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BUILDING MANGROVE FORESTS

A Nature-based Solution (NbS) to balance climate resilience and economic growth

BANGLADESH IS PLAYING AN ACTIVE ROLE IN ITS COMMITMENT TO THE NATIONAL DETERMINED CONTRIBUTION (NDC) BY AIMING TO DECREASE ITS GREENHOUSE GAS EMISSIONS BY 5-15% BY 2030. ADDITIONALLY, THE COUNTRY HAS PLEDGED TO INCREASE THE MANGROVE COVERAGE NATIONWIDE BY 5%.

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FOREWORD

Bangladesh has recognized the importance in tackling the challenges posed by climate change through the implementation of nature-based solutions and sustainable development practices. As a country highly susceptible to the adverse impacts of climate change, Bangladesh has proactively taken measures to combat this global crisis.

Bangladesh is playing an active role in its commitment to the National Determined Contribution (NDC) by aiming to decrease its greenhouse gas emissions by 5-15% by 2030. Additionally, the country has pledged to increase the mangrove coverage nationwide by 5%.

Mangroves are considered to be the best nature-based solution offering both adaptation and mitigation. They serve as a natural barrier against cyclone and storm surges, contribute to shoreline stabilisation, and act as carbon sinks by capturing significant amounts of greenhouse gases. Furthermore, the conservation and restoration of mangroves provide socio-economic benefits to local communities, including livelihood opportunities such as shellfish gathering, fishing, and beekeeping.

The collaboration between HSBC Bangladesh, the Bangladesh Economic Zones Authority (BEZA), and BRAC in establishing a green economic zone in Chattogram's Mirsharai upazila deserves commendation. This partnership aims to promote sustainable practices, enhance community resilience, and address climate risks. Specifically, the initiative includes a 55-acre mangrove plantation project at the Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) in Mirsarai, which will contribute to climate mitigation efforts and create alternative livelihood opportunities.

The booklet highlights the accomplishments, potential, and lessons learned from the implementation of mangrove forestation in Bangladesh. It emphasises the importance of further actions, knowledge sharing, and the widespread adoption of nature-based solutions not only within Bangladesh but also beyond its borders.

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A NATURE-BASED SOLUTION (NBS) TO BALANCE CLIMATE RESILIENCE AND ECONOMIC GROWTH

Bangladesh is one of the most climate-vulnerable countries in the world, and at the same time, the country is developing economically at a remarkable pace.

Over the past few decades, Bangladesh has undergone a significant paradigm shift in terms of how it aims to secure the well-being of present and future generations. The government has been diligently working towards increasing the country's resilience against climate change-associated adversities, while also reducing greenhouse gas emissions. Simultaneously, the government is committed to achieving an annual GDP growth rate of 8%, which requires increased industrialisation, employment generation, production, and trade of industrial products through the expansion of economic zones.

Rapid development often takes a toll on the natural environment. On the other hand, building climate resilience requires green growth throughout the country, including within industrial zones. This brings up the question of how to balance climate resilience and economic development to live and prosper in harmony with nature.

The most straightforward answer to the question above is 'tree planting.' Tree planting is a traditional and one of the most convenient ways to green a country, including its industrial or economic hubs. Since planted trees sequester CO_2 from the atmosphere, tree planting can help combat the climate crisis. Planted trees can also offer many benefits to society, including protection against cyclones, scorching heat, and land erosion. Furthermore,

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they can provide timber, fuel, fodder, and other livelihood needs for people, thereby increasing climate resilience.

However, technically, not all plants or forests are equally effective in carbon sequestration or enhancing climate resilience. For instance, while mangroves can store about three to four times more carbon than terrestrial forests of similar size, they do not grow everywhere. Additionally, balancing economic growth and climate resilience requires convincing industrial and financial bodies to participate in such tree-planting programs. Despite the theoretical plausibility of enhancing climate resilience through mangrove planting and the active participation of industrial and economic bodies, such efforts have been rare in Bangladesh.

The Mangrove Plantation for Climate Mitigation (MPCM) and Alternative Livelihood Project is a rare and novel initiative aimed at planting mangroves for climate mitigation and economic benefits for COVID-19 vulnerable communities. BRAC is implementing the project in partnership with HSBC and Bangladesh Economic Zones Authority (BEZA) at the Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN).

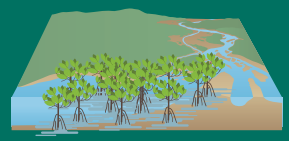
THE PROJECT

Launched	22 August 2021
Planting program was inaugurated	25 August 2021
The first phase of the project was completed	31 October 2022

Second phase of the project has been extended to plant mangroves on another **37.5** acres of adjacent land

PRIMARY GOAL

To build **15** acres of mangrove forest



Planting **40,000** mangrove saplings

(approximately)

Could offset around **492** tons of emitted greenhouse gases (GHGs)

MANGROVE PLANTATION FOR CLIMATE MITIGATION AND ALTERNATIVE LIVELIHOOD PROJECT

The primary goal of the project was to build 15 acres of mangrove forest by planting approximately 40,000 mangrove saplings in the allotted land at BSMSN, Mirsharai Upazila, Chattogram with the involvement of local communities. This plantation could offset around 492 tons of emitted greenhouse gases (GHGs) yearly and provide valuable ecosystem services and livelihood benefits to the climate-vulnerable people in and around the project area.

The planted mangroves will play a crucial role in reducing air pollutants, filtering river water, and trapping excess sediment before it reaches the ocean. The root system of the newly built mangrove forest will hold the soil tightly, protecting the coastal embankment and keeping the export processing zone safe from erosion hazards. Additionally, the canopy of planted mangroves will act as a storm barrier, shielding inland areas from cyclonic winds, flooding, and erosion by dissipating the energy of wind and waves. Mangrove vegetation can also serve as a breeding ground for marine fish and fisheries, leading to rich harvests and economic benefits for the local fishing community. Furthermore, as the site preparation, plantation raising, and maintenance activities will be carried out with the help of the local community, they will receive direct economic benefits through wage income.

The newly-built mangrove forest will enhance the overall environment and climate resilience of the people living in and around the BSMSN site. The project was launched on 22 August 2021, and the mangrove planting programme was inaugurated on 25 August 2021. The first phase of the project was completed on 31 October 2022 and based on the experience and learning from the first phase, the second phase of the project has been extended to plant mangroves on another 37.5 acres of adjacent land.

Photo: Nahid Morshed

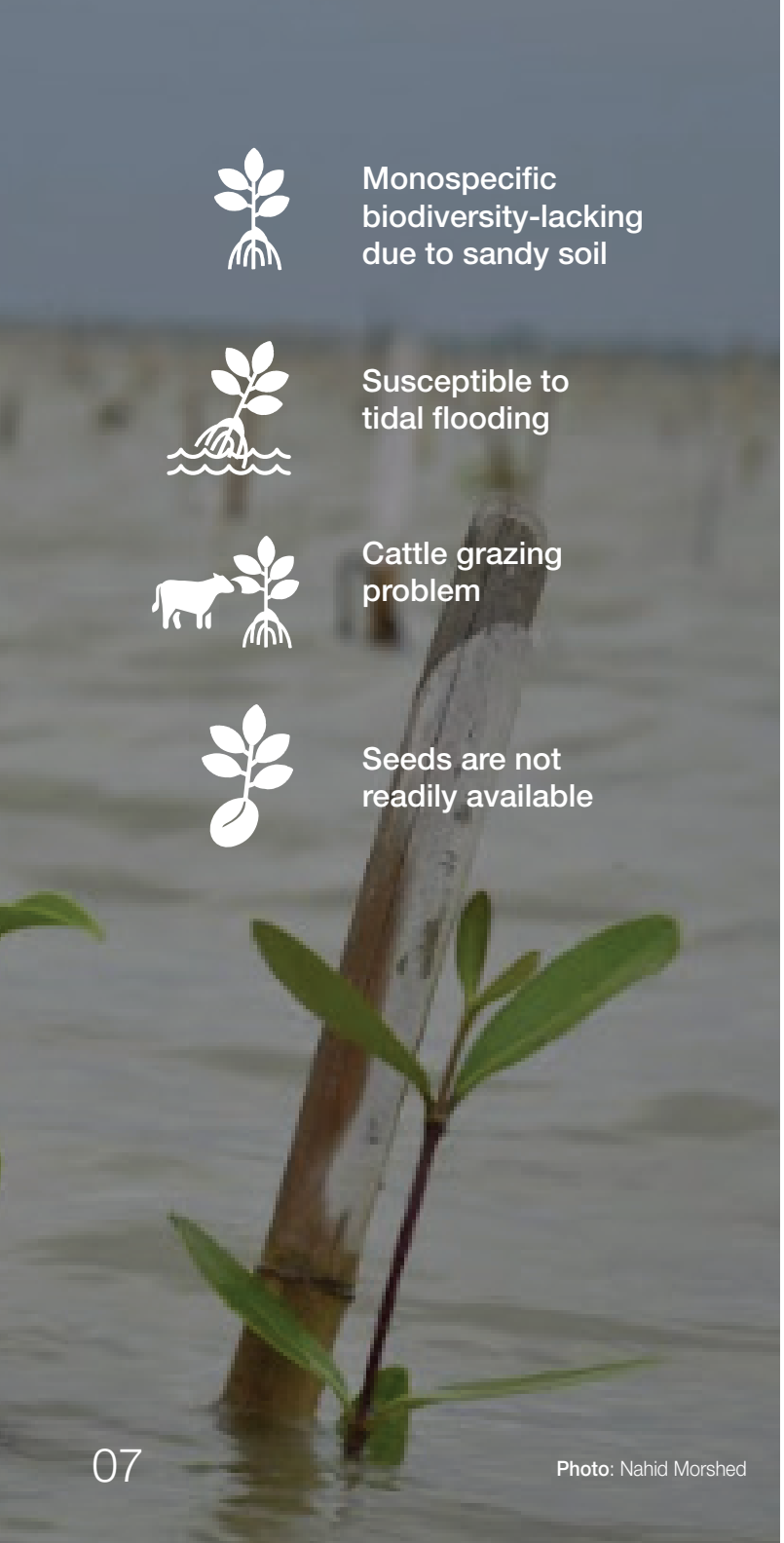


Photo: Nahid Morshed

KEY CHALLENGES
AND OUR APPROACHES TO TACKLING THEM

Before starting the planting program, the project had to overcome at least four significant technical and unique challenges:

- While the proposed planting site is newly accreted land, the soil is predominantly sandy. This soil type differs from the clay or sandy-clay soils in which mangroves typically thrive. Most mangrove planting projects in the country have focused on planting one or two pioneer mangrove species, resulting in monospecific plantations that are less conducive to biodiversity. These plantations often provide a limited number of ecosystem services compared to diverse multi-species natural mangroves. Furthermore, pioneer mangroves usually have low woody density, implying a lower degree of carbon sequestration potential than late-successional mangroves with high woody density. However, there is still a lack of frameworks to generate biologically diverse and climate-resilient mangrove forests.
- Regular tidal inundation is crucial for the development and growth of mangroves. However, in the project area, tidal inundation only occurs during the monsoon season, and not during the winter. This is due to the fact that the water level of the Feni River, the main river near the planting site, falls sharply during the winter months.
- As with many coastal areas, cattle grazing poses a significant problem for planting sites because the animals can eat or damage the newly planted seedlings.
- The availability of seeds or planting stock for mangroves is a significant challenge in raising mangrove plantations because mangrove seedlings are not readily available, and mangrove seeds cannot be stored for long periods as they lose viability quickly. Most importantly, unlike terrestrial species, raising mangrove seedlings in nurseries requires unique and specialised skills.

ACHIEVEMENTS TO DATE

Relevant stakeholders convinced of the project's merits

Because of the initial work and awareness-raising efforts, the BSMSN, BEZA, and the forest department were convinced of the importance of the project and have extended their full cooperation in relevant activities. For instance, the BSMSN has made an additional 2 acres of land available for mangrove planting, and the forest department has offered community members training to raise mangrove nurseries. BRAC and HSBC have welcomed these gestures and increased the spatial extent of the mangrove plantation area from 15 to 17 acres, with the number of mangrove saplings planted increasing from 40,000 to 52,000. Community-level discussions and school awareness programmes involving students and teachers of leading schools and colleges in Mirsharai Upazila also made local communities living in and around the project area aware of the project. A flipchart has also been created to educate community members, including students and women, about the importance of mangroves.

More CO_2 reduction is anticipated against a baseline of zero

Although the project's initial aim was to offset approximately 492 tons of CO_2 from the atmosphere, the project now intends to offset approximately 640 tons of CO_2. This increased CO_2 offsetting is possible due to the increased number of planted mangroves, with 52,000 saplings compared to the original 40,000. It is worth noting that this carbon accounting is based on the assumption that a mangrove tree, on average, can offset approximately 12 kg of CO_2. However, this carbon accounting is still a conservative estimate as it only focuses on the number of planted mangroves and disregards the additional carbon offset by naturally colonised species. In fact, our initial observations indicate that many mangrove and non-mangrove species are already colonising the project area, which may further increase CO_2 sequestration by the newly established mangrove forest. The sequestration assessment will be calculated when the sapling is four years old.

- Relevent stakeholder including the forest department were apprecated and extended their cooperation.
- Increased the spatial extent plantation area from 15 to 17 acres.
- The number of mangrove saplings planted increasing from 40,000 to 52,000.
- Students and teachers have involved in the awareness programmes.
- The project now intends to offset approximately from 492 to 640 tons of CO_2.

Photo: Nahid Mershed

Planted mangroves are now facilitating ecological succession and supporting biodiversity, including endangered species

Before the project intervention, the area was primarily a newly accreted sandy land without functional vegetative cover or noticeable biodiversity. However, through fencing, organic fertilisation, irrigation, and mangrove planting, the land has become suitable for plant growth and biodiversity. We have already recorded the natural colonisation of six non-planted mangrove species including Nona-Jhau (Tamarix troupii), Samudur labuni (Sesuvium portulacastrum), Suaeda maritima, Suaeda nudiflora, and Sagor lata (Ipomoea pes-caprae). Additionally, grasses like durba are growing first, and some other salt-tolerant herbs and shrubs are also colonising the area. The root systems, fallen leaves, and litter of planted and non-planted species are trapping sediments, resulting in an average silt layer of 3 cm. This is making the habitat complex and facilitates ecological succession.

Beyond plants, animals are also colonising the plantation area. For instance, the presence of four insect families (dragonflies, damselflies, leaf-rollers, and grasshoppers), two species of crabs (red crab

and marine swimming crab), one species of mudskipper, and six species of birds have been recorded within the plantation. The plantation site also serves as a habitat for migratory birds as it falls on the East Asian Australasian Flyway. Although a detailed survey is yet to be conducted, Pallas's fish eagle (Haliaeetus leucoryphus), Black kite (Milvus migrans), and Brahminy kite (Haliastur indus) have been spotted within the plantation, of which Pallas's fish eagle is an endangered species. The presence of a nearly threatened bird, the river lapwing, has also been noticed there. Additionally, mammals like jackals and mongoose have been observed at the plantation.

Several scientific papers have documented the presence of more than 100 fish species and the Ganges river dolphin (Platanista gangetica) in a nearby estuary. The fallen leaf litter from the mangrove plantation is likely to attract these species. In summary, the planted mangroves are now facilitating the ecological succession of plants and supporting biodiversity, including endangered species, thereby increasing the overall value of the ecosystem.

Photo: Nahid Morshed

Climate resilience and livelihood improvement of the local communities

The mangrove plantation is still young, with only one year since its establishment, and it will take about three years for a full tree canopy to develop. As such, it is too early to evaluate the protection values of these plantations in minimising the impact of cyclonic storms or coastal erosion. Nevertheless, we have already observed a positive impact on the land, with about three cm of siltation recorded on the planting site, which indicates the potential for land stabilisation mediated by the plantation.

From the perspective of community livelihood, approximately 560 person-days of wage labour engagement were generated during the first phase of the project. This is an important contribution to the community's livelihood, given that the COVID-19 pandemic hampered the local economy. Besides, some community members have mastered the art of raising mangrove nurseries, which will provide them with more opportunities, including jobs. Moreover, the government is now constructing a marine drive beside the mangrove plantation area. Therefore, mangrove-based tourism might generate income for the community in the future.

Bee cultivation in mangrove vegetation is a potential business for the Mirsarai coast since there is a wide number of flowering plants reported from the undergrowth of mangrove vegetation. Mangrove vegetation is a spawning ground for fisheries, and the fish population in nearby Feni River will be increased; as a result, a small industry of dried fish will be an emerging business in the area.

KEY LESSONS OF RAISING MANGROVE PLANTATIONS

Which species to plant?

Although keora is a widely preferred species for mangrove plantations, the choice of planting species should depend on the habitat and tidal inundation. For instance, both keora and passur seem to perform well in newly-accreted land where the habitat is clay or sandy-clay and tidal inundation is available year-round. By contrast, baen and gewa grow well near the water, especially on a sandy substrate.

What to plant?

Mangrove plantations can be established through seed, sapling, and vegetative cuttings. However, this project has taught us that a one-year-old sapling is the best bet. On the other hand, seeds can be sown or dibbled, with dibbling being the better option. Nevertheless, it is preferable to sow or dibble seeds between two high tides. For vegetative cuttings, however, hargoza (Acanthus ilicifolius) seems to perform well.

When to plant?

The early rainy season, especially after the first shower of the monsoon, is the best time for mangrove plantations. If planting is done during the late monsoon, there could be a water shortage, which would require external irrigation.

Site preparation?

Dhaincha (Sesbania bispinosa) seeds can be sown, or organic manures like cow dung can be applied to the land to improve the habitat and fertility.

Use of information technology?

Tidal information is vital for the mangrove plantation. Since tidal periods are not always available locally, introducing information technologies for offering weather and tidal information is crucial.

CONCLUSION

BRAC has created 17 acres of mangrove forest by facilitating the ecological succession process. The stability of an ecosystem is mostly dependent on the strength of the wider food chain that exists in the habitat. Nature-based solutions (NbS) can benefit both the community and the ecosystem in the current climate context. It is a process where a community can become resilient with the diversification of livelihoods in a sustainable habitat. In this age of rapid technological and industrial change, NbS is the handiest tool to deal with adverse environmental conditions. Country wide newly accreted lands are excellent sites to form new mangrove forests. With the experience gathered from mangrove plantation projects, BRAC can help in the formation of new mangrove forests that will create livelihood options and eco-tourism opportunities.

IN THIS AGE OF RAPID TECHNOLOGICAL AND INDUSTRIAL CHANGE, NATURE-BASED SOLUTIONS (NBS) IS THE HANDIEST TOOL TO DEAL WITH ADVERSE ENVIRONMENTAL CONDITIONS. COUNTRY WIDE NEWLY ACCRETED LANDS ARE EXCELLENT SITES TO FORM NEW MANGROVE FORESTS.

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