loss of connectivity between estuary and upstream lake through the construction of a barrage	Mouth closure to the sea	Loss of ecological connectivity and exchange, and fish nursery function	Artificial breaching of the estuary mouth and construction of a fishway	<b>Low success</b> Connectivity between the lake and estuary not restored as mouth remains closed and requires artificial breaching. Link with sea and marine influence lost
<b>SIPINGO ESTUARY</b>					
Urbanization	Decreased freshwater input and urban encroachment	Mouth behaviour altered, little tidal exchange	Eutrophication and anoxia	Installation of pipes at the mouth to facilitate tidal exchange	<b>Medium success</b> Pipes do not allow sufficient flushing of the estuary and connectivity, but mangroves survive
<b>SIYAYA ESTUARY</b>					
Agriculture	Destruction of riparian vegetation	Erosion of streambanks and deposition of sediments and pollutants in estuary	Filling of estuary with sediments, nutrient loading, reed encroachment and anoxia	Restoration of riparian vegetation, control of reed expansion and updated land use plans	<b>Low success</b> The project failed because of poor coordination and implementation of rehabilitation plan
<b>MGOBEZELENI ESTUARY</b>					
Engineering	Building of bridge above estuary	Tidal and riverine exchange between estuary and upstream river constrained	Mortality of mangroves upstream of the bridge, reduction in fish and invertebrate movements	Bridge demolished and replaced with a redesigned and more appropriate structure	<b>Medium success</b> Connectivity restored but full tidal range and upstream saline penetration still not achieved

# Dune rehabilitation

# and restoration

BY SIMON  
BUNDY

**MORE THAN  
PLANTING  
VEGETATION**



The maintenance and management of the dune cordon is receiving attention as the impacts of urbanization and climate change begin to affect the East African coastline. Initiatives to restore, reconstitute and “rehabilitate” coastal dunes are being pursued by various authorities, and indeed private individuals, in a bid to reinforce this natural form of coastal defence.

Coastal dune environments are important habitats that provide numerous ecological and socio-economic services. For instance, dunes serve to ameliorate the harsh, maritime effects on the near-coast terrestrial environment, provide recreational benefits and often provide a link between terrestrial habitats.

“ Initiatives to restore, reconstitute and “rehabilitate” coastal dunes are being pursued.

While dune rehabilitation measures are often pursued with the objective of “greening” or planting a specific area, the fundamentals of dune rehabilitation go well beyond the simple transformation of an unvegetated dune to a vegetated one. **They include the identification of the “sand sharing system” and the contextualization of the subject dune within the broader coastal landscape.** This should include the identification of ecomorphological processes and the functional state of the dune cordon. The re-instituting of such processes, if required, should form the primary objective of the exercise.

The “sand sharing system” is a term coined by Psuty (2002) to describe that portion of the marine and terrestrial environments of the coast where

Often human activities, including the rehabilitation, stabilization or alteration of dune forms, as well as the construction of harbours, dredging and reclamation of coastlines, changes this complex feedback process and alters the dynamic equilibrium at play along the coast, disrupting and destabilizing the eco-morphology of coastlines.

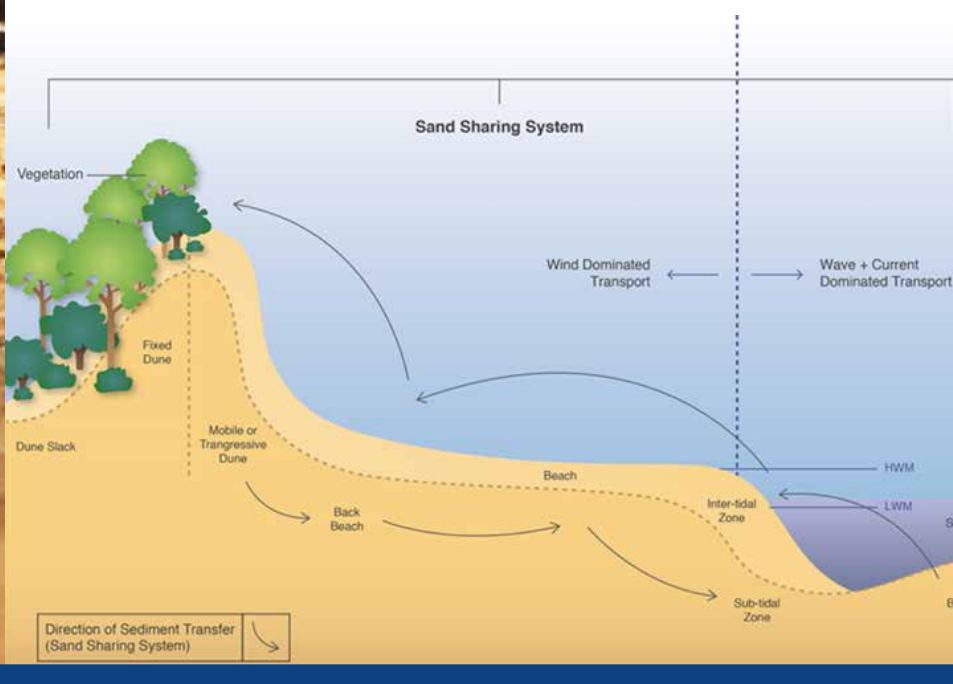
“Casuarina is the quintessential dune builder.”

As a sand-dominated coast, the southeast African coastline has been subject to a number of interventions to stabilize and reduce sediment transfer, particularly where this affects economic activities. A common initiative widely practised until the 1970s was the stabilization of dunes using the exotic tree, *Casuarina equisetifolia*, or “beefwood”. Casuarina, native to Australasia, is adept at harnessing mobile sands, stabilizing and establishing itself upon its own dune system – it is the quintessential dune builder. This attribute has been put to use outside of the tree’s natural range, including the Western Indian Ocean region where this alien tree, while serving the initial, short term objective of stabilizing mobile sands, has proved to be invasive, capable of invading nearby coastal dunes and disrupting the sand-sharing system. Ponto d’Ouro in southern Mozambique is a case in point.

Ponto d’Ouro lies within a crenulate bay, where a rocky point serves to interrupt the generally northward littoral drift. As a consequence, sand enters the calm waters of Ponto d’Ouro’s bay through not only longshore drift, but via a terrestrial sediment transfer or dune bypass system. **The dune bypass, under a natural regime, fed the bay with sediment that was moved slowly but continuously, through a corridor, onto the frontal dune and then onto the beach.**

Left: Image of the beach at Ponto d’Ouro bay and the stabilised dune bypass in the background.

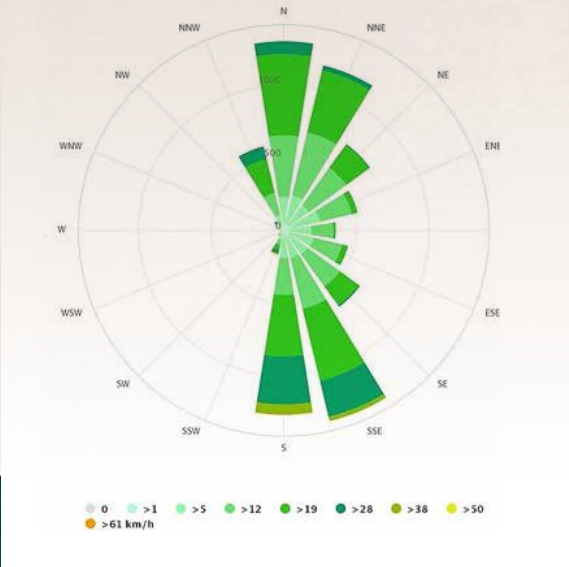
Below: This diagram illustrates the nature of the sand sharing system along the coast.



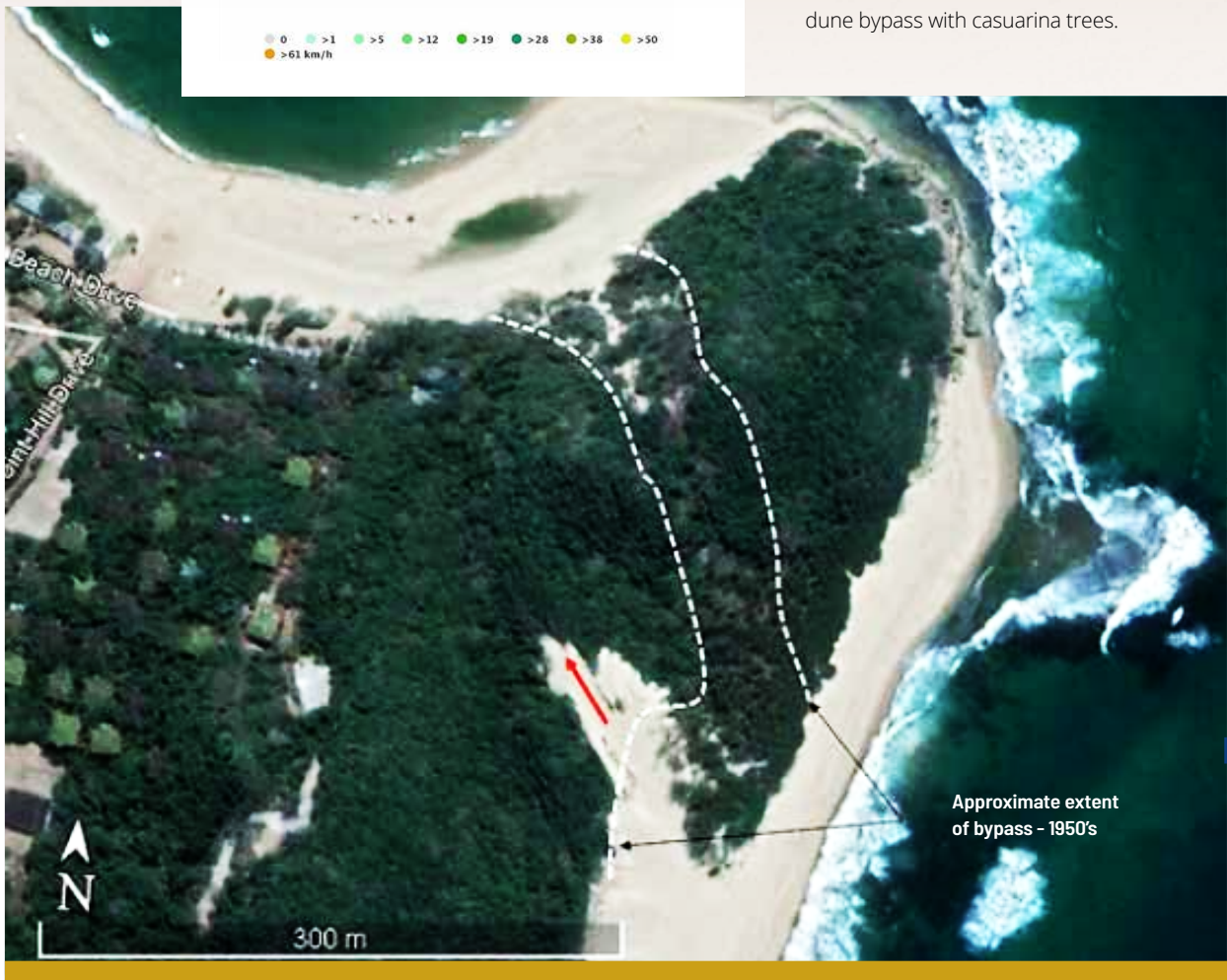
This diagram illustrates the nature of the sand sharing system along the coast.

<sup>1</sup> Littoral drift refers to the movement of sand grains along a coast parallel to the shoreline.

sediment is moved between the offshore surf bar and the frontal dune, as well as alongshore, through littoral drift<sup>1</sup>, by winds or other drivers. The transport of sediment is in a state of dynamic equilibrium with a feedback process arising between the marine and terrestrial environments. The sand sharing system is illustrated in the diagram.



**This is illustrated in the aerial image taken in 1959.** The natural conveyor of sediment remained open and functional until the 1960s, when the authorities in Mozambique undertook significant dune stabilization initiatives. These initiatives included the planting of the Ponto d'Ouro dune bypass with casuarina trees.





By 1975, this bypass system, which was aligned with the prevailing winds and sand drift direction along the coast, was dysfunctional and the system had been disrupted. An aerial image of the same area taken in 2018, shows that the bypass remains dysfunctional to this day. When functional, the bypass moved

sediment into the bay, supporting sediment budgets within the wider system. Inshore sediment transport in the bay may also be different today.

**Because of the closure of this system, two factors have become evident:**

- As sediment accumulates to the south of Ponto d'Ouro, it is curtailed by the closure of the sand bypass. **A more expansive, transgressive dune has arisen as the system undergoes an equilibrium shift and establishes a "new" bypass system.** This is illustrated in the aerial photo taken in 2018.
- **Because of the equilibrium shift, erosion events affecting coastal structures in the bay have become more prevalent.** This is illustrated in the photograph showing sea defence structures adjacent to coastal properties at Ponto d'Ouro.

This shift in sediment transport has ramifications for landowners in Ponto d'Ouro and will affect development within the town in the future. Recent attempts to stabilize the dune using vegetation and drift fences have proven ineffective.

#### Destabilization is the answer

The real response to this problem is simple. The reinstatement of the original dune bypass system, through the removal of casuarina trees would reactivate the natural sediment conveyor, with concomitant ecological and socio-economic benefits along the broader Ponto d'Ouro Marine Reserve. Dune restoration and rehabilitation therefore, does not only entail the planting of dunes, but rather the reactivation of dune dynamism and restoration of ecomorphological function.



**Left:** An aerial photograph of Ponto d'Ouro taken in 2018, indicating the original dune bypass (hatched lines) and the emerging bypass (red arrow).

**Above:** An aerial photograph of Ponto d'Ouro taken in 1959, with wind rose. Arrow indicates the "dune bypass".

**Right:** Sea defence structures on coastal properties at Ponto d'Ouro. Erosion within the bay at Ponto d'Ouro has become more prolific as development encircles it and an equilibrium shift in the sand sharing system arises because of the closure of the sand bypass to the south.



# Tidal inundation can boost mangrove restoration

BY **HENRIQUES  
BALIDY AND  
SALOMÃO BANDEIRA**

Mangrove restoration has been tested in several parts of the world but restoration success – measured by the survival of seedlings planted – has been quite low on a global scale. In Mozambique, an assessment revealed mixed results, with about 10 percent restoration success. However, in southern and central Mozambique, the classification of mangrove inundation and the restoration of hydrological flows, has been shown to increase the success of mangrove restoration.



“ Each mangrove species is adapted to a different level of exposure or submergence.

The classification of mangrove inundation classes is based on the calculated frequency of inundation for each of dominant species in a mangrove community. These computed hydrological parameters were adapted for use in the Limpopo Estuary, in southern Mozambique, and at Quelimane, the northern most delta arm of the Zambezi River, in the central part of the country.

**The Limpopo River has a relatively small mangrove area, but over half of it was wiped out during the massive floods of 2000** which displaced hundreds of people and destroyed several villages along its extensive basin. During these floods, the natural hydrology of the river was seriously affected. Heavy flooding and siltation destroyed around 60 percent

of the original mangrove area and blocked the major creeks that naturally feed the mangrove forest.

The mangroves at Quelimane extend for about 200 km and include very tall trees of up to 30 m. While the inner Zambezi delta is quite pristine, the town of Quelimane is inhabited by 250 000 people and mangrove deforestation of 3 164 ha (51 percent) was documented over a period of 10 years. Mangrove deforestation was mostly caused by the construction of dykes associated with salt pans. Consequently, hydrological restoration was used to de-block silted channels.

**Table 1 highlights the condition of the mangroves at the Limpopo and Quelimane sites and summarises the mangrove restoration process.**

**Left:** Women transporting mangrove seedlings from a nursery, for planting in new areas with regular tidal inundation (Limpopo Estuary). Photo: Henriques Balidy.

**Table 1: FOREST AND RESTORATION PARAMETERS OF LIMPOPO AND QUELIMANE MANGROVES<sup>1</sup>**

SITE	LIMPOPO	QUELIMANE
Mangrove area	928 ha	6 176 ha
Impacts	2000 floods that drowned the mangroves. Also, siltation	Deforestation, salt production, shrimp aquaculture
Area impacted as percentage of total	60%	51%
Area restored without hydrology intervention	50 ha (in 2020)	Up to 10 ha (in 2017)
Area restored with support of hydrology intervention	120 ha (in 2020)	50 ha (in 2018)
Extension of creeks de-blocked and rebuilt	4 230 m	9 875 m

<sup>1</sup> *Bandeira and Balidy 2016, Balidy 2018, CCAP/USAID 2017*



**Above:** Mangrove restoration showing active restoration by means of planting seedlings from a nursery (grey area) and passive restoration by means of hydrological rehabilitation (green area) in the Limpopo Estuary (left) and the Bons Sinais River at Quelimane (right).

“ The area restored with the use of hydrological measures amounted to 120 ha in Limpopo and 50 ha in Quelimane.

**Watson inundation classes were calibrated and adapted for Limpopo and Quelimane**

Mangrove inundation classes were originally applied to mangroves in Malaysia. For Limpopo and Quelimane, five inundation classes were defined, as detailed in Table 2.

**The hydrological restoration starts by identifying possible obstacles blocking the normal circulation of tidal water.**

It was necessary to observe tidal behavior during neap and high tide to determine the locations covered and not covered by the tidal inundation. We used community ecological knowledge to balance inundation timing and known zonation for common mangrove species. Each mangrove species is adapted to a different level of exposure or submergence. For example, *Avicennia marina* adapts better to lower levels of substrate (deeper water) while *Heritiera littoralis* prefers higher substrate levels, where water arrives only at equinoctial high tides. The substrate height was measured using topographic equipment (laser

topographic level and global positioning systems, GPS). The data were processed in ArcGIS 3.10.1. **The obstructions to normal tidal flow within mangroves had to be removed. This included modifying the dykes constructed in salt pans and aquaculture ponds in Quelimane, and heaps of deposited soil in the Limpopo Estuary.** The hydrological restoration included simply restoring hydrological connections to degraded mangroves.

**The design of the hydrological restoration scheme, which is illustrated in the maps, was preceded by a topographic survey** in the study areas, using the same topographic equipment and GPS software used to generate data on topographical levels (quotas), curves and bifurcations. GPS coordinates guided the positioning of the hydrological channels that branch off the main river or water source – the Limpopo River and the Bons Sinais River, the northernmost arm of the Zambezi Delta – to the interior where mangrove restoration is required.

Table 2: **INUNDATION CLASSES AS CALCULATED FOR MOZAMBIQUE MANGROVES (ADAPTED FROM WATSON CLASSES, VAN LOON ET AL., 2007)**

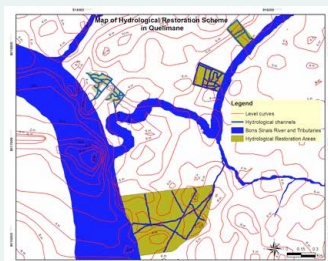
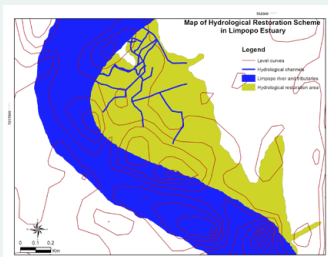
Inundation classes	Tidal regime	Elevation above mean sea level (MSL)	Inundation frequency (N° times per month)	Dominant species of mangrove communities
1	All high tides	Below 2.44 <0	56–62	<i>Rhizophora mucronata</i> , <i>Avicennia marina</i> and <i>Sonneratia alba</i>
2	Medium high tides	2.44–3.35	45–59	<i>Rhizophora mucronata</i> , <i>Avicennia marina</i> and <i>Sonneratia alba</i>
3	Normal high tides	3.35–3.96	20–45	<i>Rhizophora mucronata</i> , <i>Ceriops tagal</i> , <i>Xylocarpus granatum</i> and <i>Lumnitzera racemosa</i>
4	Spring high tides	3.96–4.57	2–20	<i>Bruguiera gymnorhiza</i> , <i>Lumnitzera racemosa</i> and <i>Xylocarpus granatum</i>
5	Equinoctial tides	= or >4.57	> 2	<i>Bruguiera gymnorhiza</i> and <i>Heritiera littoralis</i>

**Right:** Documenting and executing the hydrological restoration in the Limpopo Estuary. Photos: Henriques Balidy.





**Above:** A series of photographs shows the hydrological restoration of a former salt pan in Quelimane. Left: planning; centre: community engagement; right: a view of the constructed creeks under restoration. Photos: Henriques Balidy.



**Above:** Maps of the hydrological restoration scheme in the Limpopo Estuary (top) and Quelimane (bottom).

The excavation or opening of the hydrological channels was carried out in accordance with the maps generated by the topographic survey, and basic artisanal instruments such as hoes, shovels, machetes, handcarts and picks, were used by people from the local communities in the excavation. Similar processes have been used in Malaysia, the origin of hydrological restoration.

### Community participation

**The selection of community members to participate in excavation activities took into account gender aspects.**

**Both women and men were engaged,** but people younger than 18 years or older than 50 were excluded. Community members participated directly in most field activities, including topographic surveys, removal of obstacles, opening of the creeks, nursery development and seedling planting. Execution was coordinated by local leaders who formed the link between the technicians and the local community and were also responsible for recruiting people to carry out the work. Members

of the community directly involved in the work received agreed incentives and payment upon finishing the activities. Both in Quelimane and Limpopo, payment of incentives was carried out after the target was achieved by each member involved. For excavation, each participant received an incentive of between USD 3 to USD 8 (150 MT to 450 MT/Meticais, local currency) for every five meters of excavated channel.

The cost of planting a hectare of mangroves, equivalent to 2 500 seedlings, cost USD 67 (4 000 MT). This equates to nearly 2 MT for each mangrove planted, in both Limpopo and Quelimane.

As is illustrated in Table 1, the restoration of hydrological flows and mangrove inundation in the Limpopo Estuary and at Quelimane **proved to be a successful and cost-effective method for restoring degraded mangroves in Mozambique.** The area restored with the use of hydrological measures amounted to 120 ha in Limpopo and 50 ha in Quelimane.

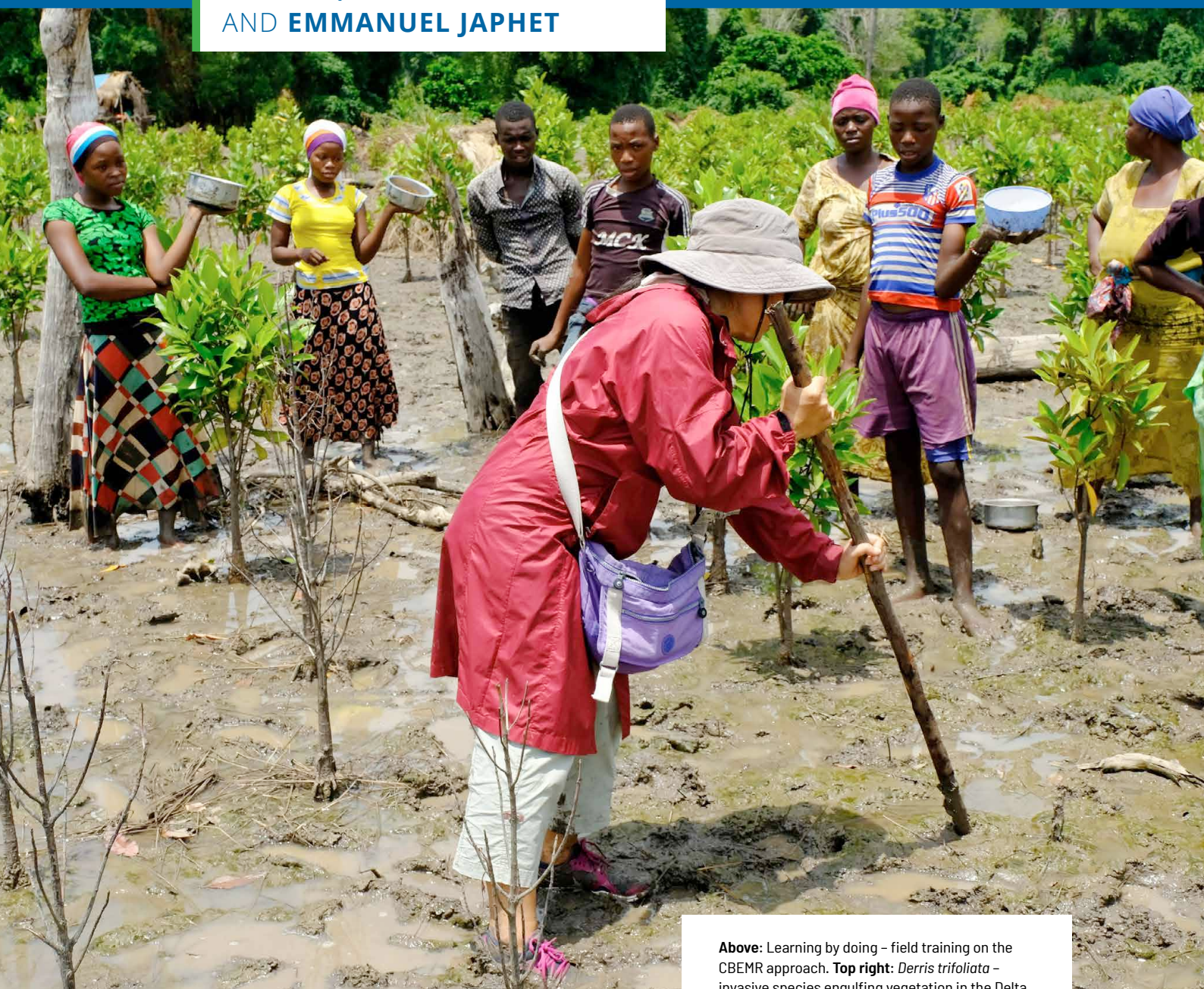
**Below:** The opening of the creeks. Photo: Henriques Balidy.



# To plant or not to plant?

## INSIGHTS FROM MANGROVE RESTORATION IN RUFJI DELTA

BY MENNO DE BOER, LILIAN NYAEGA, ELIZABETH WAMBA AND EMMANUEL JAPHET



**Above:** Learning by doing – field training on the CBEMR approach. **Top right:** *Derris trifoliata* – invasive species engulfing vegetation in the Delta.



**In the Rufiji Delta in Tanzania, Wetlands International and its partners are restoring mangroves using a novel, inclusive and much more effective approach.**

Globally, tens of millions of Euros have been spent on mangrove restoration in recent years, but the majority of these restoration projects have failed. With success rates ranging between 15 to 20 percent, a lot of conservation funding has gone to waste<sup>1</sup>. This is the result of using inadequate restoration techniques and a failure to resolve socio-economic and institutional barriers to effective restoration.

In recent years, experts from the Mangrove Action Project have piloted the so-called Community Based Ecological Mangrove Restoration (CBEMR) Approach. Rather than relying on active tree planting, this approach focuses on creating the enabling environmental conditions for natural recovery in sites that have been disturbed by human interference. **This is achieved by implementing measures that restore hydrology, sediment dynamics and soil conditions.** Planting is only applied

when necessary; for example, in the absence of a nearby seedstock that supports natural mangrove recruitment. Beyond introducing technically sound restoration approaches, the CBEMR approach also addresses socio-economic factors that compromise long-term sustainability of mangrove restoration and constrain implementation at a landscape scale.

**Wetlands International first put this approach into practice in Cacheu National Park, Guinea Bissau, where it restored a total of 200 ha of mangroves in three years.** Of these, 60 ha of mangroves were established through planting, while 140 ha were restored through the CBEMR approach. Whereas planting projects yielded mixed results, the CBEMR measures demonstrated a rapid recovery of enabling environmental conditions and a mangrove re-colonisation rate that was faster than expected.

<sup>1</sup> Kodikara et al. (2017). *Have mangrove restoration projects worked? An in-depth study in Sri Lanka; Primavera and Esteban (2008). A review of mangrove rehabilitation in the Philippines: successes, failures and future prospects.*

“ As part of the continent-wide Mangrove Capital Africa (MCA) Programme, which is supported by DOB Ecology, Wetlands International is now implementing the CBEMR approach in the Rufiji Delta in Tanzania.

**From Guinea Bissau to Tanzania**

The Rufiji Delta is home to the largest concentration of mangroves in Tanzania, but over the years it has been affected by a complex set of factors, including climate change and anthropogenic pressures, triggering a loss of mangroves and a reduction in their quality and productivity. These factors include overharvesting of mangrove trees for wood fuel and building materials, conversion of mangrove areas for other uses such as salt production, human settlement and agriculture, and, in particular, rice farming and cattle grazing.

Nonetheless, Rufiji is different from Guinea Bissau. In Guinea Bissau the hydrology was drastically disturbed, which led to mangrove loss; in Rufiji that is not the case. Studies conducted by Wetlands International on the

status of ecological resources in the Rufiji Delta estimate that about 7 004 ha of mangroves were lost as a result of rice farming between 1991 and 2015. This translates into an annual loss of about 292 ha. **After several years, rice fields are abandoned but mangroves do not return.**

An analysis of the situation led to a novel restoration approach; rather than just planting, Wetlands International is now restoring the environment to allow for regeneration. This includes clearing of grass cover, removal of the invasive climber *Derris trifoliata* and digging channels to increase water flow. Where propagules are not abundant, enrichment planting is done. **Monitoring is conducted with Mangrove Watch, a system of maps and remote sensing tools that allows restoration efforts to be tracked on a large scale.**



For more information, please contact Wetlands International on [communicationsEA@wetlands-eafrica.org](mailto:communicationsEA@wetlands-eafrica.org) and click on the following links for further reading:

To plant or not to plant: <https://www.wetlands.org/publications/mangrove-restoration-to-plant-or-not-to-plant/>



### Long-term sustainability

The MCA Programme adopted a holistic approach by working simultaneously on strengthening institutional capacity for sustainable mangrove management, livelihood improvement and participatory mangrove restoration. In restoration, the programme works with community organisations in the Delta, local district governments, national government authorities such as the Tanzania Forest Service and non-governmental organizations such as Pakaya, Foundation for Energy, Climate and Environment, and WWF Tanzania. **By jointly initiating the work, the programme learns about the issues that need to be addressed for successful restoration,** facilitates monitoring and ownership of the interventions. This approach of awareness-raising and learning has proved to be essential for long term sustainability and upscaling of the successful approaches.

In addition, with the understanding of the intricate links between local livelihoods and ecosystem health, the programme not only involves the communities in active restoration, but also develops models to promote replicable community-led livelihood activities such as sustainable fisheries and non-fish mangrove products.

Moreover, to ensure sustained restoration, joint patrolling efforts informed by Mangrove Watch<sup>2</sup> will be introduced to provide regular updates of where mangroves are threatened in the delta.

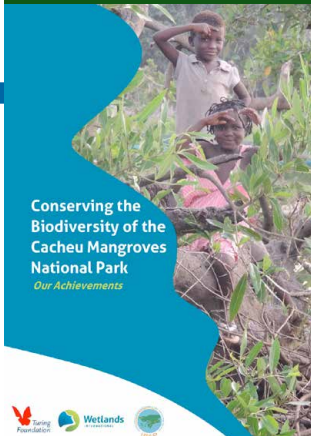
<sup>1</sup> Global monitoring system for mangrove forests.

The Guinea Bissau case: <https://www.wetlands.org/publications/conserving-biodiversity-cacheu-mangroves-national-park-guinea-bissau/>

### LESSONS FROM IMPLEMENTATION:

During implementation of the CBEMR approach, we have learned the following lessons:

- The approach has the advantage of substantially reduced implementation costs compared to planting. Because of these lower costs, considerably larger areas can be restored using assisted natural regeneration approaches compared to widespread planting.
- Natural regeneration occurs under specific biophysical, socio-economic and cultural conditions. Therefore, restoration should be backed by sound data and evidence, particularly on threats, changes in the environment and perceptions of communities who live and interact with the mangrove ecosystems on a daily basis.
- For successful implementation and ownership of the approach, there is a need to strengthen the institutional and individual capacity of involved stakeholders.
- Embedding restoration in a larger framework of mangrove management such as review and implementation of mangrove management plans is a central component of sustainable mangrove management and restoration.



Conserving the Biodiversity of the Cacheu Mangroves National Park  
Our Achievements



Global Mangrove Watch: <https://www.globalmangrovetwatch.org/>

# Pioneering mangrove restoration project in WIO region

BY JAMES KAIRO AND  
ABEL KIPRONO

**In Africa, mangrove forests have been neglected, abused and removed. Whereas forest restoration has been used as a tool to manage lost and degraded mangrove areas around the world, trial mangrove plantation in Kenya started in the 1990s. These early planting experiments were conducted at Gazi bay in the South coast of Kenya; and involved all major species of mangroves in Kenya.**

**Above:** A reforested mangrove site at Gazi bay, Kenya. Community participation is key to sustainable mangrove management. (© Rob Barnes, Grid Arendal, 2017).



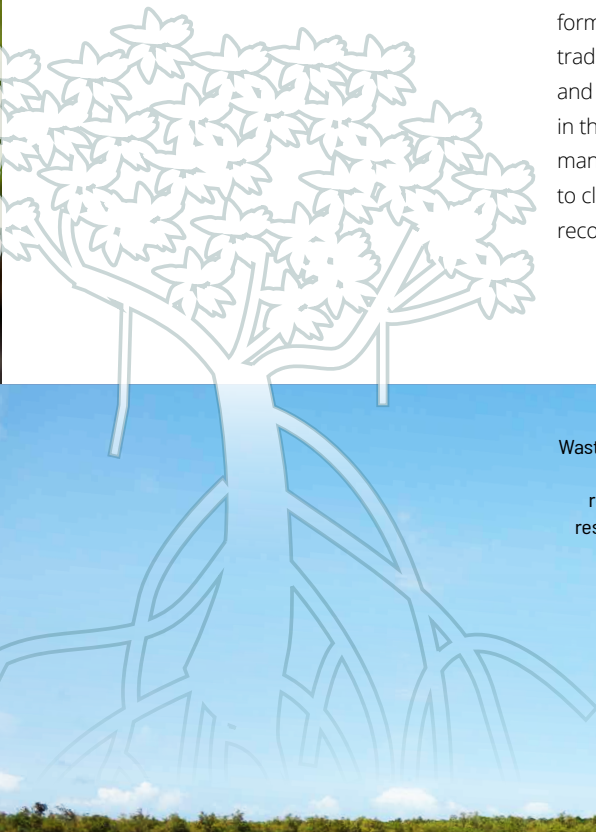
The 615 hectares of mangroves in Gazi Bay, Kwale County, on the south coast of Kenya, maybe the most studied mangrove ecosystem in Africa.

Located in the south coast of Kenya, the 615 hectares of mangroves of Gazi Bay maybe regarded as the most studied mangrove ecosystem in Africa.

**All nine species of mangrove trees that have been described in the Western Indian Ocean (WIO) region can be found in Gazi bay;** either as pure or in mixed stands. *Rhizophora mucronata* and *Ceriops tagal* are the dominant species, occupying almost 80 percent of the mangrove forest formation. Mangroves in Gazi Bay have traditionally been exploited for timber and non-timber resources. However, in the 1980s, over-harvesting of mangroves for industrial fuel-wood led to clear felled areas that have failed to recover naturally.

In 1990, a pilot mangrove reforestation programme was initiated to rehabilitate degraded intertidal areas, restock denuded mudflats, and transform disturbed forests into more uniform stands of higher productivity. Planting of propagules and saplings was done in 1x1 m<sup>2</sup> and 2x 2 m<sup>2</sup> matrices respectively. By 2019, more than 0.6 million trees of mainly *Rhizophora mucronata*, *Ceriops tagal*, *Avicennia marina* and *Sonneratia alba* had been planted as monocultures in a total area of 18.0 hectares. **Survival rates range from less than 100% in high energy sites to 97% in protected sites away from the sea.** Maximum annual increment (MAI) varies with species. *Sonneratia alba* recorded a maximum growth rate of 1.1 metres/year while *Ceriops tagal* had the lowest MAI of 0.3 meters/year amongst cultivated mangroves species.

The cost to successfully restore mangroves in Gazi Bay ranges from USD 150/ha to USD 1 000/ha, depending on the type of planting material, planting techniques and site conditions. Transplanting of saplings (either nursery-raised or wildings) costs three times more than direct planting of propagules. This is minus the cost of maintenance and monitoring in the initial five years, which is estimated to average USD 1 000/yr.



Wasted effort at Vanga Bay, Kenya. Poor species-site matching is responsible for most mangrove restoration failures in the region. (© Hamadi Mwamlavya).





Successful mangrove reforestation. A 19 years Rhizophora plantation at Gazi bay, Kenya (© : KMFRI mangrove team).

There are many lessons that can be derived from the mangrove restoration experiments in Gazi. Of great importance are the gains associated with trials and errors approach that was used in establishing the different mangrove species across the intertidal complex. This allowed our understanding of ecological range of species and silvicultural treatments. Based on this, we learnt that the species, *Sonneratia alba* should always be grown in areas close to the sea. *Avicennia marina* has a wide tolerance range to salinity and as such can be grown both at the near shore as well as on the landward side. Using our experiences in Gazi, we have developed an annual calendar for mangrove reforestation in WIO that is based on seasonality of the species. **To maximize success, planting should be planned to coincide with the season of highest propagule production across all species.** Other lessons learned are:

- i. The need for **regular and long-term monitoring** using communities in order to track growth performance of trees
- ii. Continued awareness creation on the value of mangrove ecosystem and the need to conserve it enhances **community ownership of the restoration project**
- iii. **Stakeholder participation** is key to successful mangrove restoration projects
- iv. **Development of alternative Income Generating Activities** (IGAs) is important to bolster community livelihoods whilst reducing overdependence on mangrove forest resources.
- v. **Mangrove restoration should be mainstreamed with national forest programs for sustainable financing**

Our mangrove restoration scheme in Gazi has adopted mixed approaches involving government agencies, non-governmental organization, donor agencies, and local communities. Involvement of multiple stakeholders allows sharing of resources and expertise. **Community participation is central in the establishment, maintainance, and long term monitoring of replanted mangrove sites.** While there exist few hurdles such as use of inappropriate planting techniques, sustainable financing is among the major challenges hindering successful mangrove reforestation activities in Kenya. To address this, deliberate effort should be made by governments and international partners to increase support for mangrove restoration during the UN's Decade of Ecosystem Restoration scheduled from 2021 – 2030.

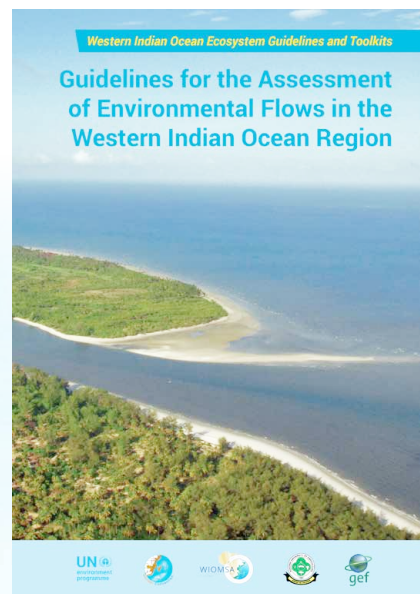
# The EFlow Guidelines

WILL BE LAUNCHED ON  
25<sup>TH</sup> OF SEPTEMBER 2020

TO MARK THE **WORLD RIVERS DAY** ON  
27<sup>TH</sup> SEPTEMBER 2020

**The Western Indian Ocean (WIO) region has several important river basins whose runoff drains to the ocean through estuaries and deltas.** In many instances, poor management of river basins has resulted in changes to river flows, degradation of water quality and changes in sediment loads. These hydrologic alterations are now impacting critical coastal and marine ecosystems, leading a reduction in ecosystem goods and services that support the livelihoods of coastal communities, as well as national economies. Other pressures, such as pollution, dam construction, or unsustainable irrigation and livestock practices – have also had an enormous impact on rivers, changing the quality, quantity, and timing of their water flows. These changes can have a profound impact on life for riverside communities. Residents may no longer be able to find as many fish to eat or clean water to drink. Crops may dry up, hurting both agricultural and livestock farmers. Communities could get sick from bathing or drinking contaminated water.

**To address this threat, many stakeholders around the world have begun to implement environmental flow (Eflow) assessments, which seek to determine the magnitude, frequency, timing, and quality of water and sediment flows necessary to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.** Nairobi Convention states, in recognition of the importance of Eflow assessments to freshwater, coastal, and marine ecosystems, have worked to create a new set of Guidelines for the Assessment of Environmental Flows in the Western Indian Ocean Region.



The guidelines, which were produced in partnership with WIOMSA and the Sokoine University of Agriculture, are the first to provide a standardized, region-wide approach to conducting an Eflows assessment and outline a step-by-step guide on how to conduct such assessments to enable learning and cross-fertilization across the region.

THIS WILL BE RELEASED ON  
25 SEPTEMBER 2020  
on  
[nairobi-convention.org](http://nairobi-convention.org)

# Unleashing Madagascar's community-led **mangrove restoration movement**

BY **LALAO  
AIGRETTE**

**Below:** Lalao Aigrette.  
Photo: Leah Glass Blue  
Ventures.



**Below:** A 19 year old mangrove plantation at Gazi Bay. Photo: KMFRI



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The actions proposed by the community aligned with the commitment of the Government of Madagascar to restore 4 million ha of forests (mangroves included) under the African Forest Landscape Restoration Initiative (AFR100).

Madagascar’s mangrove forests represent roughly 2 percent of the world’s mangroves and are the fourth largest in Africa in extent. They supply coastal people with a wide range of benefits including income, food, building materials, fuelwood and charcoal. Despite the importance of mangrove ecosystems, remote sensing analysis shows a nationwide net loss of 21 percent (57 359 ha) from 1990 to 2010. This loss puts the livelihoods of coastal populations at significant risk.

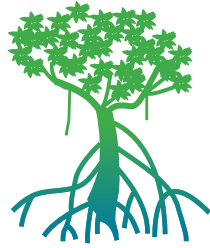
## blue ventures

beyond conservation

To address Madagascar’s mangrove loss and increase mangrove forest cover, **Blue Ventures created a Blue Forest programme in 2011. This established initiative currently supports over 50 coastal community groups across five sites along the west coast of Madagascar** (Bay of Tsimipaika, Bay of Mahajamba, Barren Isles, Belo sur mer and Bay of Assassins) where 98 percent of the country’s mangroves are located. This article shares the experience of mangrove restoration in Bay of Assassins located in the southwest Madagascar.

In the Bay of Assassins, the mangrove restoration activities started with a participatory workshop organised at village level. The workshop identified the direct and underlying causes threatening mangroves, with a view to finding potential solutions and strategies for mangrove preservation and management. Putting an area under strict protection and replanting the heavily degraded mangrove areas were identified by communities as the urgent actions needed for the restoration and preservation of remaining mangrove forests. **The actions proposed by the community aligned with the commitment of the Government of Madagascar to restore 4 million ha of forests (mangroves included) under the African Forest Landscape Restoration Initiative (AFR100).**

**Left:** Women planting mangrove propagules. Photo: DIT Louise Jasper.



The active participation of the community is crucial to ensure that degraded areas are rapidly replanted.

**Community members were provided with technical and administrative assistance by Blue Ventures' field technicians.**

Customary regulation (known as *Dina* in Malagasy) was established to govern the management of the mangroves in three areas: strict protection areas, sustainable harvest areas, and replanting areas.

**Degraded areas were identified through participatory mapping and ground truthing.**

Once the targets for restoration had been established, the replanting session was scheduled and the annual goals were defined. Community members were then supported in replanting and monitoring the replanted area. The focus of the replanting was on species that were previously cut down, including *Ceriops tagal*, *Rhizophora mucronata* and *Bruguiera gymnorrhiza*. For these species, direct plantation of the propagule (seeds) is possible and they can be collected immediately before



planting. The rainy season (October to April) is the best time for planting in most regions. This is the time when the propagules are abundant and mature, and the sea level is high. It is important that planting takes place at low tide and at the beginning of spring tide to ensure that the propagules are submerged twice daily, for several days. **The dates of the mangrove replanting sessions were planned and decided by communities themselves** and communicated in advance to the Blue Ventures' technicians who ensure that the techniques for replanting are followed and respected. A technician participates in each session. A short video, which describes the spacing of the plantation and the collection of good seeds, is shown prior to the start of the replanting sessions and the technician is on hand to offer support. In the southwest region, reforestation is an activity that promotes the active participation of women and youth who are empowered to challenge inequalities.

Although community members are not paid when collecting seeds or undertaking replanting activities, some of the individuals in these vulnerable communities are not in a position to replant the mangroves on a voluntary basis, even though they are fully aware that the degradation of the resource directly impacts the fisheries on which they depend. In order to address this issue, in the southwest, meetings were organised by Blue Ventures to consult the community on the best way to increase participation at the replanting events. **Through these discussions, Blue Ventures and the communities came to a mutual decision that the best solution was to provide meals to the communities after a mangrove replanting day.**

In the Bay of Tsimipaika, where the deforested mangrove area is enormous (over 1 000 ha), the active participation of the community is crucial to ensure that degraded areas are rapidly replanted and not left uncovered for too

long. Thus, each of the existing groups in the village (football teams, community saving groups, youth groups, women's associations, etc.) were mobilized to participate in replanting efforts. The groups were invited to agree to their annual mangrove replanting targets (in hectares) for which they would be supplied with various goods to support their livelihoods, including cooking materials, uniforms, etc.

To date, 478 ha of degraded mangrove have been replanted by communities with an average survival rate of 75 percent. **Communities have confirmed that when the mangroves are restored, there is a direct and positive impact** on their fishing activities, with their catches increasing in size.

Although multiple stakeholders are jointly contributing to mangrove replanting efforts in order to restore mangrove ecosystems, community-led mangrove restoration has been particularly successful. Locally led efforts, such as those in Madagascar, are proving vital for pushing forward the AFR 100 policy to restore Africa's forests.

*This mangrove restoration work has been supported by the UK Government's International Climate Finance (ICF) and Darwin Initiative, the Global Environment Facility (GEF) and the MacArthur Foundation.*

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**Far Left:** Mangrove propagules ready for planting. Photo: Leah Glass Blue Ventures.

**Left:** Community members planting mangrove seeds. Photo: Leah Glass Blue Ventures.



# Restoring and protecting mangroves

BY JAMES  
KAIRO, ANN  
WANJIRU AND  
MWANARUSI  
MWA FIRIKA

THROUGH CARBON  
FINANCING

**Below:** A 19 year old  
mangrove plantation at  
Gazi Bay. Photo: KMFRI .



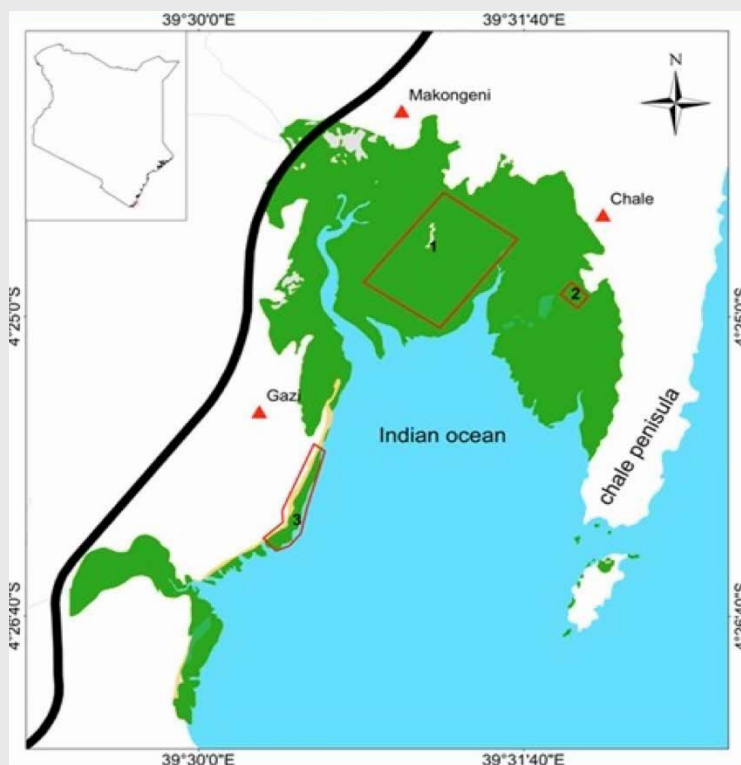
**A pioneering carbon offset project is saving mangroves and generating direct income for communities at Gazi Bay in Kenya.**

Since 2013, a team at Kenya Marine and Fisheries Research Institute (KMFRI), working with partners in the United Kingdom, has generated USD 15 000 per year through the sale of mangrove carbon credits.

The initiative is backed by international organizations such as Earthwatch Institute (UK), World Wildlife Fund, Saudi Aramco, WIOMSA and the Natural Environment Research Council of the UK.

KMFRI team has spent the last three decades working with local communities in Gazi Bay, approximately 65 km south of Mombasa, to restore and protect disappearing mangrove forests in the bay. As illustrated in the accompanying map, at Gazi Bay several villages surround the 615 ha mangrove forest. **Local communities depend on mangroves for wood and non-wood products and services, such as firewood, building poles, traditional medicine, fisheries resources and shoreline protection.**

However, mangroves have been extensively used and degraded since the 1980s through local and commercial logging, both legal and illegal. The loss of mangroves has led to shortages of firewood and building poles, a decline in fisheries and increased coastal erosion and a consequent urgent need for the rehabilitation, conservation and sustainable utilization of mangrove resources at Gazi Bay.



The map shows mangroves of Gazi Bay, Kenya, including the activity areas managed by local people for the sale of mangrove carbon credits and other benefits.

**A programme to rehabilitate degraded mangrove areas, and transform disturbed stands to uniform stands of higher productivity, was launched by KMFRI at Gazi Bay in the 1990s.**

The programme gained momentum in 1994 when the local community was fully integrated into the reforestation and monitoring effort. In 2012, Saudi ARAMCO, through Earthwatch UK, supported a short training course on community-based mangrove reforestation and management. The course targeted local people who were trained on mangrove nursery establishment, out-planting and maintenance. In 2013, communities adjacent Gazi bay signed a commitment to replant some 4 000 mangrove seedlings per annum in the degraded areas of Bay through a carbon offset programme called “Mikoko Pamoja”.

**Mikoko Pamoja or “mangroves together” is the first community-type project in the world to restore and protect mangrove forests through the sale of carbon credits on the voluntary carbon market.** More than 60 percent of revenue raised through Mikoko Pamoja is channelled to a special community benefit fund, headed up by local

representatives, for spending on priority community projects in the fields of water and sanitation, education and health. The remainder of the money generated is used to hire a project coordinator and local labourers to help protect an initial 117 ha of mangroves, and replant mangroves in degraded areas.

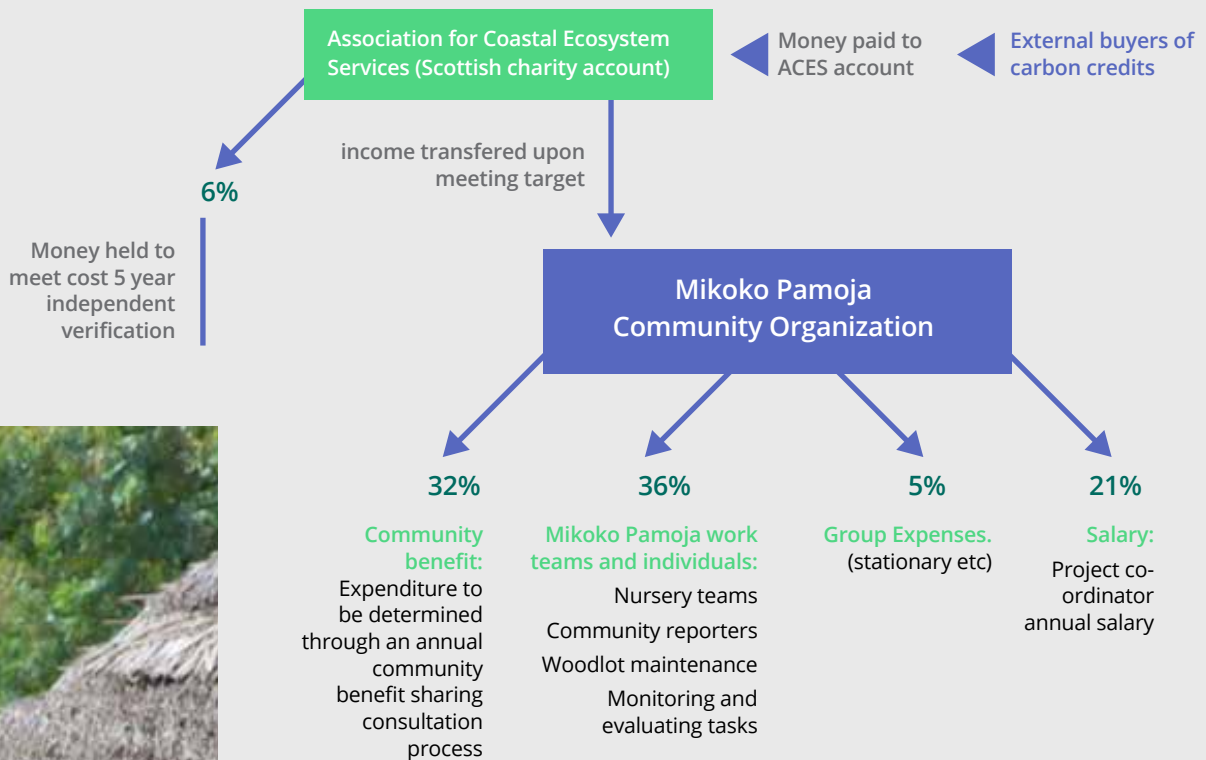
As well as storing large quantities of carbon that would otherwise contribute to climate change, mangroves provide crucial feeding and nursery habitats for fish and other wildlife. The intertwining mangrove roots provide a home and shelter from predators for juvenile fish, crabs and other marine life, supporting biodiversity and also filtering water and protecting shorelines. Goods and services generated by mangroves in Gazi Bay have been valued at USD 3 000/ha/year<sup>1</sup>.



<sup>1</sup> Kairo, et al., , 2009.,*Journal of Sustainable Forestry*,28:3,395 – 414

# MIKOKO PAMOJAS: BENEFIT SHARING

The benefit sharing scheme that is being implemented by Mikoko Pamoja



Water is supplied to people living in Gazi Bay, thanks to a water project funded by Mikoko Pamoja. Photo: Rob Barnes, Grid Arendal

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In 2017, Mikoko Pamoja received the coveted United Nation’s Equator Prize for its remarkable work of advancing mangrove conservation for climate benefits, community development, and biodiversity conservation.

In 2017, Mikoko Pamoja received the coveted United Nation’s Equator Prize for its remarkable work of advancing mangrove conservation for climate benefits, community development, and biodiversity conservation. In the same year, Hollywood actor, Leonardo Dicaprio, supported the replication of Mikoko Pamoja in Vanga, located 70 km south of Gazi Bay; in a transboundary conservation area between Kenya and Tanzania. Today, Vanga Blue Forest or VBF – is offsetting double the volume of CO2 captured by Mikoko Pamoja and thus generating USD 30 000 per annum for community development and conservation. **The future goal is to expand Mikoko Pamoja to include seagrasses, and replicate this innovative community based project in other mangrove areas in the Western Indian Ocean region.**

# New guidelines

TO STRENGTHEN EFFORTS  
TO PROTECT AND RESTORE  
MANGROVE ECOSYSTEMS



BY JAMES  
KAIRO, JARED  
BOSIRE AND  
ANGELA  
PATNODE

**All across coastlines in the Western Indian Ocean region – from South Africa to Somalia and the islands of Comoros, Madagascar, Mauritius and Seychelles – it is hard to imagine life without mangroves. This critical habitat constitutes the backbone of the economic activities of many coastal communities.**

**Mangroves, trees that thrive in saltwater, provide feeding and nursery grounds for fish and other marine life, meaning that they offer both food and a source of income across the region.** Coastal residents in many countries rely on invertebrates that are nurtured by mangroves. Other communities

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**Left:** Effective community participation is key to success in mangrove restoration at Limpopo Estuary, Mozambique.





“  
Mangroves  
absorb five  
times more  
carbon  
from the  
atmosphere  
than forests  
on land

”

profit from valuable marine species that congregate around mangroves as feeding and/or nursery grounds. Still others depend on mangrove wood for fuel, construction and traditional medicine, while some seaside populations, like those in Kenya, have created eco-tourism opportunities around the mangroves, taking eager visitors kayaking through the forests.

But the benefits of mangroves extend beyond economic and food security.

**They are crucial to the global fight against climate change** because of their ability to sequester carbon at impressive rates – mangroves take five times more carbon out of the atmosphere than forests on land.

Despite their economic, environmental and societal benefits, **mangrove ecosystems have been under threat in the WIO region.** Overexploitation, land use conversion, coastal development, among other threats

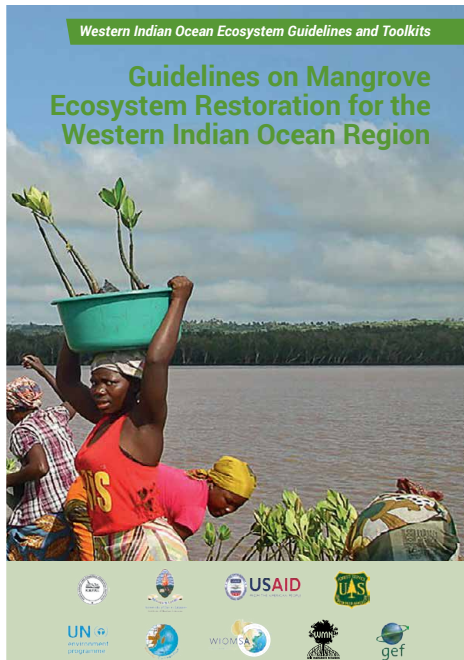
have caused a decline in mangrove forest cover. Therefore, protecting and restoring these ecosystems is vital to the way of life of many coastal populations.

**Governments and advocates in the region have recognized the urgent need to take action to protect mangroves**, which is reflected in numerous restoration projects undertaken over the years. However, some of these projects have failed, which is why the Nairobi Convention worked with WIOMSA, the United States Agency for International Development and the WIO Mangrove Network to support the development of the Guidelines on Mangrove Ecosystem Restoration in the Western Indian Ocean.

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**Above left:** Mbwemkuru River discharging to the Indian Ocean at Msungu Bay, southern Tanzania.

**Above Right:** Caring of planted *S. alba* in Gazi Bay, Kenya.

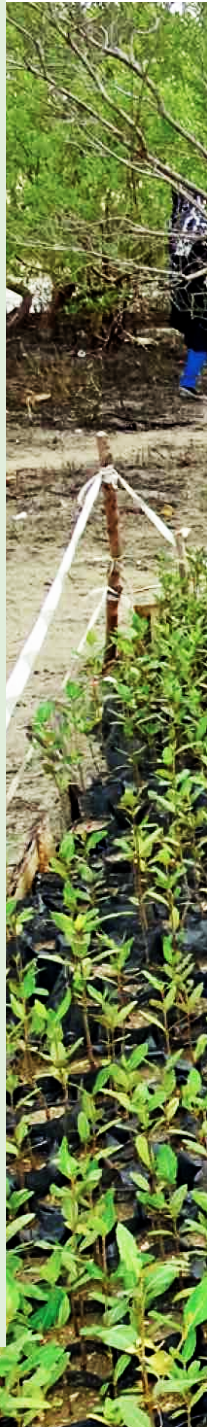


**By using the Guidelines, governments, local communities, donors and other managers of restoration projects can ensure that their investments are used wisely** – thus reducing wasted efforts and resources and increasing the benefits provided by these critical habitats. The Guidelines were officially launched in the lead-up to the International Mangrove Day on 24th July 2020 during a webinar attended by 227 participants, comprising of Nairobi Convention government representatives; WIOMSA; WIO-C members; various UN Agencies (including UNEP Regional Seas Programmes); WIOSAP Project Implementing Partners and Regional Task Force members; the WIO Mangrove Network; the Global Mangrove Alliance and many other regional and global partners from research, academic and civil society organizations. The guest of honor was Prof Micheni Ntiba, the Principle Secretary Ministry of Agriculture, Livestock and Fisheries, State Department of Fisheries, Aquaculture and Blue Economy, Kenya. UNEP was represented by the Director Ecosystems Division, Susan Gardner.

**The Guidelines are the first in the region to analyze the reasons behind past failures and provide solutions. They provide a step-by-step guide on how to build successful restoration projects, suitable for the WIO, and highlight case studies from around the region.**

**In order to develop the Guidelines,** the project's partners coordinated several in-country and regional consultations and expert knowledge-sharing sessions, as well as a comprehensive literature review of past and ongoing mangrove restoration efforts. Before producing the final version, the first draft of the Guide was reviewed by regional experts. The Guidelines have been tested in the field and used to establish mangrove demonstration projects in Kenya with the support of The Nature Conservancy and other agencies even as they get adopted across the region.

It is hoped that these Guidelines will help countries in the region achieve sustainable development goal 14.2 on protecting coastal and marine habitats, as well as sustainable development goal 13 on climate action. The Guidelines also provide a vital means to help actors contribute to the upcoming [UN Decade on Ecosystem Restoration](#). Also, since mangroves are important carbon sequesters, states can incorporate mangrove restoration into their Nationally-Determined Contributions under the [Paris Agreement](#).



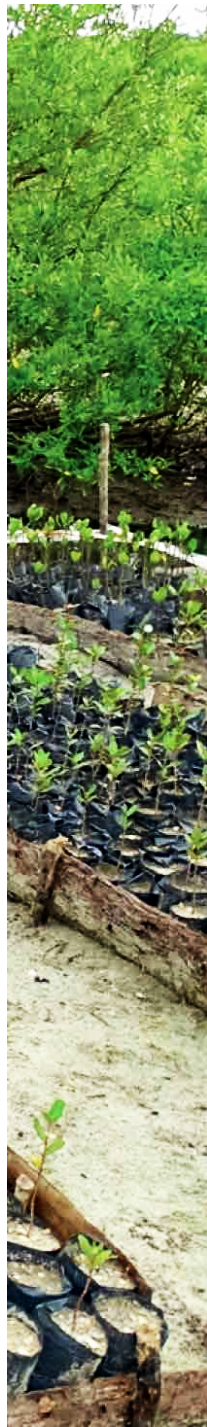
**Below:** A local community mangrove nursery with *A. marina* and *C. tagal* at Kilimani, Zanzibar.



## A PRIORITY FOR CLIMATE CHANGE MITIGATION AND ADAPTATION

The United Nations proclaimed 2021 to 2030 as the Decade on Ecosystem Restoration under a common goal: *preventing, halting and reversing* the degradation of ecosystems. Restoring degraded ecosystems, such as mangroves, is an efficient and cost-effective way people can work with nature to address the most pressing challenges facing humanity. Healthy mangroves capture and store carbon; as well as serving as habitat for fish and other wildlife, protecting shorelines from erosion, and providing harvestable wood and non-wood products. When degraded, “co-benefits” provided by mangroves are greatly diminished along with the ecosystems’ capacity to sequester carbon. Restoration and protection of mangroves is, therefore, recognized as a priority for both climate change mitigation and adaptation and several countries in the WIO have identified measures that harness these benefits in their revised National Determined Contributions (NDCs) to the Paris Agreement<sup>1</sup>.

Find online copies of the [Guidelines and supporting materials](#) at [nairobi-convention.org](http://nairobi-convention.org) and [wiomsa.org](http://wiomsa.org).



<sup>1</sup> INDC Portal <http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>

# NEW PUBLICATION PROVIDES MOMENTUM FOR DEVELOPMENT OF AN OCEAN GOVERNANCE STRATEGY FOR THE WESTERN INDIAN OCEAN REGION

**In 2015, the globe took a historic step. All member states of the United Nations adopted the Sustainable Development Goals (SDGs) – which simultaneously aim to “promote prosperity while protecting the planet” by 2030. Of the 17 goals adopted, Sustainable Development Goal 14 – which commits countries to protect ‘Life Under Water’ – is of particular significance, as one of the first universal acknowledgements of the critical role that coastal and marine ecosystems play in the health of our planet and ourselves.**

Five years later, countries in the Western Indian Ocean (WIO) have made enormous strides in achieving certain SDG 14 targets. The Seychelles, for example, has designated a staggering 30% of its marine areas as protected, blowing past SDG 14.5 committing

countries to protect at least 10% by 2020. WIO countries have developed a Regional Action Plan on Marine Litter, which will help drive actions to achieve SDG 14.1 to reduce this form of marine pollution. All around the region, meanwhile, efforts are underway to restore and protect coral reefs, seagrass, and mangroves, contributing SDG 14.2 on safeguarding critical habitats.

Nevertheless, comprehensively achieving SDG 14 by 2030 could remain difficult without comprehensive and coordinated action amongst WIO countries. The ocean is a complex and diverse resource with many users, ranging from local fishers and tourists all the way up to international shipping and mining companies, and their activities the ocean all impact one another and indeed, the wider population. For example, irresponsible fishing practices could damage the integrity of critical habitats, thereby lessening the appeal of a tourist attraction. Yet despite the interconnected nature of these resources, the management of ocean activities is often scattered amongst many different institutions and sectors. This can lead to inadequate coordination when it comes to efforts to conserve and sustainably use the ocean, as called for under SDG 14.

**A stronger ocean governance framework at the national, regional, and global levels could help achieve such coordination.** Policy harmonization, new legislation, and institutional reform – i.e. improved ocean governance – can help ensure that the ocean is managed and protected so that its resources can be enjoyed for generations to come.

Photo: Garby Barathieu.

For this reason, the Nairobi Convention, in executing the **SAPPHIRE project and in partnership with WIOMSA**, developed The State of Ocean Governance in the Western Indian Ocean Region, a **publication that reviews the status and trends in ocean governance** in the WIO and identifies key gaps, challenges, and opportunities in relation to global norms and best practices.

Specifically, it focuses on the policy and legal instruments and strategic plans at the global, African, and WIO levels; addresses the governance arrangements in sectors like maritime security or fisheries; summarizes features of national ocean governance; and describes selected international experiences in regional ocean governance.

**THE PUBLICATION WILL BE LAUNCHED at a meeting with the African Union (AU), Regional Economic Commissions (RECs) relevant to the WIO, Nairobi Convention Focal Points and other key partners ON 16 SEPTEMBER.**

The AU designated the RECs as Focal Points for the achievement of Agenda 2063, a priority of which is the sustainable utilization of marine resources. In turn, the African Ministerial Conference on the Environment (AMCEN), through the Cairo Declaration of 2015, agreed to support efforts aimed at protecting the marine ecosystems through various initiatives such as the development of Ocean Governance Strategy for Africa. AMCEN also requested the Regional Seas Conventions (of which the Nairobi Convention is one) to work with regional bodies on ocean governance.

The document can serve as a resource for stakeholders looking for an assessment of the current state-of-play of ocean governance at the national and regional level. It can help them address identified gaps, act on opportunities to increase cooperation, share resources and knowledge, and secure financing for common objectives. The Nairobi Convention therefore hopes that this publication and meeting can help serve the AU, RECs, states, and other ocean stakeholders as they consider how to move forward on developing an ocean governance strategy for the region.

Read the document on [www.nairobiconvention.org](http://www.nairobiconvention.org)

## CALL FOR RESEARCH PROPOSALS FOR MARINE RESEARCH GRANT I

WIOMSA IS INVITING SUBMISSION OF PROPOSALS FOR ITS MARINE RESEARCH GRANT (MARG I) FOR 2021. The MARG I programme provides young and upcoming scientists with a reliable and flexible mechanism to turn their ideas into research projects.

From now onwards, calls for MARG I proposals will be issued in the second half of the year, with the approved projects starting in January of the following year.

**PLEASE NOTE THAT, APPLICATIONS CAN ONLY BE SUBMITTED THROUGH THE ONLINE SYSTEM.** Only those applications submitted via this system will be processed. Applications should be completed, and support documents uploaded at the <https://proposals.wiomsa.org/marg-i-support-for-research-in-home-country/>. *Please read the instructions carefully before completing the relevant form.*

**THE DEADLINE FOR SUBMISSION OF PROPOSALS IS 25TH SEPTEMBER 2020.**

For detailed instructions for applying for these grants, download **the call for proposals** and to apply visit <http://proposals.wiomsa.org>



## About **WIOMSA**:

The Western Indian Ocean Marine Science Association promotes the educational, scientific and technological development of all aspects of marine sciences throughout the Western Indian Ocean region with a view towards sustaining the use and conservation of its marine resources.



Join **WIOMSA**: Sign up for membership at [www.wiomsa.org](http://www.wiomsa.org)

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## **THE NAIROBI CONVENTION,**

signed by Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa, and Tanzania, aims to promote a prosperous Western Indian Ocean region with healthy rivers, coasts, and oceans. It provides a platform for governments, civil society, and the private sector to work together for the sustainable management and use of the marine and coastal environment.



[www.nairobiconvention.org](http://www.nairobiconvention.org)

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