Mangroves Restoration in Coastal Karnataka

Planting completion report

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Introduction

Mangroves are plant communities occurring in the inter-tidal zones along the coasts of tropical and subtropical countries. They are highly productive ecosystems with rich biodiversity and valuable contributions to the economy and coastal protection. Mangroves provide a unique and critical habitat for various species, including fish, crustaceans, and birds. Mangroves act as a natural buffer against coastal erosion by stabilizing shorelines. Their root systems trap sediments, preventing soil erosion and protecting adjacent areas from storm surges. Mangroves can filter pollutants and improve water quality, offer opportunities for sustainable livelihoods, such as eco-tourism, traditional fishing, and aquaculture. Mangroves ecosystem account for highest value on 'per-hectare basis for any ecosystem (Costanza et al., 1997). These services are influenced by various environmental, biological, social, economic, cultural and political factors. Mangroves provide an extensive range of ecosystem services including carbon sequestration, nutrient cycling, water purification, provision of nursery habitats, coastal erosion control, moderations of extreme events and biodiversity reserves (Ruitenbeek 1994; UNEP-WCMC 2006; Naber et al 2008). They are breeding ground for various marine fauna and create habitat for bees and other insects and animals. They act as protective wall against strong winds and waves. They also provide food, medicine, fuels and construction materials to the local communities. Mangroves possess a higher efficiency to trap the carbon dioxide from the atmosphere up to four times more carbon than that of terrestrial forests and store them within their ecosystem which is often referred as "Blue carbon".

Conserving the world's forests represents the most cost-effective climate solution available today. As well, actions to protect, restore, and manage forests sustainably will contribute to inclusive growth, poverty eradication, achieving food security, and maintaining biodiversity, among many other environmental and development benefits. The west coast of Karnataka is a combination of fresh water and salt water ecosystem comprising of estuaries, mangroves, coral reefs and other wetlands. These are rich in microscopic plant life and diverse vegetation. This region supports fishery and plant products, water supply to urban and rural population, flood control, erosion buffering, wild life habitat, recreation and tourism. Further, mangroves help to filter out pollutants from being released into the sea – thus serving as a bio-filter. The combined vast natural resources of both sea and estuaries generate sustainable output worth millions of rupees. The UNEP ranks them as one of the most carbon-rich ecosystems on earth, due to their ability to store huge amounts of carbon (about 1,000 tons per hectare!) over thousands of years. Mangrove only account for less than 0.4% of the world's forests and less than 1% of the area

of tropical rainforests. Scientifically it is now well established that mangroves play a dominant role in reducing the impact of cyclones and tsunamis and thereby reduce human loss and damages to natural resources and property in the coastal areas. Restoration efforts can enhance biodiversity and support the recovery of endangered species.

The mangrove forests of Uttara Kannada district lie in between freshwater marshes of the Western Ghats and marine waters of the Arabian Sea. Uttar Kannada, a district along the central west coast of India is a combination of different set of landscapes. The region is one of the biodiversity hot spots and includes tropical forest of Western Ghats; productive coastal plain and five west flowing rivers. Region is blessed with five rivers which have an influence of rich tropical forests and on their bio-physical characters. All these estuaries have small catchment areas and yet they have significant contribution to economy of the region. The Uttara Kannada coast has over 132,000 families belonging to various communities whose livelihoods are tied up with the small-scale agriculture and fisheries. The district is one of the highest forested (about 80 % of the geographical area) and lowest population density districts in Karnataka. The district has a narrow coast with hills of Western Ghats almost touching the coast in many places. The district of Uttara Kannada, located along the western coast of India, is home to extensive mangrove ecosystems, particularly in the estuaries of rivers such as the Kali, Aghanashini, and Sharavathi. These mangroves are biologically diverse and play a vital role in sustaining the livelihoods of local fishing and agricultural communities.

The Aghanashini estuary, in particular, represents a well-functioning socio-ecological system where communities in this region rely heavily on mangroves for small-scale fisheries, aquaculture, and agriculture. Moreover, the intricate cultural traditions tied to these ecosystems underscore their importance beyond mere economic value.

With the support of Himalaya Wellness Company, the Snehakunja Trust (SKT) has implemented a mangrove plantation project aimed at the conservation and restoration of mangroves along the Aghanashini River during 2024 in Kumta region of Uttara Kannada district. The current report highlights the detailed processes and activities undertaken as part of this initiative, adhering to standard protocols for mangrove restoration.

Objectives

The main objectives of this project are to:

1. Conserve the biodiversity through restoration of Mangroves by planting 1 lakh saplings Kumta, Uttara Kannada and improving the Mangrove area.
2. To maintain an eco-friendly environment around the region and reduce global warming, air pollution, soil erosion and improve greenery. Mangroves to act as carbon sinks.
3. Increased benefits in terms of flood control, ground water recharge, coastal erosion control.
4. Hosting education & awareness programs on environment sustainability among the local community including carbon sinks, climate change mitigation and adaptation measures.

Approach

1. **Baseline surveys**: Initial assessments to identify degraded mangrove areas and understand local environmental conditions.
2. **Community engagement**: Active involvement of local communities through awareness workshops, nursery trainings and participatory planning.
3. **Nursery rising**: Mangrove species have been raised in the nursery to get optimum survival rates.
4. **Species selection**: Choosing native mangrove species suited to the specific ecological conditions of the Aghanashini estuary.
5. **Site preparation**: Clearing invasive species and preparing the area for planting while minimizing disturbances to existing biodiversity.
6. **Plantation activities**: Implementation of mangrove planting using scientifically backed techniques such as propagule planting and planting of nursery raised saplings.

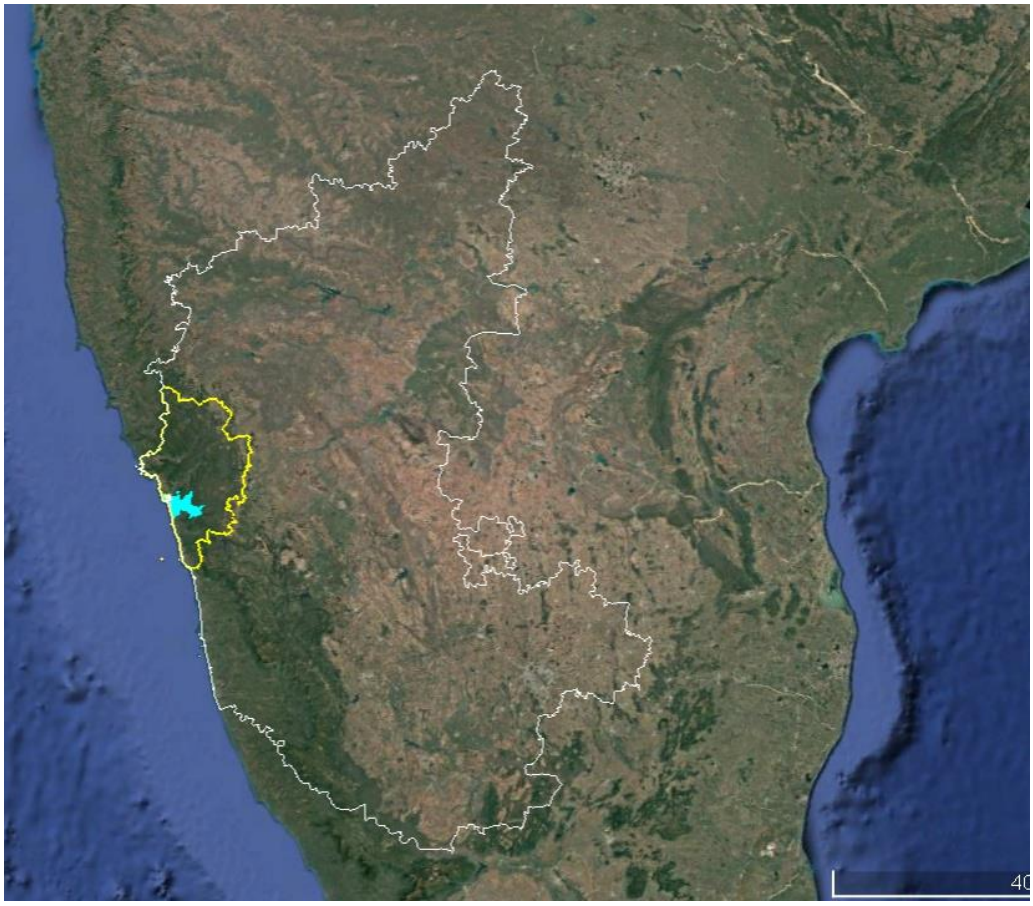

Fig. 1 Project site- Kumta, Uttara Kannada

Nursery raising

As part of the mangrove restoration efforts, a nursery has been established in Masuru where we raised 50,000 saplings (Table 1), encompassing six mangrove species. some of the rare and non-dominant or sparsely distributed species, such as *Bruguiera cylindrica* and *Rhizophora apiculata* were also raised in the nursery to ensure species diversity in the Aghanashini estuary.

The species raised in the nursery include:

1. *Avicennia officinalis*
2. *Rhizophora mucronata*
3. *Kandelia candel*
4. *Bruguiera cylindrica*
5. *Rhizophora apiculata*
6. *Sonneratia alba*

Nursery raising methods

Each mangrove species was propagated using techniques tailored to their ecological requirements to ensure optimal growth and survival rates:

1. ***Avicennia officinalis***: Seeds were collected during the fruiting season and pre-soaked in freshwater before planting in polybags filled with a mixture of estuarine soil and sand. The seedlings were kept in partially shaded areas until they developed strong root systems.
2. ***Rhizophora mucronata***: Propagules were directly collected from mother trees and planted in polybags. These were placed in standing water to simulate intertidal conditions, ensuring proper root and shoot growth.
3. ***Kandelia candel***: Propagules were planted in containers filled with a mixture of estuarine soil.
4. ***Bruguiera cylindrica***: Rarely available species hence the seeds were carefully germinated in freshwater before being transferred to polybags. These were placed in shaded nursery beds and watered regularly.
5. ***Rhizophora apiculata****:* Propagules were planted in a mixture of estuarine soil and sand in containers.
6. ***Sonneratia alba*****:** Seeds were soaked in water to encourage germination and planted in polybags. The seedlings were grown under controlled conditions with periodic inundation to simulate their natural environment.

Table 1: List of species raised in the nursery

Species	**No. of individuals**
Avicennia officinalis	40000
Rhizophora mucronata	3500
Kandelia candel	4500
Bruguiera cylindrica	500
Rhizophora apiculata	1000
Sonneratia alba	500

Fig. 2. Different stages of nursery

Fig. 3. Different stages of nursery

First phase of planting

The first phase of planting involved the procurement of 25,000 saplings from Vanasiri Farm and Nursery, comprising four species: *Avicennia officinalis*, *Avicennia marina*, *Rhizophora apiculata*, and *Kandelia candel*. In addition to these nursery-grown saplings, 25,000 viviparous seeds were planted, representing two species: *Rhizophora mucronata* and *Kandelia candel*.

The planting activities commenced in the first week of August and were carried out across three locations within the Aghanashini estuary: Kagalgunda, Mulligajani, and Musuru. Prior to planting, several critical environmental factors were considered, including salinity, land elevation, and tidal circulation. These parameters guided the selection of suitable species for each location, ensuring better survival and growth of the plants in their respective microhabitats.

Fig. 4. Planting of mangroves with community particpation in Masuru, Kumta. Uttara Kannada district

Second phase of planting

The second phase of planting began in the first week of November at the previously used locations, Kagalgunda and Musuru. During this phase, a total of six species were planted, each matched to its optimal ecological conditions.

Species from the Rhizophoraceae family, such as *Rhizophora mucronata* and *Rhizophora apiculata*, were planted in areas of low elevation, which are more prone to regular tidal inundation. In contrast, species from the *Avicennia* genus were distributed across low to mid-elevation zones. Among these, *Avicennia marina* was planted closer to the river mouth, as it thrives in highly saline environments, whereas *Avicennia officinalis* was planted in areas with relatively lower salinity levels.

This strategic approach to species selection and site matching aims to enhance the resilience of the plantation while contributing to the ecological restoration of the Aghanashini estuary.

Fig. 5. Planting in Muligajani

Fig. 6. Planting sites at Mulligajani and Kagalgunda

Fig. 7. Planting sites at Masuru

Table 2: Total planting details

Sl. No.	Place	Species	Total numbers planted
1.	Mulligajani	*Avicennia officinalis*	5250
2.	Mulligajani	*Avicennia marina*	520
3.	Mulligajani	*Rhizophora mucronata*	2150
4.	Mulligajani	*Rhizophora apiculata*	200
5.	Mulligajani	*Kandelia candel*	2000
6.	Kagalgunda	*Avicennia officinalis*	28850
7.	Kagalgunda	*Bruguiera cylindrica*	270
8.	Kagalgunda	*Rhizophora mucronata*	9950
9.	Kagalgunda	*Rhizophora apiculata*	1225
10.	Kagalgunda	*Kandelia candel*	5275
11.	Kagalgunda	*Sonneratia alba*	150
12.	Masuru	*Avicennia officinalis*	30350
13.	Masuru	*Rhizophora mucronata*	7300
14.	Masuru	*Kandelia candel*	5725
15.	Masuru	*Bruguiera cylindrica*	250
16.	Masuru	*Rhizophora apiculata*	325
17.	Masuru	*Sonneratia alba*	220
		Total	**100010**

Project outcomes

1. Increase in area of major carbon sinks - critical coastal habitats restored and their ecological productivity enhanced, reduced emission of CO_2 and other GHGs
2. Mangrove based livelihood improvement such as crabs, mullets, fish and shrimp
3. Increase in mangrove area and biodiversity conservation
4. Increased non-market economic benefits such as flood control, ground water recharge, coastal erosion control, etc.
5. Conservation awareness on climate change and carbon sinks, forests – mitigation and adaptation measures

Fig.8. Planted sites with sign board

Monitoring

The planted area has been already mapped using global positioning system (GPS). Using GIS technology area will be divided in to grids and representative sample plots will be permanently marked. Sampling pots will be of 10 meter X 10 meters size. Regular monitoring of survival rate and growth will be carried out using vernier caliper and measuring tape.

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