# Restoring Climate-resilient Mangroves and Communities

## A case study from Djibouti

Photo credit : Jeff Vincent

**The United Nations Environment Programme (UNEP) has been working with the Government of Djibouti and partners since 2010 on two climate adaptation projects, funded by the Global Environment Facility (GEF)'s Least Developed Countries Fund (LDCF). The projects have been building the resilience of ecosystems and communities against climate change through a practice known as 'Ecosystem-based Adaptation.'**

Djibouti is a small coastal country in the Horn of Africa, where the Gulf of Aden crosses with the Red Sea. Djibouti is one of the most water-scarce countries in the world, made up of approximately 90% desert. Most of Djibouti's population lives in coastal areas, home to coral reefs, mangroves, estuaries and the country's main port. Djibouti is highly vulnerable to climate change. According to climate projections, Djibouti is expected to become even hotter and drier and, unless action is taken, risks losing part of its coastline to rising sea levels, threatening livelihoods and water and food security.

Mangrove forest represents a critical ecosystem to build resilience against climate change impacts along Djibouti's coastal zones. Mangroves provide a natural defense against extreme weather events and buffer against sea level rise while absorbing carbon, acting as a haven for biodiversity and providing livelihood options for coastal communities. Globally, each hectare of mangrove forest provides ecosystem services worth an estimated US $33,000-$57,000 annually (UNEP 2021).

Restoring and rehabilitating mangroves represent key adaptation measures that Djibouti is pursuing as part of its National Adaptation Plan of Action and Nationally Determined Contributions.

### Project Title

Phase 1: Implementing NAPA priority interventions to build resilience in the most vulnerable coastal zones in Djibouti (2010-2016)
Phase 2: Implementing adaptation technologies in fragile ecosystems of Djibouti's central plains (2014-2023)

### Executing Agency

Ministry of Environment and Sustainable Development, Djibouti

### Key Figures

**2,000**
Hectares of coastal area restored with mangrove forest in Tadjourah

**800+**
Hectares of mangroves rehabilitated and 15 ha of mangroves restored in Khor Angar

**16**
Community members trained in mangrove restoration in Khor Angar and Raysali

### Funding

Supported by the Global Environment Facility's Least Developed Countries Fund

Co-finance
$16.6m

GEF Grant
$9.43m

# Ecosystem-based Adaptation: Mangrove Restoration on Djibouti's Coast

Mangrove restoration is an important task to reach the Global Biodiversity Framework's target of restoring 30% of degraded terrestrial, inland waters, and coastal and marine ecosystems by 2030, contributing to the UN Decade on Ecosystem Restoration and the UN Decade for Ocean Science for Sustainable Development. In Djibouti, key barriers to mangrove restoration include financial and human capacity constraints, inadequate legislation, weak compliance, information gaps and a lack of diversified and resilient livelihoods.

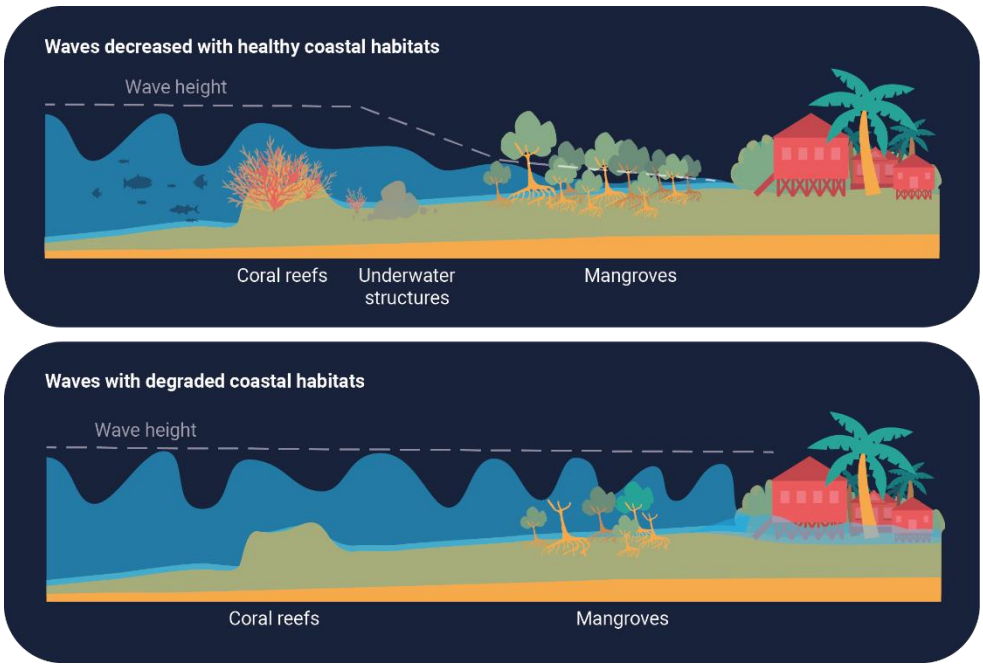
The GEF-funded adaptation projects in Djibouti embraced ecosystem-based adaptation (EbA) to overcome these obstacles, using nature to reduce the impacts of climate change on people and ecosystems. EbA measures (e.g. restoring the mangroves and watersheds) were combined with "grey" infrastructure interventions (e.g. building walls and micro-dams) and activities to enhance alternative and resilient livelihoods.

The first LDCF project carried out EbA at two sites, Khor Angar in the north (home to Djibouti's most important mangrove forest) and Damerjog in the south. Over the years, a combination of climate change and human activity had reduced the size of the mangrove by half. The outer edges of the forest were destroyed by camel grazing and wood harvesting, while long periods of drought likely contributed to mangrove degradation (Khalil n.d.). Sandbanks formed by rising seawater blocked fresh water from entering the forest, causing the mangrove trees to die and debris to gather. The project hired local community members to restore and maintain the mangroves. After clearing the debris from 50 ha of mangrove, water could once again flow and allow the forest to regenerate. Four plant nurseries were set up, growing more than 10,000 mangrove seedlings. Over 40,000 new mangrove trees were planted, consisting of two species, *Rhizophora mucronata* (10%) and *Avicennia marina* (90%). These are the two most commonly found mangrove species in Djibouti and are well-adapted to local conditions. They were planted in three sites covering 15 ha and surrounded by fencing to prevent damage from camels.

After the positive experience in Khor Angar, the second LDCF project took place in the pilot site of Raysali in the northern Tadjourah region. This site contains mangrove forest and is vulnerable to coastal erosion and sea level rise. The Raysali mangrove had been heavily degraded by wood harvesting (due to the high dependence of rural households on forest products for camel fodder, construction poles, firewood and charcoal) and coastal erosion and sedimentation caused by chronic drought. Only two trees of two different mangrove species remained, where originally there had been about five ha of mangrove forest. A nursery was created and 15,000 seedlings were planted. Two species of mangrove - *Avicennia marina* and *Rhizophora mucronata* – were planted to restore the forest, sourced from mangrove forests in Khor Angar and Djibouti City.

Based on the experience of both projects in Khor Angar and Raysali, guidelines were developed to build capacity nationally and support further mangrove restoration work in Djibouti.

Figure 1: How Ecosystems Protect Communities From Coastal Flooding



## Sustainable Livelihoods and Community-based Mangrove Restoration

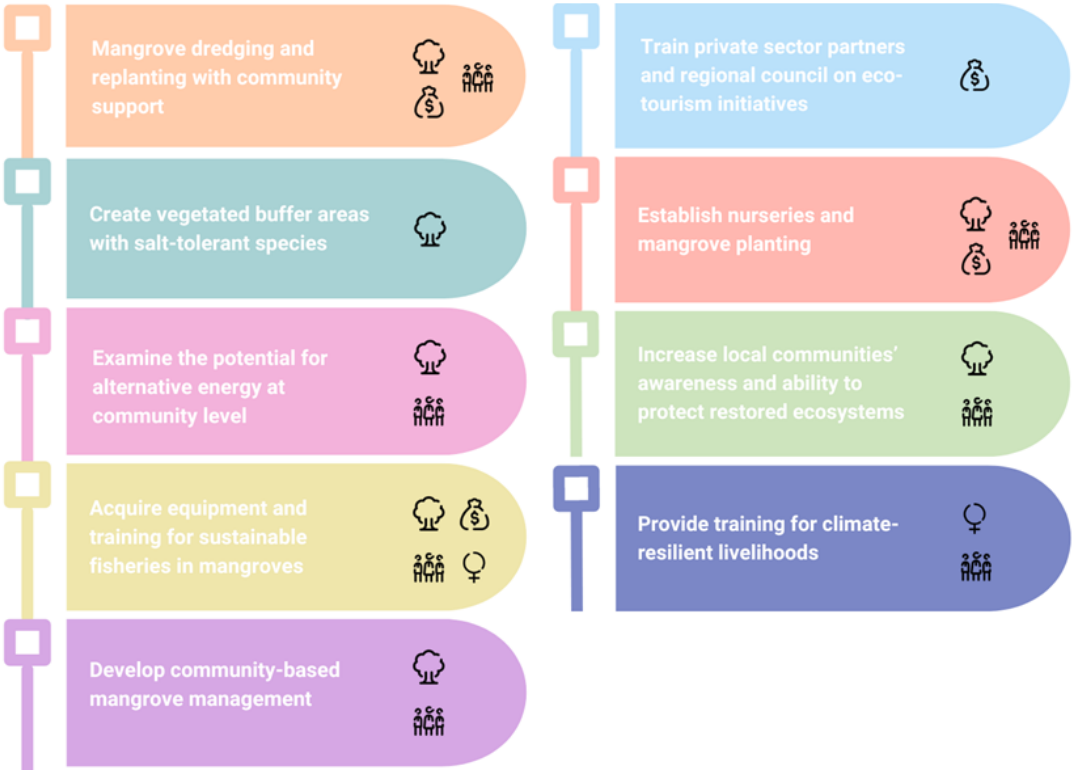
Mangroves provide a nursery for fish and shellfish and a nesting and migration site for birds, supporting biodiversity and providing sustenance and an income for local people. Around 110 people were trained in mangrove restoration (80 people in Khor Angar and 30 in Raysali).

The EbA project distributed fishing equipment to local fishers and trained 25 people in Khor Angar and 35 in Damerjog, eastern Djibouti, in sustainable fishing practices. Cooperative fishing associations were established to encourage activities beneficial to both fishing and mangrove protection. Women took the lead, organizing seminars to raise awareness of the importance of protecting the local environment. The women's fishing cooperative in Khor Angar started with six members and grew to 11. The project ignited an increased interest in sustainable fisheries, and fishers reported increased income.

Women in Raysali and the nearby village of Adbouya participated in handicraft training to sell crafts to tourists, providing an alternative source of income. The surrounding community in Raysali has seen an increase in biodiversity, with the return of fish and birds, and more opportunities from ecotourism.

According to Lowine Hill, Chief Technical Advisor at UNEP, it is essential "to really involve the community from the get-go… so that when the project is finished, the community already know what the value added is, what they gain from it, how they can own it themselves. They can continue the work that has been started by the project."

Figure 2: Project Interventions




## Lessons Learned

**Lesson 1: Choose optimal restoration sites and weatherproof them to overcome biophysical challenges.**

- As restoration and rehabilitation of critical, sensitive mangrove ecosystems take shape in EbA projects, there is a need to better understand how ecological approaches can be better applied in fragile areas. Carrying out restoration in coastal areas brings weather-related challenges and biophysical constraints. Young mangrove trees need suitable soil substrates, enough water and shelter to give the plants the best opportunity for survival.
- In Raysali, the project team found that mangroves planted in degraded areas without regular freshwater intake had high mortality rates, whereas those in sheltered areas with sufficient freshwater supply thrived. Mangrove rehabilitation was planned for a site in Kalaf, in the Tadjourah region, but it failed when the mangrove nursery was destroyed

twice by strong winds and heavy storms. In Raysali, the nursery and fence surrounding the site were damaged on two occasions by high winds and storms.

- These experiences show the importance of choosing an appropriate restoration site with optimal climate, environmental and soil conditions. This includes soil composition which needs to receive the right amount of water, be sheltered from extreme climate events, and have structures strong enough to withstand storms.

### Lesson 2: Restore using grey-green technologies for adaptation in coastal zones.

- Restoration efforts using hard, grey technologies need to be combined with soft, green measures such as community engagement, livelihood diversification, capacity building and training, that address the many drivers of climate vulnerability.
- In the Djibouti EbA projects, restoration and rehabilitation of mangrove ecosystems were combined with a diverse range of hard adaptation technology options (e.g. gabion walls, levees, rainwater harvesting and drip irrigation). When using green infrastructure, it was vital to select mangrove species that are not only well adapted to local conditions but also ideally locally or regionally sourced.
- In Raysali, only two trees of the *Avicennia marina* and *Rhizophora mucronata* species were found on the site. With virtually no mangrove forest remaining, the team transported seeds of the same species from a similar mangrove forest near Djibouti City to re-establish the forest. *Avicennia marina*, also known as grey or white mangrove, has strong roots that are resilient against storms. In Khor Angar, seeds were collected from the existing mangrove forest. The team planted species that are highly adapted to Khor Angar's salty soils.

### Lesson 3: Get the timing right and improve baselines for projects.

- Timing is everything when it comes to restoring fragile ecosystems. During the first replanting attempt in Raysali, seeds were lost as they were collected more than a week before sowing was scheduled and became spoiled. During the next intervention, the team made sure to sow the seeds within 48 hours of collection. Mangroves can only be planted during low tide, which sometimes happens at night. The extreme heat in Djibouti also makes it difficult for people to work outside and is not conducive to planting crops during many months of the year. Projects need to consider factors like these when planning and implementing mangrove restoration, being flexible and responding to weather conditions.
- The mangrove restoration intervention lacked baseline information on biodiversity indicators which made it difficult to measure the project's impact on biodiversity. In addition, there was some discrepancy over the final numbers of mangrove trees planted. Future projects will benefit from better baseline studies and improved reporting practices to provide valuable mangrove restoration and conservation data.

### Lesson 4: Work with local communities and co-design sustainable long-term solutions.

- Mangrove trees have been a source of firewood and timber for local communities in Djibouti's vulnerable coastal areas. But overuse has contributed to the decline of mangrove forest, alongside animal grazing, pollution, and climate change. Mangrove restoration must be accompanied by sustainable use and management, so that mangroves can continue to support communities, biodiversity, and climate adaptation into the future.
- Community members in Khor Angar and Raysali learned about the benefits of mangroves and participated in practical training in mangrove restoration. Some of them became "guardians" of the seed nurseries who motivated and sustained the restoration work. They were paid for their work, which provided a welcome additional income for their families. But it is critical to go beyond financial compensation to ensure that communities can sustainably use mangroves into the future. Since it can take a long time for ecosystem restoration to generate benefits, this must be accounted for in the planning and financing of EbA.
- Given the scale and pace of climate change, communities in the project areas are still very vulnerable and call for long-term livelihood support through mangrove maintenance, fishing, tourism, and handicrafts. In Djibouti, ecotourism represents an opportunity to diversify the income of local communities while conserving mangrove forests and building resilience against climate change.

A fisherman points out areas of mangrove growth in northern Djibouti after a community-led push to restore the ecosystems. Credit: UNEP/Hannah McNeish

Credit: UNEP/Hannah McNeish

## Sustainable Development Goals


## References

Khalil, A.S.M. (n.d.). *Khor Angar Mangroves: Assessment of the Status/ Degradation Causes, and Options for Restoration*. Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

United Nations Environment Programme (2021). *Becoming #GenerationRestoration: Ecosystem restoration for people, nature and climate*. Nairobi.

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## Further Resources

**Project Factsheet (Phase 1):**
Implementing NAPA Priority Interventions to Build Resilience in the Most Vulnerable Coastal Zones in Djibouti, 2010-2016

**Project Factsheet (Phase 2):**
Implementing Adaptation Technologies in Fragile Ecosystems of Djibouti's Central Plains, 2014-2021

**Stories**:
Oasis Dreaming: Regreening the Djiboutian Desert

Flood walls and forests help Djibouti adapt to climate change

**Video**:
Climate Action in Djibouti



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