INDIA SUNDARBANS MANGROVE RESTORATION

Document Prepared By NEWS & UNIQUE forestry and land use

Project Title	India Sundarbans Mangrove Restoration
Version	1.0
Date of Issue	26-01-2015
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The A/R project activity of this grouped project is restoring mangrove ecosystems in the Indian Sundarbans contributing to climate change adaptation, biodiversity conservation and GHG emission reductions. The project proponent will implement the project together with local communities. In the first instance of this project, the project activities will be carried out over an area of 4,550 hectares. These project activities will involve:

1. Site and species selection considering the following criteria: i) evidence of stability or accretion, either from near shore bathymetry showing shallow slope, or through appearance of pioneering species; ii) suitable salinity conditions (normal range of 20–30 ppt); iii) daily tidal influences consistent with regional norms (approximately 4–6 meters)

2. Seed selection and raising seedlings and saplings in a tree nursery

3. Community planting (densities of around 5,000 trees per ha), maintenance and guarding of around 2,500 mangroves/ ha established. First 2–3 rows from the low tide level along the river bank will be planted with Avicennia and middle to the inner sides of the mudflat by Rhizophora and other viviparous species.

The Indian Sundarbans ecosystem consists of about 100 islands, half of which are inhabited and protected by a centuries old system of ring embankments extending some 3500 km in length. The degradation of the ecosystem has resulted in loss of mangrove cover, loss of productive fisheries and other species, and loss of important bioshield functions in which mangroves serve to dissipate wind and wave energy. Inhabitants are vulnerable to sea level rise, increasing storm intensity, and local manmade aquaculture practices that contribute to erosion of embankments in some parts of the system. Recent storms (notably Cyclone Aila in May 2009) resulted in 900 km of embankment breaches through the Sundarbans; this has left many parts of the rice-growing region infertile for up to 5 growing seasons and the area adjacent to the Bidya and Matla Estuaries is in a markedly depressed economic state.

This grouped project is a community initiative aiming to provide a new financing mechanism to overcome the current barriers to contribute positively to wetland restoration through mangrove afforestation in a multi-species environment and to allow communities to benefit voluntary carbon market. A key ecosystem restoration objective of the project is to re-establish the ecosystem functions relating to wave and wind erosion control to protect embankments, and to re-establish functioning ecosystems that can also enhance biodiversity. The socio-economic rationale for the project is to provide an economic stimulus in a depressed area, and to protect important livelihood functions for local communities. The ARR and restoration activities will provide greenhouse gas mitigation benefits and also important adaptation benefits in addressing climate change impacts. Such impacts include ongoing sea level rise and a probable increase in storm intensity.

The Nature Environment & Wildlife society (NEWS) is implementing the “Mangrove restoration project” in the Sundarbans represented by Mr. Biswajit Roy Chowdhury. NEWS has been

implementing the project on behalf of the French food and beverage company Danone, who is the developer of the project. In July 2011, Danone, together with Credit Agricole, Schneider Electric and CDC Climat, has decided to launch an innovative carbon investment fund, the Livelihoods Fund, which fundamental goal is to create social value for rural communities and contribute to their food security through the restoration of their ecosystems. The Livelihoods Fund provides investors access to biodiversity friendly carbon credits that aid the rural poor through large scale and social impact projects.

Danone agreed to transfer all its rights and obligations under the contract signed with NEWS to the Livelihoods Fund, under the terms and conditions in respect of these contracts which shall remain unchanged. As a result, the Livelihoods Fund replaces Danone as the project developer of "Mangrove restoration project". The Livelihoods Fund replaces Danone as project participant in any relevant project documentation and is fully committed to support the further development and implementation of the "Mangrove restoration project" as initially agreed and planned. NEWS agrees that it remains fully bound by the terms of the contract it has originally signed with Danone.

Assuming a conservative annual carbon sequestration rate of 10.0 tCO2/ha which considers above and below ground biomass, dead wood and soil organic carbon (SOC) the project will sequester 45,393 tCO2 per year. Based on this ex-ante estimation, the project will sequester around 907,861 tonnes of CO_2 over 20 years.

Total carbon offsets (20 years)	907,861 tCO_2-e
Annual carbon offsets (tCO_2/year)	45,393 tCO_2-e
Carbon sequestration rate (tCO_2/ha/year)	10.0 tCO_2-e

1.2 Sectoral Scope and Project Type

The activity implemented corresponds to the VCS sectoral scope 14: "Agriculture, Forestry and Other Land Use" as Afforestation, Reforestation and Revegetation (ARR) AFOLU project category. The project is a grouped project.

As indicated in section 3.1.11 of VCS AFOLU requirements, when soil organic carbon pool in project scenario is not deemed below *de minimis*, all ARR projects shall comply also the WRC requirements (Wetlands Restoration and Conservation). Soil Organic Carbon pool is an important part of the total amount of the carbon sequestration of this project, therefore this project will comply not only ARR requirements but also WRC. It is important to observe, though, that the present project do not consider GHG emissions reductions and therefore do not fall under the description of WRC project in section 4.2.19 of AFOLU requirements (version 3.4).

1.3 Project Proponent

Organization name	Livelihoods Fund
Contact person	Mr. Jean-Pierre Rennaud
Title	General manager
Address	15 rue de Helder; 75009; Paris; France
Telephone	+33 1 44 35 20 84
Email	jprennaud@livelihoods-venture.com

1.4 Other Entities Involved in the Project

Organization name	Nature Environment and Wildlife Society (NEWS)
Role in the project	Project development and implementation
Contact person	Ajanta Dey
Title	Joint Secretary and Project Director
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Telephone	+91 33 22234148
Email	ajanta@naturewildlife.org

Organization name	UNIQUE forestry and land use GmbH
Role in the project	Carbon project development support
Contact person	Matthias Seebauer
Title	AFOLU carbon project development expert
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Telephone	+49 7612085340
Email	Matthias.seebauer@unique-landuse.de

1.5 Project Start Date

The start data of the project activity is: 28-09-2010, when local communities and NEWS started plantation and management activities.

1.6 Project Crediting Period

Project crediting period: **28-09-2010 – 27-09-30**

Total numbers of years: **20 years renewable**

The actual grouped project longevity will be greater than the crediting period; this is because the project design does not include harvesting or thinning in the project scenario; use of mangroves timber is illegal in the Indian Sundarbans.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals (Pending)

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2011	-1,768
2012	1,676
2013	8,542
2014	18,188
2015	30,558
2016	35,783
2017	39,002
2018	42,488
2019	45,632
2020	49,246
2021	51,738
2022	54,789
2023	57,215
2024	60,081
2025	61,754
2026	65,968
2027	68,591
2028	70,827
2029	73,011
2030	74,538
Total estimated ERs	907,861
Total number of crediting years	20
Average annual ERs	45.393

Based on the Non-permanence Risk Assessment of this project, (pending) % buffer credits are to be deposited in the AFOLU pooled buffer account.

1.8 Description of the Project Activity

Mangrove restoration in the Sundarbans is undertaken by NEWS supported by Livelihoods Fund.Activities are implemented in the 5,400 sq km transition area of Sundarban Biosphere Reserve outside of the 4260 sq km protected area comprising the core and buffer zone.

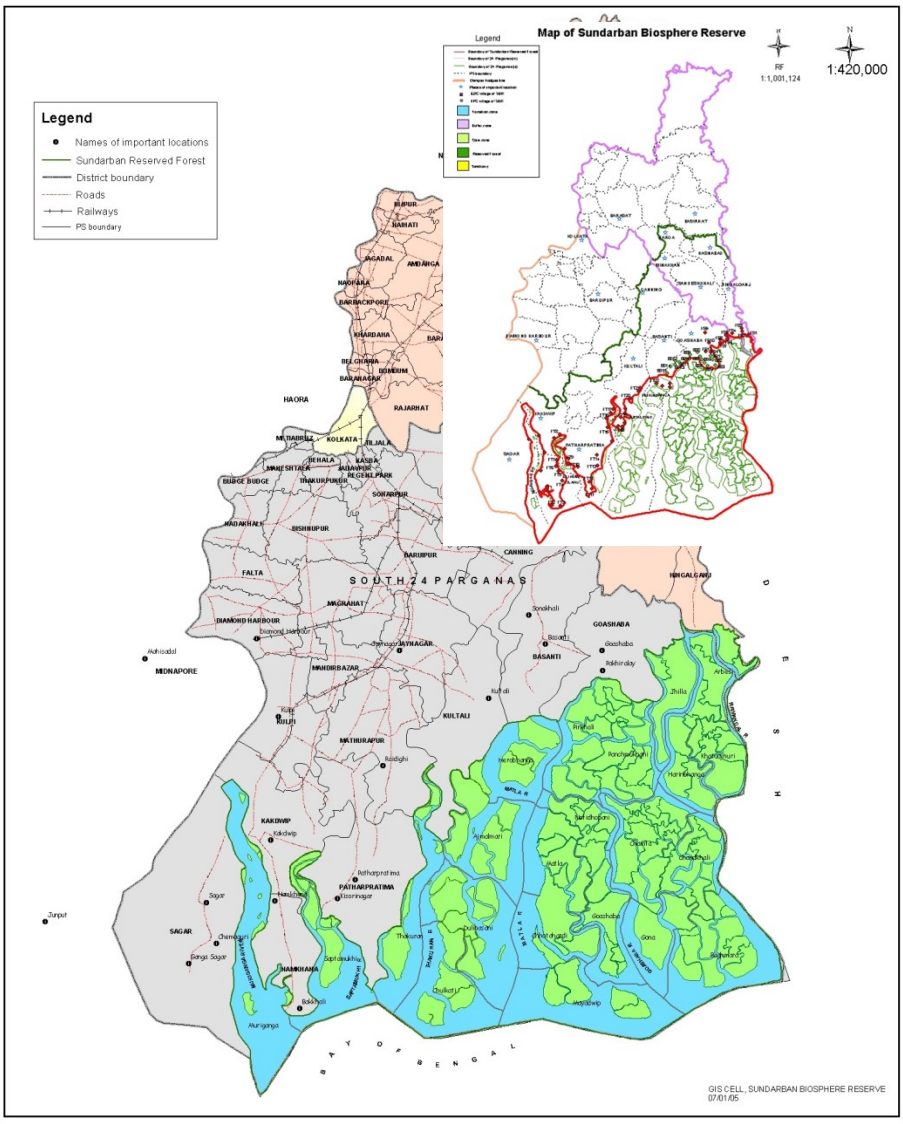
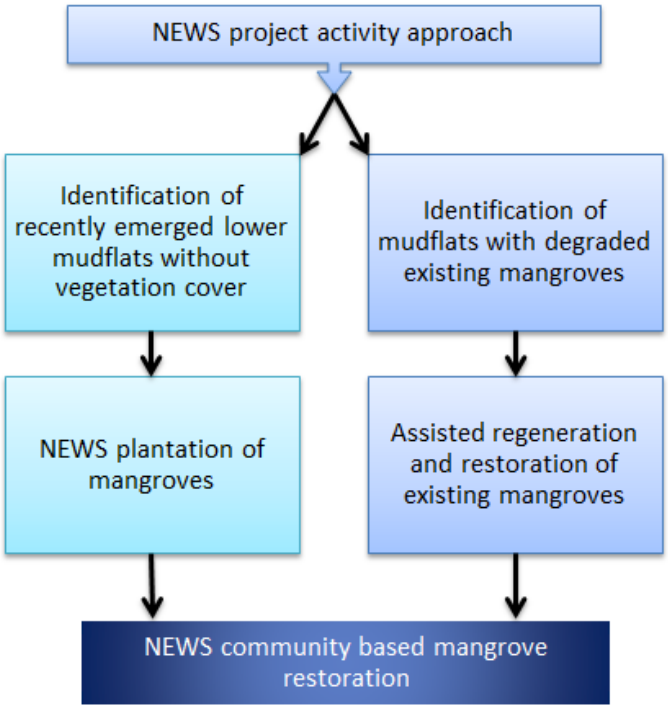


Figure 1 Sundarban Biosphere Reserve

This transition area is inhabited by around 4.5 million people, with densities higher than state and much higher than national average. The main drivers and incentives for NEWS towards mangrove restoration are expressed by high anthropogenic pressure in terms of grazing, illegal net-fishing on mudflats, prawn seed collection, and illegal fuel wood collection. The extension of non-forest land use into mangrove forest area is pronounced and reclamation of mangrove mudflat areas for illegal fishery encroachment is continuing. NEWS observed continuous impact on river banks by local fishermen and prawn seed collectors destroying mangroves, be it naturally natural regenerated or planted as part of community or other initiatives and the demand for small timber and fuelwood for local communities is putting high pressure on existing mangroves. Plantation activities by other initiatives and communities are done in the project area but they do not sustain due to above mentioned pressures.

Naturally, a dynamic hydrology is always changing the character of mudflats leading to the erosion and accretion patterns if the mudflats are not stabilized by sufficient and sustainable vegetation cover. Salinity is increasing due to reduction in the critical minimal supply of fresh water as a result of up-stream anthropogenic impacts such as the Farakka barrage, tectonic eastward tilt, delinking of creeks, pollution of main rivers with perennial fresh water sources due to industrial garbage dumping, sewage, as well as the impact of climate change.

The NEWS restoration approach includes two main activity areas:



When NEWS started project activities, it was evident that many mudflats are characterized by patches of degraded existing mangroves in upper mudflat regions and blank areas towards the lower mudflats. Therefore project activities were designed to assist the communities in restoring/

regenerating areas with existing mangroves and to establish new plantations on blank mudflat areas. The standardized NEWS community approach includes the following steps:

- Consultation and sensitization of communities, inquiry in meetings if communities support mangrove restoration
- On affirmation, discussion and agreements with Panchayats (community governance institution):
    - For getting permission to undertake the job in that village as also discussion made for group formation from the village people to implement the project
    - Explain the project, objectives, community orientation, benefits and understand community needs
    - Periodic meetings are held with the community to explain the project objectives, community orientation, benefits and understand community needs
    - The contracts are signed for execution of the process and transfer of carbon rights to the Livelihoods Fund
    - A person is appointed from the village to supervise the works undertaken
- Planning and organization of detailed restoration activities grouped into three types of initial conditions:
    1. natural scattered mangrove groves, mostly bare mudflats
    2. A fairly good layer of mangroves in the upper mudflat area and bare areas in the lower areas for NEWS plantation ,
    3. Community mangrove plantation with clear signs of degradation due to lack of maintenance and monitoring, empty patches emerged in between but lower mudflats getting stabilized more and more ready to receive propagules naturally.
- Permission of the mudflat area given by Land and Forest Protection Committee
- Meetings held with the Karmadhakshya of the concerned blocks to take permission for plantation in the land and maintaining it

- Examination of sites; analysis of local mangrove species abundance including natural propagules for species selection; assessment of site-specific tidal levels
- Area measurement by means of GPS to identify the potential NEWS areas
- Community meetings, awareness camps to organize seed collections, nursery preparations, and plantations as well as to appointing guards from the community for protection of mangroves

- Planning and implementation of protection and maintenance activities of the existing mangroves including controlling illegal felling and fishery encroachments; enrichment and corridor plantations to connect/ maintain the existing mangrove patches.

- Management of degradation drivers: illegal grazing - supporting communities to grow fodder grass in homesteads; planting 'Subabul' trees along the embankments of villages; fuelwood consumption - introduction of smokeless challah (cook stoves) in few villages to reduce fuelwood consumption and dependence on mangroves. Continuous awareness raising activities for mangrove protection - street plays, skits on mangrove protection with school children

- Continuous networking with all stakeholders concerned about mangrove protection: regular Panchayat meetings, Bon-o-Bhumi Raksha Committee meetings, meetings with policymakers at all administrative levels such as district magistrate, environment secretary, sub divisional officers, block development officers , sub divisional police officers to update and coordinate mangrove conservation activities in the Sundarbans

- Strong cooperation with National Green Tribunal , Eastern Zone to enforce and monitor regulations for protection and conservation and reduce the continued reclamation and change in landuse of the mudflats in Sundarbans

Detailed plantation activities include:

- Species selection is been done for two types of mangrove gropus: Viviparous group and Pseudoviviparous group. These are selected according to the nature of soil, tidal amplitude and salinity grades. The activities in the whole project area promote on-site biodiversity through introduction of multi-species planting models. Planted species selected by the NEWS are: Avicennia alba, A. marina, Bruguiera gymnorrhiza, B. cylindrical, Rhizophora apiculata, Sonneratia apetala, Ceriops decandra and Excoecaria agallocha; and very few Xylocarpus granatum. Equilibrium density of mature populations will typically vary from 1500 to 2000 plants per ha. The models proposed can be applied both to islands and mudflats along rivers and are normally Avicennia dominant (80–90%) with various other species.

- Plantation efforts in this project focus mainly on Avicennia alba (Black mangrove Avicennia) which thrives at lower substrate level and withstands 5 to 5½ hours of saline water submergence. Along the upper, more soil stabilized sites, Sonneratia apetala is planted. Both of these species have lateral roots with spongy pneumatophores. The baffle action of mangrove roots and trunks will substantially lower tidal currents and suspended sedimentary materials will be deposited while ramification of roots through the sediment will gradually bind and stabilize the substrate. The table below summarizes important parameters and ecological characteristics of the most important tree species NEWS is planting in this project[1]. The mean annual increment values are used for the ex-ante estimation.

[1] The table can be found in: Iftekhar et al. (2008). Vegetation dynamics in the Bangladesh Sundarbans mangroves: a review of forest inventories. Wetlands Ecol Manage (2008) 16:291–312.

Species	Salinity – soil (ppt.)	Salinity – water (ppt.)	Light requirement	Successional stage	Mean height (m)	% planted in project
Avicennia spp.	7-9	85	Strong light demanding	Pioneer	12-18	80%
Bruguiera spp.	8-11	37	Shade tolerant	Mid-seral	15	20%
Ceriops spp.	7-13	72	Shade tolerant	Mid-seral	3-5	
Excoecaria spp.	5-17	85	Modest light demanding	Mid-seral	12-15	
Sonneratia spp.	3-8	44	Strong light demanding	Pioneer	30	

Table 1 Important parameters for the Mangrove species selected

- Plantation sites are selection based on the following criteria:
    - Evidence of stability or accretion, either from near shore bathymetry showing shallow slope, or through appearance of pioneering species
    - Evidence of pioneer grasses or other species on plot or in adjacent areas
    - Suitable salinity conditions (normal range of 20–30 ppt.)
    - Daily tidal influences consistent with regional norms (approximately 4–6 meters)
    - Adequate local community participation to engage in a planting and 20 year maintenance/ monitoring scheme involving around 2500 saplings per hectare, generally with first 2–3 rows from the low tide level along the river bank with the species of Avicennia and middle to the inner sides of the mudflat by Rhizophora and other viviparous species

- Site selection is initiated by NEWS in response to community interest while working on other community-based livelihood activities in the Indian Sundarbans. Land rights are also subsequently confirmed by NEWS. Subsequent site selection was conducted through the due diligence review (DDR) undertaken for the Livelihoods Fund, IUCN and Ramsar Secretariat dated 5 July 2010. The review was undertaken by Dr Jack Ruitenbeek (Consultant to IUCN), Somenath Bhattacharyya (Senior Wetlands Advisor, Institute of Environmental Studies and Wetland Management, Kolkata), and Dr Lalit Banerjee (Mangrove Wetland Specialist, Joint Director (retired) Botanical Survey of India). The benchmark criteria used for the DDR included those established through the Climate Community and Biodiversity Alliance (CCBA), which included primarily a comprehensive assessment of community benefits and biodiversity benefits, including suitability of plantation sites according to physical attributes (soils, species, tidal conditions, salinity) and to the Ramsar Wise Use Principle.

- Land Preparation: No land preparation is generally required. Some areas may have abandoned residue from abandoned traditional fishing structures or lines; these remnants will be removed. No disturbance of substrate is done during preparation.

- Spacing and Plantation density: Plantation density is generally not less than 5000/ha (on an average ~1m x 2m spacing) for all open mudflats of wetland.

- Two methods of planting are used: (i) direct planting of seeds; and, (ii) planting of nursery-raised seedlings. Seed planting is done only for Avicennia Marina and Avicennia Alba species. Other seedlings Bruguiera gymnorrhiza, Rhizophora apiculata, Ceripos decandra including those of Avicennia Marina and Avicennia Alba species are raised in nurseries close to the site using local seeds; planting is done when the seedlings are adequately mature to withstand the natural conditions (usually up to four to five months.) All planting, monitoring and maintenance at the site is be done by local community members.

- Tending/ pruning & thinning: The process involves minimal thinning or pruning, and no harvest as it is illegal to harvest mangroves in West Bengal. A certain level of mortality is expected due to natural influences and competition; a target density of 2,500 surviving stems per hectare is expected.

- Replanting: Replanting will only occur in the event of unexpected high mortality rates that would result in final densities significantly less than 2,500 stems per hectare.

- Plant Protection: At time of plantation a protective barrier of more mature nursery-bred seedlings will create a protective shield in the lower tidal areas for the areas under direct planting.

- Seedlings are collected in bags from the waters as they come along in the months of August to October .Usually it varies from 3,500 to 4,000 seedlings per bag, out of which only 2300-2500 survive and are found suitable for plantation. Some are taken for nursery preparation by women

- Transfer of technical knowledge on mangrove restoration: Discussions are organized to transfer the knowledge of mangrove plantation to women groups; regular meetings in villages among the community to ensure the entire mechanism of plantation is standardized and understood; Methods and /or means undertaken during all these meetings are direct face to face discussions, sometimes phone discussions, audio visual projections, use of laptops, showing presentations on screen with vocal practical demonstration.

- The rates of payments for jute bag making, nursery saplings, plantation etc. are determined after necessary meetings with the village community

- The monitoring processes like protecting against human intervention, disease checks, mortality checks, survival and growth, intervening when and where necessary are discussed and implemented.

- Meetings are done repeatedly in presence of other Panchayat members and staffs to keep constant contact and to know about the actual situation prevailing in the village

Figure 2 Active participation of women in the villages

1.9 Project Location

The grouped project is located in West Bengal district, India, located in the South of Dampier Hodges line, between the following coordinates; latitude: 21° 30´ - 22°45´ N; longitude: 88°00´-89°05´ E. The project are outer boundary and the first instances are shown in the map below.

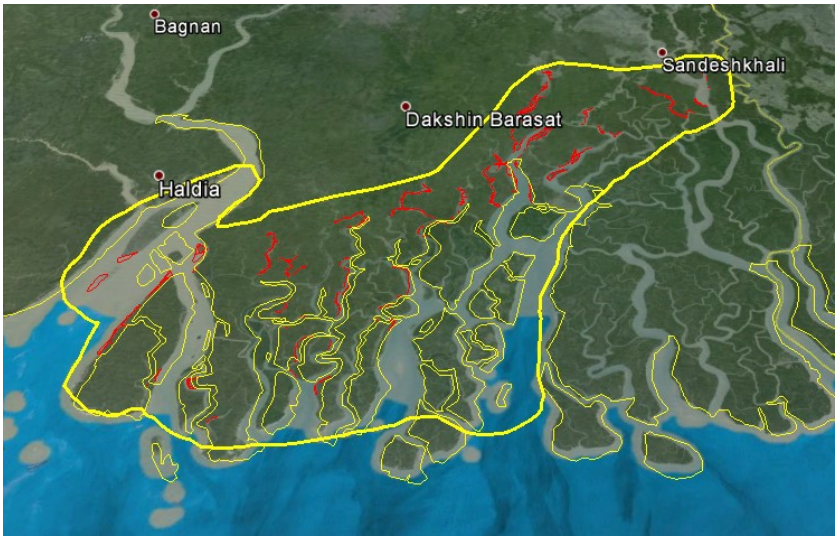


Figure 3 Outer NEWS project boundary in yellow with first instance activity projects in red

The first project instances will encompass around 362 plantation and restoration sites. The project area is divided into different zones to organize the activities and NEWS field coordination. The table summarizes the NEWS first activity instances for each zone.

Zone	No of plots	Total area (ha)	Average size (ha)
Bidya	36	219.87	5.1 (30.0-0.22)
Matla	130	1649.84	12.5 (237.8-0.06)
Raimongal	30	193.17	5.4 (37.38-0.27)
Sagar	37	1482.21	29.9 (336.56-1.14)
Saptamukhani	129	1005.15	9.3 (56.45-0.17)

The geographic locations and boundaries of each discrete project activity instance is determined using a GPS and are identified with a unique number and geographic coordinate. The Google Earth Map below is an example that shows a NEWS plantation area

Figure 4 Plot M 44

The details of each parcel of land are enclosed in the supporting documentation where the location of the planting sites in each village including detailed information for each planting plot is shown on Google Earth image (kml file) or shape file.

1.10 Conditions Prior to Project Initiation

The baseline scenario is the same as the conditions existing prior to the project initiation. This scenario is described in Section 2.4 (Baseline scenario). Environmental conditions of the project area are described here.

Climate:
The annual average rainfall of the Sundarbans is 1,600 mm with annual variations of 1,300 to 2,000 mm. Studies between 1990 and 2008 show that there has actually been an increase of rainfall over the Delta (WWF 2010). The annual mean (over a period of ten years: 2000-2009) min and max temperatures vary between 12°C and 28°C respectively.

Hydrology:
The area is inundated twice per day, during high tide. The salinity decreases along the coast from west towards east (and of course from the sea towards inland). The weather has a high seasonality, with around 80 percent of the annual rainfall occurring during monsoon (June-October) (Chowdhury 2010)[2].

Soils:
Regarding other geophysical parameters, all areas in the delta generally exhibit good site conditions for mangrove planting. Soils of the mudflats mainly consist of silt, sand and clay in different grades in different locations. Ambient salinity is consistently in the 20–25 ppt. range; highest recorded levels seldom exceed 30 ppt. while lowest levels after heavy monsoons may go as low as 12 ppt. for brief periods (Ruitenbeek 2010[3]). The native mangrove ecosystem tolerates these levels with the dominant species being Avicennia. The area shows an annual inter-tidal range of 6 meters, normally with two high tides daily. Various influences have caused most areas to be a mix of clay and sediment, with some areas also showing small quantities of sand. Some sites are dominated by clay, in which Rhizophora thrives and is often dominant.

Ecosystems:
The Sundarbans is a stretch of largely impenetrable mangrove forests lying at the southern tip of the Indian state of West Bengal, and stretching into southern Bangladesh. Extending about 350 kilometers along the Bay of Bengal from the Hooghly River estuary to the Meghna River estuary, the Sundarbans are a part of the world's largest delta formed by the rivers Ganges, Brahmaputra and Meghna. The whole tract stretches inland from the sea for almost 130 kilometers. Within this geographical area, forests cover nearly 10,000 sq. km interlinked by a complex network of tidal waterways with small islands of salt-tolerant mangrove forests, this area is most famous as the last surviving coastal habitat of the Royal Bengal Tiger. In the 4,267 sq. km that constitute forests within the Indian Sundarbans, 2,585 sq. km form the Sundarbans National Park, set up to preserve the globally dwindling population of the Tiger in its natural habitat. The area outside the National Park has been subject to human use for centuries, and mostly converted for agriculture. Close to 4.5 million people live in the Indian Sundarbans with about 85 percent subsisting on a single paddy crop (WWF 2010)[4]. Various non-timber forest products and plantations help generate considerable employment and income generation opportunities for at least half a million poor coastal population. Originally covering most of the coastal zone between the Hoogly and the Meghna Rivers, the area of the Sundarbans has been reduced to half over the last 200 years, due to clearance for agriculture (Chowdhury 2010)[5].

[2] http://www.crbom.org/SPS/Docs/SPS18-Sundarbans-1.pdf
[3] Due Diligence Review (Sundarbans) 5 July 2010
[4] http://assets.wwfindia.org/downloads/sundarbans_future_imperfect__climate_adaptation_report.pdf
[5] http://www.crbom.org/SPS/Docs/SPS18-Sundarbans-1.pdf

The frequency and intensity of extreme storm (cyclones) represents a large factor in many of the stories emerging from the Sundarbans. A study from 1990 to 2000 found that frequency of storms and cyclones were actually on the decline in the Bay of Bengal over the period from 1970 to 2000. However, the magnitude of cyclones had gone up. A later study (2000 to 2008) found that the trend of severe cyclones over the Bay of Bengal registered a 26% increase over last 120 years. The frequency and intensity of severe cyclonic storms increased in the Northern Bay of Bengal (WWF 2010).

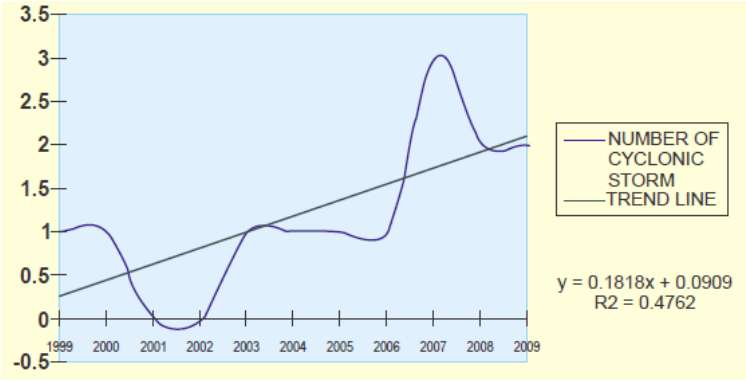


Figure 5 Frequency of cyclone storm over Northern Bay of Bengal (WWF 2010)

Rare and endangered species and their habitats:
The Sundarbans support an exceptional biodiversity with a wide range of flora and fauna including more than 27 mangrove species, 40 species of mammals, 35 species of reptiles, and 260 bird species (Giri et al 2007)[6]. The following description is from WWF (2011)[7]:

As home to a significant portion of one of the world's largest contiguous block of mangrove forests, the portion under natural vegetation in Indian Sundarbans Delta holds a prominent global place and a part of it has been designated as UNESCO World Heritage site in 1987 in recognition of its high biodiversity as well as the occurrence of endangered and highly threatened species, including the only population of tigers found in a coastal mangrove habitat. The most prominent feature of the Indian Sundarbans Delta is the ubiquitous mangrove ecosystem that dominates the landscape. The Indian Sundarbans Delta accounts for 85 per cent of all mangrove habitats found in India; 63 of the 69 mangrove plant species found in the country exist in the Indian Sundarbans Delta. More recent research suggests that the area may hold up to 140 mangrove, mangrove associates, back mangrove and coastal zone flora (Naskar, 2010). At least, seven of these mangrove species or species group are threatened and require immediate conservation measures, viz., Aegiceras corniculatum, Heritiera fomes, Kandelia kandel, Nypa fruticans, Rhizophora spp., S. apetala and S. caseolaris (Chaudhuri and Choudhury, 1994).

The table below is listing threatened or endangered fauna of the Indian Sundarbans Delta and its status based on IUCN.

[6] http://adsabs.harvard.edu/abs/2007ECSS...73...91G
[7] http://assets.wwfindia.org/downloads/indian_sundarbans_delta__a_vision.pdf

Groups/common name	Scientific name	IUCN Red List Status
REPTILES		
1. Leatherback Sea Turtle	*Dermochelys coriacea*	Critically Endangered
2. Hawksbill Sea Turtle	*Eretmochelys imbricata*	Critically Endangered
3. Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Vulnerable
4. River Terrapin	*Batagur baska*	Critically Endangered
5. Three-striped Roofed Turtle	*Batagur dhongoka*	Endangered
6. Red-crowned Roofed Turtle	*Batagur kachuga*	Critically Endangered
7. Spotted Pond Turtle	*Geoclemys hamiltonii*	Vulnerable
8. Crowned-River Turtle	*Hardella thurjii*	Vulnerable
9. Narrow-headed Softshell Turtle	*Chitra indica*	Endangered
10. Asian Giant Softshell Turtle	*Pelochelys cantorii*	Endangered
11. Indian Softshell Turtle	*Nilssonia gangetica*	Vulnerable
12. Indian Peacock Softshell Turtle	*Nilssonia hurum*	Vulnerable
13. Indian Rock Python	*Python morulus*	Near threatened
14. King Kobra	*Ophiophagus hannah*	Vulnerable
BIRDS		
1. White-rumped Vulture	*Gyps bengalensis*	Critically Endangered
2. Greater Adjutant Stork	*Leptoptilos dubius*	Endangered
3. Lesser Adjutant Stork	*Leptoptilos javanicus*	Vulnerable
4. Greater Spotted Eagle	*Aquila clanga*	Vulnerable
5. Darter	*Anhinga melanogaster*	Near Threatened
6. Black-headed Ibis	*Threskiornis melanocephalus*	Near Threatened
MAMMALS		
1. Royal Bengal Tiger	*Panthera tigris tigris*	Endangered
2. Fishing Cat	*Prionailurus viverrina*	Endangered
3. Gangetic Dolphin	*Platanista gangetica*	Endangered
4. Irrawaddy Dolphin	*Orcaella brevirostris*	Vulnerable
5. Finless Porpoise	*Neophocaena phocaenoides*	Vulnerable

Figure 6 Threatened or endangered fauna of the Indian Sundarbans Delta (WWF 2011)

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

To demonstrate that the mangrove restoration project activity are in compliance with all the applicable legal and regulatory requirements, the applicable Central and State Government laws and regulations which are implemented prior to 2010 are scrutinized.

The following are the list of such laws which are implemented.

- Indian Forest Act,1927 with West Bengal amendments,1981 & IFA-'27 1988
- National Forest Policy,1988
- The West Bengal Protected Forests Rules
- The Forest (Conservation) Act, 1980 with 1988 Amendments FCA-'80
- The Biological Diversity Act,2002 (Act No. 18 of 2003) Other Acts
- The Wildlife(Protection) Act 1972 and its Amendments with WL(P) Act Schedule

- The West Bengal Trees (Protection and Conservation in non-forest areas) Act, 2006

1.12 Ownership and Other Programs

1.12.1 Right of Use

Legal title to the land:
Ownership in the region essentially follows three general models. (i) state lands; (ii) private lands; and, (iii) abandoned private lands that are subsequently administered by local government authorities. State lands are typically under control of Forest Department if they are outside of the embankment system.

The abandoned private lands usually have arisen because of embankment retreat after storm damage has been incurred. The highest implementation risk exists on this category (abandoned lands) because landowners can legitimately lay claim to these areas generations after they have been abandoned; this has occurred in India in other circumstances. Private land ownership does not necessarily confer all entitlements to resources on the land (certain rights of expropriation still exist, for example). Some forest resources in India are covered by agreements involving a Joint Forest Management model developed in West Bengal. This “Arabari Model” governs forest use and eventual harvesting, but such models have not yet been applied within mangrove ecosystems. Recent legislation, which bans mangrove cutting, effectively removes the potential commercial value of a mature forest (although this does provide assurances of protection from illegal harvesting).

Under these circumstances, NEWS selected suitable planting areas which are owned by the government. The project area parcels are owned by the government and land use is defined by the Land and Forest Protection Committee (Bhumi Raksha Committee) and local Panchayats.

Rights of access to the sequestered carbon:
Distribution of all benefits resulting from the mangrove restoration carried through the Project for the beneficiary community. The communities have agreed that the plantation mangrove is carried out for the benefit of the local communities who have recognized the benefits generated out of such plantations, including mangroves as a bio-shield, increased biodiversity, to protect embankments against climate change consequences, increased productive activities like fishing, etc. and increased new income generating options, with the only exception being the carbon credits generated by Project.

The communities have agreed that the property rights on the carbon credits generated by this restoration are exclusively allocated to the proponent of the Project. Under this agreement, the beneficiary community is committed not to assert any property rights over the carbon credits generated and/or to be generated. The sharing of VCUs between project stakeholders is governed by a series of agreements that extend over all activities in Sundarbans. A copy of the community agreement is available as supporting documentation.

A Contract Transfer Agreement informs the local communities involved in this project of the shift from Danone to the Livelihoods Fund and of its effects. In that respect, this shift does not affect

the rights and obligations of the local communities arising from the above mentioned arrangements they agreed with NEWS for the purpose of implementing the project.

1.12.2 Emissions Trading Programs and Other Binding Limits

GHG removals generated by this project will not be used for compliance with binding limits to GHG emissions since such limits are not enforced in India. There are no emissions trading programs in place in the country

1.12.3 Other Forms of Environmental Credit

The grouped project is not being used to create other environmental credits

1.12.4 Participation under Other GHG Programs

This grouped project started validation process under A/R CDM and is listed as 'unvalidated' project on the UNFCCC website[8] since the validation was not completed. The project proponent decided to switch from the CDM process to the validation and verification process under the VCS.

1.12.5 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Grouped project requirements:
The eligibility criteria for inclusion of new project activity instances are demonstrated in accordance with the paragraph 3.4.9 of the VCS Standard (Version 3.4). Any new instance will meet the following criteria:

1) VCS: Meet the applicability conditions set out in the methodology applied to the project

All the new instances will accomplish the applicability conditions of the methodology AR-ACM0014: Afforestation and reforestation of degraded mangrove habitats, version 03.0. These conditions are described in the section 2.2 of this project description, to justify the inclusion of the first project instance areas.

2) VCS: Use the technologies or measures specified in the project description, and

3) VCS: Apply the technologies or measures in the same manner as specified in the project description

[8] http://cdm.unfccc.int/Projects/Validation/DB/U8PML4HH2RJCPDAV27DZRYOS6GKEB4/view.html

All new plantation areas included as new activity instances will be planted with native species mangrove trees in the same structure and with the same manner as specified in this project description (see section 1.8).

4) VCS: Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area

5) VCS: Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances

The baseline scenario and the demonstration of additionality are determined for the entirety of the geographic project area within which project activity instances are developed. The regional baseline scenario for all new project areas will be consistent with the baseline identified in section 2.4 where the tool *"Combined tool to identify the baseline scenario and demonstrate additionality in ARR CDM project activities"* has been applied. All new areas shall present similar barriers than the first instance project. As the whole project occurs inside the biosphere area of the Indian Sundarbans, all legal characteristics and protections of the areas are equal. The first project instances have been selected to be representative for the entire project region.

In addition this grouped project and the present project description refers to the following general requirements for Grouped projects as specified in the VCS Standard:

1) VCS: Occur within one of the designated geographic areas specified in the project description.

The new instances will be placed inside the outer boundary described above.

2) VCS: Comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial compliance with multiple sets of eligibility criteria is insufficient.

The new instances will fulfil all requirements described in this section of the project description.

3) VCS: Be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.

In future monitoring reports accuracy information about the technologies or measures applied as well as the geographic information of the new project areas will be included. All polygons will be geo-referenced and compiled in a GIS based database system.

VCS WRC project requirements:
VCS Wetlands Restoration and Conservation (WRC) project requirements shall also be met according to section 3.4.3 of VCS AFOLU requirements:

1) VCS: There is no hydrological connectivity to adjacent (non-project areas) or

2) VCS: It is not possible for hydrologically connected areas to have a negative impact on the hydrology within the project area that could cause a significant increase in GHG emissions, or

3) VCS: Where projects are hydrologically connected to adjacent areas that may have a negative impact on the hydrology within the project area, projects shall demonstrate that such impacts will not result in a significant increase in GHG emissions, as follows:

a) Peatland projects shall establish a buffer zone to ensure that potential negative impacts to the hydrology in the project area, such as causing the water table in the project area to drop or otherwise negatively impacting the hydrology, are mitigated. The buffer zone may be inside or outside the geographic boundary of the project area. Where it is outside of the project area, the buffer zone shall be adjacent to the project geographic boundary and binding water management agreements with land holders in the buffer zone shall be in place by the time of the first verification. The size and shape of the buffer zone shall be sufficient to avoid such negative impacts on the project area, which may be demonstrated through peer reviewed literature or expert judgment.

b) All other wetland projects shall establish a buffer zone as set out in Section 3.4.3(3)(a) above, or implement project activities or establish a mitigation plan to ensure that impacts to the hydrology (eg, interrupted water or sediment supply) do not result in a significant increase in GHG emissions. Emphasis shall be placed on hydrological connectivity that is immediately adjacent to the project area. Coastal wetlands shall consider hydrological connectivity originating from adjacent lands and shall follow the applied methodology with respect to oceanic impacts.

- Where a project activity to mitigate impacts from hydrological connectivity causes an increase in GHG emissions in the project area or buffer zone, such emissions shall be included in GHG accounting where above de minimis (as set out in Section 4.3.3)

Requirement 3.4.3. has been created specifically to avoid potential impacts on GHG emissions. This is not a project claiming for GHG emission reductions and is not a typical WRC project as described in section 4.2.19. (is not a RWE.a project restoring or managing water table depth, nor a REW.b project avoiding peat fires, and nor a CIW project).

As a mangrove ARR and restoration project in the Sundarbans scattered in a large number of smaller mudflats, there is a continuous connectivity with adjacent areas. Naturally, the dynamic hydrology of the world's largest river delta is always changing the characters and conditions of mudflats leading to the erosion and accretion patterns. The Ganges-Brahmaputra-Megha system is the second largest hydrological system after the Amazon covering 1.75 Mio sq. km with 644 Mio people and a surface run-off of 1.350 billion m3.

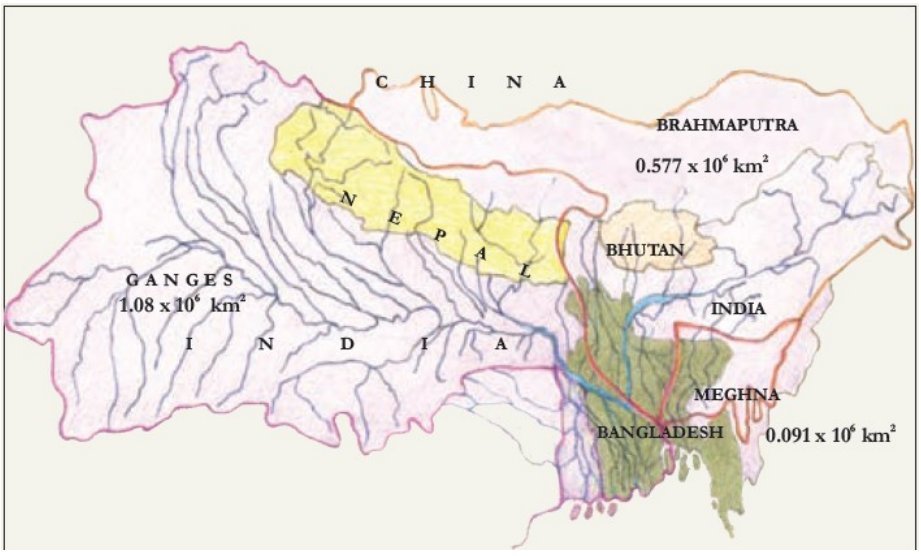


Figure 7 The Ganges-Brahmaputra-Megha system

As a result of large-scale hydrological changes the Indian Sundarbans has lost large areas due to erosion as well as new areas have emerged, see map below.

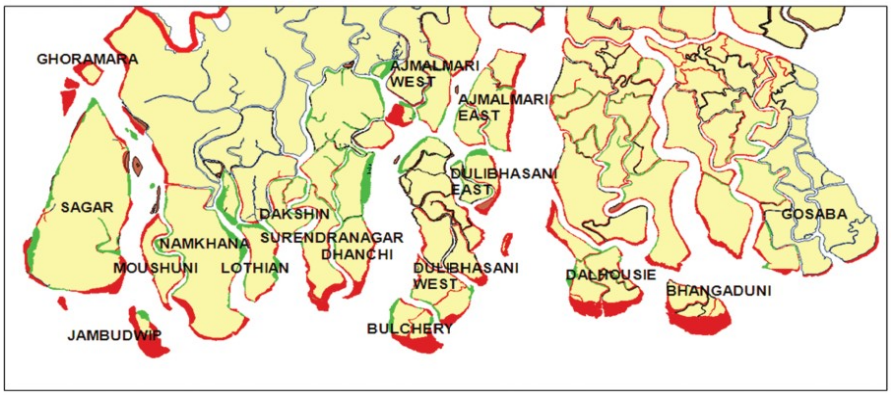


Figure 8 Zones of erosion and accretion in the Indian Sundarbans between 1969 and 2009 (WWF 2011)

As a result of up-stream anthropogenic impacts, salinity is increasing due to reduction in the critical minimal supply of fresh water such as the Farakka barrage, tectonic eastward tilt, delinking of creeks, pollution of main rivers with perennial fresh water sources due to industrial garbage dumping, sewage, as well as the impact of climate change. These baseline anthropogenic impacts heavily influenced the hydrology negatively within the Sunderbans and play an important role in the continuous degradation of the natural mangrove ecosystems.

Against this background, the scattered nature of small-sized NEWS project parcels it is not expected to have significant changes on GHG emissions due to potential impacts in hydrology and potential impacts will not contribute to the draining of flooded areas or to the flooding of drained areas. However, as a result of the general (baseline) large scale hydrological changes the only hypothetical impact would be the decrease in stocks in carbon pools due to an increase

of tree mortality, for instance if erosion at a particular NEWS sites causes loss of planted mangrove biomass. Nevertheless, the wide distribution of NEWS plantation parcels is mitigating a significant loss and significant increase on GHG emissions in relation to those expected in the baseline.

Leakage Management

VCS AFOLU 3.6.1 indicates that "Activities to mitigate ecological leakage in WRC projects may include the establishment of a leakage management zone inside the project boundary" and section 3.4 considers ecological leakage in WRC projects as: "Ecological leakage occurs in WRC projects where a project activity causes changes in GHG emissions or fluxes of GHG emissions from ecosystems that are hydrologically connected to the project area".

Additional information about leakage is provided in the relevant sections.

Commercially Sensitive Information

None.

Further Information

Additional information is provided in the relevant sections and as supporting documentation

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (Version 3.0[9]).

ARR methodological tools:

- "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)
- "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)
- "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.0)
- "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1)

[9] https://cdm.unfccc.int/filestorage/8/A/E/8AE9TYMDSZJP762KF3CL0NWR5HBIUV/EB75_repan29_AR-AM0014_ver03.0.pdf?t=MFJ8bmRxdnk3fDCqH8AUJgFID5LIQ4LTGzg6

- "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)

Other methodological ARR CDM tools which are applied include,

- Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in ARR CDM project activities (Version 01.0.0)

- Calculation of the number of sample plots for measurements within ARR CDM project activities (Version 2.1.0)

2.2 Applicability of Methodology

Applicability conditions of the methodology AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (Version 03.0)

a) The land subject to the project activity is degraded mangrove habitat

The selected approved afforestation and reforestation baseline and monitoring methodology AR-AM0014 "Afforestation and reforestation of degraded mangrove habitats"(Version 03.0) defines degraded mangrove habitat" means wetlands[10] where, in their natural state, mangrove vegetation can grow and have soil or sediment that is usually water-logged with water that is saline or brackish, and that were subjected to impacts resulting in decrease of forest cover below that reported by the host Party to the CDM Executive Board according to paragraph 8 of annex to Decision 5/CMP.1 (A/R CDM modalities and procedures).

According to the 2003 IPCC GPG LULUCF guidance wetland category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. The mudflats which will be planted or restored with mangroves are all inundated twice per day, during high tide and are all influenced by ambient salinity which is consistently in the 20–25 ppt range; therefore all areas fall under the wetland category.

The planting areas of this A/R project activity are emerged mudflats which were created by the local system dynamics and are locally called "char", which are basically located along embankments. Overall, there has been a decline in mangrove forests in the Indian Sundarbans (see figure 8).

[10] "Wetlands" as defined in "Annex A: Glossary" of the IPCC GPG LULUCF 2003. http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Glossary_Acronyms_BasicInfo/Glossary.pdf

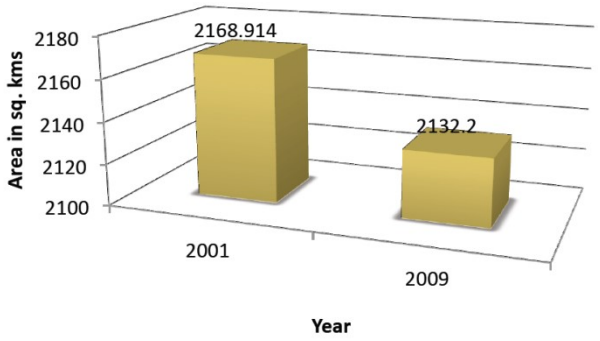


Figure 9 Total Forest Cover Changes in the Indian Sundarbans (World Bank 2012)

The degradation of the Indian Sundarban System as a whole including the mangroves and their associated ecosystems is connected with a number of factors, some of which are related to population pressure and others to physical processes and characteristics. These impacts have resulted in a decrease of forest cover and, more importantly, will prohibit natural regeneration of the project areas above the forest definition of India.

Population pressures: [11]

Population in this area approaches 2.5 million and has increased by approximately 2% annually over the past decade (preliminary analysis of Census India 2011 as documented previously); population densities in some census blocks approach 2000/ km^2, which is about double the State average density. In some Sundarban blocks as much as 50% of the local population relies on fishing[12] as a livelihood within the creeks and channels of the inhabited areas. Pressures on the "free" natural resource base are exacerbated because inhabitants are among the poorest in the region (34% of the inhabitants within the Sundarbans Delta are below the poverty level compared to 24% in adjacent blocks outside the delta.) The access by boats and small livestock on mudflats provides a constant threat to existing vegetation or to natural establishment of pioneer mangrove species and saltmarsh grasses because of this disturbance; traditional prawn harvesting on these mudflats also creates a persistent disturbance[13] and, even though wood-cutting from mangrove is banned, the practice continues. Recent studies by the School of Oceanographic Studies, Jadavpur University[14], examining existing data and satellite maps of forested areas of the Indian Sundarbans Delta estimate that there has been a 5 percent loss of cover in the 20 years between 1989 and 2009; there is a strong correlation with population pressure and poverty incidence.

Natural Regeneration Failure due to hazard impacts in partially degraded areas:

[11] Unless otherwise noted values are cited from WWF 15 March 2011, India Sundarbans Delta: A Vision, [Notably Chapter 4 on Impacts].
[12] District Statistical Handbook (South 24-Parganas; North 24-Parganas), Bureau of Applied Economics and Statistics, Government of West Bengal, 2006.
[13] Declining fish catch per effort is a corollary to the degradation that is linked to the extraction of near shore biological resources at unsustainable levels (Fisheries Department, Government of West Bengal, 2008). A number of harvesting practices such as ring seining, mini-trawling and purse seining are known for their decimating impacts on the juvenile populations.
[14] Hazra S, 2010. Temporal change detection (2001-2008) of the Sundarban. Unpublished report. WWF-India, Kolkata (cited in India Sundarbans Delta: A Vision.)

The same Hazra (2010) study has found that over the period 1989-2009 often degraded forest is being replaced by saline blanks, further reducing forest cover. The creation of saline blanks is largely attributed to sporadic inundation of the upper reaches of the island during high tide and storm surges and subsequent drying.

Propagule Poor Areas:

In regions far from the forest zone, the availability of wild seeds or propagules through natural transport tidal mechanisms has decreased because of the large distances to the natural forest and source of propagules. For example, current mangrove restoration in the Canning town area in the upper Matla estuary is approximately 35 km from the forest zone and is only possible through introduction of nursery raised saplings. In addition, the rising salinity levels in the Indian Sundarbans due in part to sea level rise as well as reductions in fresh-water flows to the delta inhibit the natural establishment of mangroves. Based on the salinity levels, the seeds have the capacity to survive in the saline waters at minimum of ten days and maximum of 120 days. Based on field observation by NEWS the mortality of directly seeded mangrove propagules is as high as 50% compared to the planting of saplings raised in nurseries which reach survival rates of 65-75%.

Figure 10 Women of the villages are collecting seeds for nursery preparation

In the following the location of seed collection for each of the four different planting zones in the project is described:

- Bidya-Raimongol area: The areas which are close to the forest reserve like Bali/Amlamethi, the seeds are available in sufficient numbers esp. Avicennia, Bruguiera. However, areas in the upper parts of the Basanti block and areas in North 24 Parganas like Dulduli and Amtoli the seed drift with the tidal waves is weak being too far from the forest.

- Matla area: In the upper reaches, (Canning block) mostly Avicennia seeds are found. However, from the middle part of Matla river (Basanti block), Bruguiera are also found,

and towards the last reaches (Kultali block) almost all species seeds are found because of its proximity to the biosphere reserve forests.

- Saptamukhani-Thakuran area: The diversity of seeds is sufficient here being close to the biosphere reserve forest.

- Sagar island area: Only Avicennia can be found, and almost all seeds have to be collected and brought here from other parts of Sundarbans.

The above factors are relevant to differing degrees at different sites but at least one (if not all) has normally contributed to on-going degradation and will continue to be a factor in areas that are not actively managed through techniques being used in this project.

b) More than 90 per cent of the project area is planted with mangrove species. If more than 10 per cent of the project area is planted with non-mangrove species then the project activity does not lead to alteration of hydrology of the project area and hydrology of connected up-gradient and down-gradient wetland area;

100% of the project area is planted with site specific, multi-species mangrove communities which is in line with the best practice option of the methodology where the potential mangrove community in the project area is multi-species and/or zoned, planting should, as far as possible, be designed to re-establish the multi-species composition and/or zonation, taking into account the ecological requirements of each species concerned.

Project activities will not lead to any changes in hydrology of land subjected to afforestation. The only project activity/measure is planting. Therefore, there will be no flooding, digging, drainage, ditch blocking or any other direct activity involving the alteration of the hydrology.

c) Soil disturbance attributable to the A/R clean development mechanism (CDM) project activity does not cover more than 10 per cent of area.

There will not be any aerial site preparation in this afforestation project activity; for example planting Avicennia saplings (uprooted from nature or bag raised), it is necessary to scoop the soil up to 5 cm depth and then plant the saplings. Small and thin propagules of Avicennia are liable to be disturbed and washed away from the planting site. Therefore some supporting care is taken. The best way of planting Avicennia is to select mature seeds and bury them at 2.5–5 cm depth in the mud; these will sprout and develop into good saplings. Less than 10% of the total surface project area will be disturbed.

Applicability conditions of the tool: "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)

a) Forestation of the land[15] within the proposed project boundary performed with or without being registered as the ARR CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.

This grouped project is in compliance with applicable legal and regulatory requirements as outlined in section 1.11.

b) This tool is not applicable to small - scale afforestation and reforestation project activities.

"Small-scale afforestation and reforestation project activities under the CDM" are those that are expected to result in net anthropogenic greenhouse gas removals by sinks of less than 16 kilotonnes of CO2 per year and are developed or implemented by low-income communities and individuals as determined by the host Party (9/CMP.3).

This grouped project will generate more than 16 kilotonnes of CO_2 per year, so it is not a small-scale afforestation and reforestation project.

Applicability conditions of the tool: "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)

a) *The tool is applicable to all occurrence of fire within the project boundary.*

b) *Non-CO2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.*

Burning biomass is completely forbidden in the project area; therefore this tool does not apply.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.0)

This tool has no internal applicability conditions.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1)

This tool has no internal applicability conditions.

[15] In the context of this tool, forestation is used for the identification of possible land use scenarios that go beyond afforestation and reforestation as defined in the Marrakech Accords and includes the any establishment of forest through natural or artificial means.

Applicability conditions of the tool: "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)

a) *This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.*

This project occurs in a protected area where no agricultural activities are allowed. The project will not apply any activity that implies any drainage of wetlands or peat lands directly or indirectly. The project parcels are degraded mangrove mudflats or newly emerged mudflats with which are not used for any agricultural activities.

Applicability conditions of the tool: "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" (Version 01.0.0)

This tool has no internal applicability conditions

Applicability conditions of the tool: "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 2.1.0)

This tool has no internal applicability conditions

2.3 Project Boundary

The project boundaries of the first project activity instances are described in section1.9. Kml files and shape files of all project parcels are available.

Selection of carbon pools and greenhouse gases accounted

Carbon pool	Whether selected	Justification/Explanation
Above-ground biomass	Yes	This is the major carbon pool subjected to project activity
Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity
Dead wood	Yes	Carbon stock in these pools may increase due to implementation of the project activity
Litter	No	Litter biomass is subjected to high turnover and displacement due to tidal currents. It is a conservative choice to exclude the pool from accounting because the project activity will not decrease the rate of accumulation of litter.
Soil organic carbon	Yes	Carbon stock in these pools may increase due to implementation of the project activity

Table 2 Carbon pools selected for GHG net emissions reductions in the baseline and project

Sources	Gas	Whether Selected	Justification/Explanation
Burning of woody biomass	CO_2	No	CO_2 emissions due to burning of biomass are accounted as a change in carbon stock
	CH_4	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology
	N_2O	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology

Table 3 Project emissions sources accounted

The map below shows the project parcels of the first project instances. A full project inventory of all parcels is available as supporting documentation.

2.4 Baseline Scenario

To identify the baseline scenario and demonstrate additionality of this project activity the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) is applied.

Applicability

The afforestation project does not lead to violation of any applicable law even if the law is not enforced. This is evidenced by the Letter of Approval provided by Host Country (in process).

Procedure

STEP 0. Preliminary screening based on the starting date of the A/R activity

A contractual agreement between NEWS and the Livelihoods Fund became effective in July 2010. As part of this agreement Livelihoods is funding the planting and maintenance of the mangrove restoration activity. In return, the Fund is entitled to all CERs and VERs relating to the reduction in greenhouse gas emissions generated by the A/R activity. Therefore, the incentive from the planned sale of CERs (partly as up-front funding) was seriously considered in the decision to proceed with the project activity. The project start date marks the starting point of mangrove afforestation and restoration activities in the field.

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a. Identification of alternative land use scenarios to the proposed project activity

The following alternatives to the project activity will be evaluated:

1. Continuation of the pre-project land use
2. Natural mangrove regeneration of the land within the project boundary
3. Mangrove afforestation of the land within the project boundary performed without being registered as Livelihoods VCS grouped project activity

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

To demonstrate that identified alternatives to the project activity are in compliance with all the applicable legal and regulatory requirements, the applicable Central and State Government laws and regulations which are implemented prior to 2010 are scrutinized.

The following are the list of such laws which are implemented prior to 2010.

- Indian Forest Act,1927 with West Bengal amendments,1981 & IFA-'27 1988
- National Forest Policy,1988
- The West Bengal Protected Forests Rules
- The Forest (Conservation) Act, 1980 with 1988 Amendments FCA-'80
- The Biological Diversity Act,2002 (Act No. 18 of 2003) Other Acts
- The Wildlife(Protection) Act 1972 and its Amendments with WL(P) Act Schedule
- The West Bengal Trees (Protection and Conservation in non-forest areas) Act, 2006

All the above policies are taken into consideration while evaluating the alternatives to the project activity and the following alternatives listed are in compliance with the applicable laws and regulations.

STEP 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

The barriers included are:

- Investment barriers, other than insufficient financial returns
- Institutional barriers,

- Technological barriers;
- Barriers related to local tradition;
- Barriers due to prevailing practice;
- Barriers due to local ecological conditions,
- Barriers due to social conditions and
- Barriers relating to land tenure, ownership, inheritance, and property rights.

The table below displays the barrier analysis matrix which identifies alternatives and barriers. A more complete discussion of the barriers follows

Table 4 Barrier analysis matrix

Alternative land use scenarios	Investment	Institutional	Technological	Local tradition	Prevailing practice	Ecological conditions	Social conditions	Land tenure
Continuation of the pre-project land use								
Natural mangrove regeneration of the land within the project boundary						X		
Mangrove afforestation of the land within the project boundary performed without being registered as Livelihoods VCS grouped project activity	X	X	X					

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers

Scenario 1: Continuation of the pre-project land use

The land-use and management prior to the implementation of the project activity has no barriers to implementation. All project areas are classified as mudflats - shoals that are simply salt marches with no or some existing shrubby biomass vegetation.

Due to the high population densities of up to 2000/km^2, and the high dependency on fishing and prawn seed collection (as much as 50% of the local population) within the creeks and channels of the inhabited areas the pressures on the "free" natural resource base are exacerbated.

Scenario 2: Natural mangrove regeneration of the land within the project boundary

Natural regeneration failure due to hazard impacts in partially degraded areas. A study by Hazra (2010)[16] study has found that over the period 1989-2009 often degraded forest is being replaced by saline blanks, further reducing forest cover. The creation of saline blanks is largely attributed to sporadic inundation of the upper reaches of the island during high tide and storm surges and subsequent drying. Further, in regions far from the forest zone, the availability of wild seeds and propagules through natural transport tidal mechanisms has decreased because of the large distances to the natural forest and source of propagules.

The access by boats and small livestock on mudflats provides a constant threat to existing vegetation or to natural establishment of pioneer mangrove species and saltmarsh grasses because of this disturbance; traditional prawn harvesting on these mudflats also creates a persistent disturbance and, even though wood-cutting from mangrove is banned, the practice continues.

Scenario 3: Mangrove afforestation of the land within the project boundary performed without being registered as Livelihoods VCS grouped project activity

Institutional Barriers:

This project activity is a first attempt in the region to include the communities in mangrove plantations and to institutionalize this engagement. Hitherto, all work of restoration was done by the Forest Department with the people having little stake in its activities apart from wage income. Therefore, at the beginning, the absorptive capacity of local villages to conduct this activity has been identified as a barrier in the project areas. The model that NEWS is proposing in this project is essentially based on using self-help groups (SHGs) to expand into afforestation. NEWS gets communities together to plant and manage the mangrove cover in their sites. Much of the institutional barrier is an inability for community level organizations (such as self-help groups at the village) to interact meaningfully with state level organizations on issues such as large scale mangrove plantation. The technology is not difficult (but not used systematically either by state or community level associations) and prevailing practice (monocrop without community participation at limited scales often with replanting on the same site) excludes community interests. Institutional barriers are primarily related to a lack of transparent government capacity to engage with stakeholders. The lack of capacity has been documented in recent World Bank assessments, which generally identify inadequate training, inadequate intergovernmental coordination, and inadequate budgetary resources for the weakness on the government institutional side[17].

[16] Hazra S, 2010. Temporal change detection (2001-2008) of the Sundarban. Unpublished report. WWF-India, Kolkata (cited in India Sundarbans Delta: A Vision.)

[17] World Bank 2011 (forthcoming). Building Resilience for Sustainable Development of the Sundarbans through Estuary management, poverty reduction, and biodiversity conservation; Draft Final Report

Investment barriers, other than economic/financial barriers:

The basic rational behind the project is twofold: wetland restoration of degraded wetlands and to provide an economic stimulus in a depressed area and to protect important livelihood functions for local communities. However, the benefits are of indirect or long-term nature, no direct incomes are expected from the forest, and no thinning and harvesting activities are expected; therefore, no timber production is projected (recent legislation in India bans the cutting of mangrove trees for most purposes).

There is neither credit nor credit funding for non-profitable activities. The reforestation is possible because of the benefits that the project provides to the Livelihoods Fund. The project is developed and implemented by NEWS and local communities. NEWS has demonstrated capacity in environment conservation awareness and in mobilizing local people but needs funding to finance such activities. Local communities do not have the capacity for implementing the project without the support of NEWS. While some private funds are available from wealthier individuals for community projects, at this stage such funds are more typically being directed to investments that directly generate income or that provide “hard” infrastructure such as cyclone shelters; soft investments such as mangrove bioshields are not within the scope of such initiatives.

Technological barriers:

The contribution of the technical assistance for mangrove restoration is necessary for the project’s success. NEWS with the help of the carbon benefits and financing from the Livelihoods Fund, is investing in a participatory training and capacity building process in the project region. Thereby NEWS is investing in communities and ensures long-lasting results. By means of these trainings it shows the locals how to go about the plantation and naturally regenerated mangroves in a scientific manner, so that these resources have better chances of survival, and the people are equipped with the knowledge base to manage their forests in the future.

On the other hand, as mentioned in the previous paragraphs, without the infrastructure provided by NEWS (which depends on funds from Livelihoods), local communities would not be able to develop a restoration project on a significant scale.

Many of the areas within this zone are propagule poor: the natural ecosystem is relatively far-removed and natural regeneration is limited by a paucity of propagules in areas that might otherwise feature a natural mangrove forest. Early field survey work undertaken by NEWS showed that villagers in some areas of the Sundarbans would need to travel up to 50 km, for example, to gather Rhizophora propagules. The methods used by NEWS in this project overcome this barrier by providing training on proper propagule identification, selection and gathering coupled with the logistical means to transport these to a decentralized nursery.

Sub-step 2c. Determination of baseline scenario (if allowed by the barrier analysis)

In applying the decision tree to the outcome of sub-steps 2a and b, the following baseline scenario has been identified:

Is forestation without being registered as an ARR project activity included in the list of land use scenarios that are not prevented by any barrier?

⟶ If yes, then:

Does the list contain only one land use scenario?

→ If yes, then the proposed A/R CDM project activity is not additional.

→ If no, then continue with Step 3: Investment analysis.

→ If no, then:

Does the list contain only one land use scenario?

→ If yes, then the remaining land use is the baseline scenario. Continue with Step 4: Common practice test

→ If no, then through qualitative analysis, assess the removals by sinks for each scenario and select one of the following options:

Option 1: Baseline scenario is the land use scenario that allows for the highest baseline GHG removals by sinks. Continue with Step 4: Common practice test, .

Option 2: Continue with Step 3: Investment analysis.

According to this the baseline scenario is identified:

Continuation of the pre-project land use

STEP 4. Common practice analysis

The project activity is the "first of its kind". At a regional scale no systematic tree planting and restoration efforts are underway. The potentially degraded target in the Sundarbans is conservatively estimated to be 20% of a total area of 4000 km^2, or an 80,000 ha total restoration requirement. West Bengal Forest Department historically plants about 150 ha annually in monocrop Avicennia. World Bank has provided financing under a national Integrated Coastal Zone Management (ICZM)[18] project for mangrove restoration in West Bengal. West Bengal Irrigation Department is currently working on 1000 km of embankment repairs and reconstruction and has indicated mangrove bioshields of 50–200 m in its design drawings but no explicit budgetary resources have been made available to plant such bioshields. In summary, current and anticipated planting efforts in the absence of this project are estimated to be less than 200 ha annually on a total area of 80,000 ha of which up to 20,000 ha would be fringing bioshields to protect embankments (Ruitenbeek 2010).[19]

Outcome: The proposed project activity is not the baseline scenario and, hence, it is additional.

2.5 Additionality

Demonstration and assessment of additionality has been done in section 2.4. using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" version 01, as it is required in the selected methodology.

[18] http://moef.nic.in/downloads/public-information/SICOM%20Brochure.pdf

[19] Due Diligence Review (Sundarbans) 5 July 2010

2.6 Methodology Deviations

No deviations

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Under the applicability conditions of the applied methodology AR-AM0014 "Afforestation and reforestation of degraded mangrove habitats" (Version 03.0), it is expected that the baseline carbon stocks in litter and soil organic carbon pools will not show a permanent net increase.

The baseline net GHG removals by sinks are therefore calculated using Equation 1 of the methodology:

$$\Delta C_{BSL,t} = \Delta C_{TREE-BSL,t} + \Delta C_{SHRUB-BSL,t} + \Delta C_{DW-BSL,t}$$

Where:

$\Delta C_{BSL,t}$	= Baseline net GHG removals by sinks in year t; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	= Change in carbon stock in baseline tree biomass within the project boundary in year t; t CO_2-e
$\Delta C_{SHRUB\_BSL,,t}$	= Change in carbon stock in baseline shrub biomass within the project boundary in year t; t CO_2-e
$\Delta C_{DW\_BSL,t}$	= Change in carbon stock in baseline dead wood biomass within the project boundary, in year t; t CO_2-e

Two baseline strata are distinguished in this project:

1. **Zero Baseline Biomass:** All blank mudflat areas with no vegetation cover at the time of the project start in 2010 are included in this stratum. It is further sub-divided into 3 strata categorizing the timing and growth of NEWS plantations planted within this zero baseline biomass stratum (see table 12).

Figure 11 Typical NEWS plantation plots in the zero baseline stratum without vegetation in 2010

According to the methodology, the baseline emissions have to be calculated with the AR-Tool 14 A/R Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1). Chapter 5 of this tool outlines the conditions that an ARR project has to fulfil in order to estimate the carbon stock and change in carbon stock in the baseline as zero.

1. Carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are met:

(a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity;

As a mangrove restoration project mangrove trees are never hrevested being also illegal in the Indian Sundarbans.

Most plots in this stratum were completely blank in 2010 or with very insignificant pre-project vegetation. NEWS developed a protocol and guidelines for treating situations where mangrove tree specimens were inside the intended plantation area. Plot measurement and delineation was undertaken in a way that large agglomerations of existing mangrove trees were deliberately excluded from the planting plots. A large agglomeration was taken to be anything greater than 4 trees. Agglomerations of this size or smaller would be included within the plot boundaries. Surveyors suggested that such incidents were relatively infrequent, with on average one such inclusion for every plot area of 50 ha (average plot area in the portfolio is around 16 ha).

(b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity;

If any existing trees are available prior to project activity start, they form part of the overall restoration approach.

(c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.

As a holistic mangrove restoration project, all trees are monitored as part of the carbon inventory permanent sampling system.

2. Changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands for which the project participants can demonstrate, through documentary evidence or through participatory rural appraisal (PRA), that the following indicators apply:

(a) Observed reduction in topsoil depth (e.g.as shown by root exposure, presence of pedestals, exposed sub-soil horizons);

(b) Presence of gully, sheet or rill erosion; or landslides, or other forms of mass-movement erosion;

(c) Presence of plant species locally known to be indicators of infertile land;

(d) Land comprises of bare sand dunes, or other bare lands;

(e) Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;

(f) Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

As a mangrove restoration project in a heavily degraded mangrove ecosystem in the Sunderbans many of the typical degradation indicators in the baseline apply, in particular b) and d). Therefore, changes in carbon stocks in trees and shrubs are accounted as zero for this baseline stratum.

2. Dwarf mangrove baseline biomass:

Apart from establishing new mangrove plantation, a core activity in this project is to restore degraded mangrove 'chars' through community based protection and management. Therefore, a large share of the project areas is characterized by pre-existing vegetation prior to project start. The origin of this pre-project biomass is either from natural regeneration or community plantation with poor survival rates. Most of this vegetation is characterized as shrubby or dwarf mangroves which normally occur in degrading areas where nutrients, freshwater, and inundation by tides are all limited. Any mangrove species can be dwarfed, with trees generally limited in height to approximately 1 meter or less. Apart from this, also patches of normal mangrove trees are present on such areas.

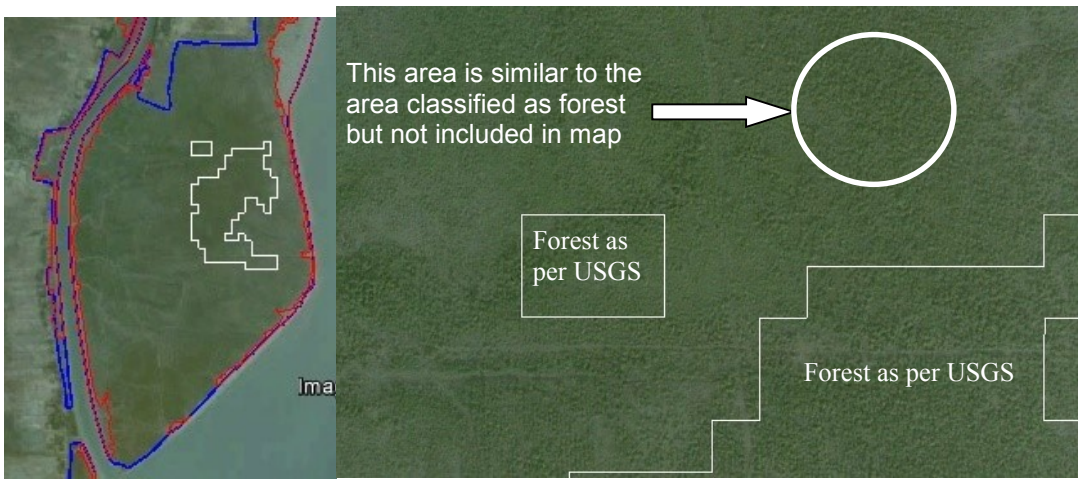
Therefore, a classification method for the year 2010 was applied to first identify and conservatively exclude 'normal' mangrove forest patches from these areas and then further classify the dwarf (shrub) vegetation into different crown cover classes. Finally, a shrub baseline is calculated for this stratum.

Classification method to exclude existing mangrove forest patches:
The USGS (2011)[20] dataset of Global Distribution of Mangroves was used to identify mangrove forests according to a specific definition. The dataset shows the global distribution of mangrove forests, derived from earth observation satellite imagery (Giri et al. 2011)[21]. One of the challenges of this dataset is that small patches (< 900-2,700 sq-m) of mangrove forests cannot be identified using this approach. Therefore this dataset was used in combination with Google Earth images of the project areas in 2010 to support and to improve accuracy. The USGS data set is available as supporting documentation.

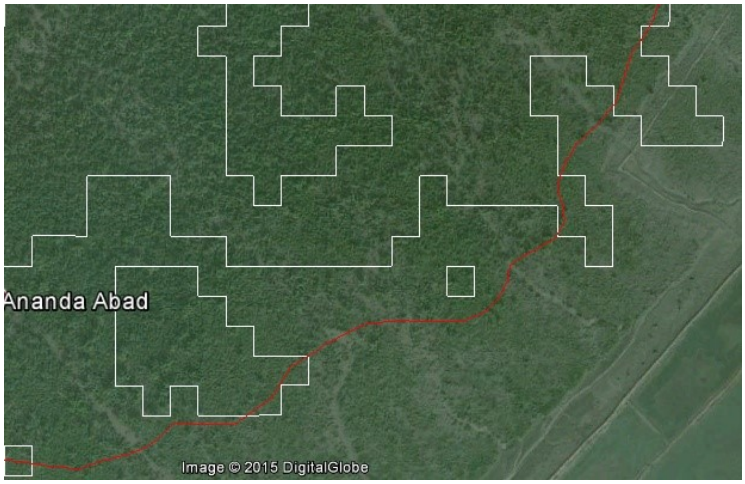
According to USGS map only 123 ha of the project areas in this stratum are identified as mangrove forests. When this USGS map is overlaid on Google Earth it was observed that this 123 ha is not correct since many small forest patches showed the same RGB-signatures but were not classified as mangrove forests (see examples below).

[20] http://data.unep-wcmc.org/datasets/4

[21] Giri C, Ochieng E, Tieszen LL, Zhu Z, Singh A, Loveland T, Masek J, Duke N (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. Global Ecology and Biogeography 20: 154-159. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1466-8238.2010.00584.x/abstract



Therefore it was decided to use USGS map combining with Google Earth. Reference of forest signatures to be excluded are taken from the USGS map and all similar areas falling in project boundaries are identified on imagery of year 2010 wherever possible on Google Earth and classified/delineated as forest further excluded from project boundaries. Likewise all plots are analysed visually on screen and delineated using Google Earth. Later QGIS software is used for preparing map layouts and area calculation. Example is given below:

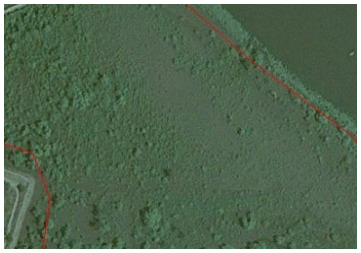


In above picture white lines are showing forest as per USGS map as it can be seen on the map similar forest is after white line is not classified as forest. Red line is approx. corrected forest boundary based visual interpretation using Google Earth.

With this approach the NEWS intervention areas within this stratum were delineated in existing mangrove forests as per global peer-reviewed study and shrub/ dwarf mangroves which are subject for NEWS restoration activities. These dwarf mangroves are further classified into different crown cover classes applying the following steps:

- It is not possible to classify Google Earth images and calculate actual tree density.
- Therefore all dwarf-forest areas delineated using Google earth area classified by visual interpretation in broad three categories as following, dense shrubs, low density shrubs and

young plantations. Examples are given below in following order; dense, low and young plantations


Change in carbon stocks in baseline tree biomass within the project boundary in this stratum can be estimated as zero for the same reasons as described for the zero baseline stratum. A shrub baseline is calculated for this stratum in order to account for pre-project dwarf mangrove vegetation.

For the calculations of changes in carbon stocks of the dwarf mangrove baseline in this stratum the following equations are used:

Baseline carbon stocks in shrubs are calculated following the equation of the AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 4.1):

$$C_{SHRUB;T} = \frac{44}{12} * CF_s * (1 + R_w \sum_i A_{SHRUB}, * b_{SHRUB,i}$$

$$b_{SHRUB,t} = BDR_{SF} * b_{forest} * cc_{SHRUB}$$

Where:

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary in the baseline; t CO_2e

CF_S = Carbon fraction of shrub biomass, tC (t.d.m.)$^{-1}$

R_s = Root-shot ratio for shrubs; dimensionless

$A_{SHRUB,i}$ =Area of shrub biomass estimation stratum I, ha

$b_{SHRUB,i}$ = Shrub biomass per hectare in shrub biomass estimation stratum I, t d.m.ha^{-1}

BDR_{SF} = Ration of shrub biomass per hectare in land having a shrub crown cover of 1.0 and the default above-ground biomass content per hectare in forest in the region where the project is located

b_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located, t d.m.ha^{-1}

CC_{SHRUB} = Crown cover of shrubs in shrub biomass estimation stratum I at the time of estimation, expressed as a fraction

Crown cover:
Following the shrub classification, the project areas in this stratum can be classified according the crown cover presented as:

Crown cover range (%)	Conservative value of Crown Cover for calculations
<10%	10%
10-70%	70%
70-90	90%
>90%	100%

Bforest:
There are 14 research sites distributed across the Indian Sundarbans (Western, Central and Eastern zone) which are subject to various scientific studies on mangrove vegetation and soil carbon (see Mitra et al, 2014)[22]. The average value of aboveground biomass of these stations is used:

Bforest = 116.8 t d.m. ha^{-1}

Next, default values taken from the tool AR-TOOL14 are applied.

Carbon fraction of shrub biomass	CFs	0.47
Root-shot ration for shrubs	R/S	0.4
Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0	BDR	0.1

Changes in the carbon stocks in baseline dead wood biomass - $\Delta C_{DW\_BSL,t}$

As already demonstrated, baseline of living biomass is accounted as zero in the zero baseline stratum. Consequently, changes in carbon stocks in dead wood in the baseline may also be estimated as zero.

The dwarf mangrove baseline stratum includes pre-project vegetation, however, as a result of the classification, mangrove trees have been excluded. AR-TOOL 12 “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” (Version 03.0) only provides calculation methods for areas with trees; it is assumed that dead wood biomass derived from shrubs may be estimated as zero.

[22] Mitra,A.; Zaman,S (2014). Carbon sequestration by coastal Floral Community. Teri

3.2 Project Emissions

The ex-ante actual net GHG removals by sinks are estimated using the equation 2 described in section 5.5 of the methodology AR ACM0014 (Version 03.0):

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where

$\Delta C_{ACTUAL,t}$	Actual net GHG removals by sinks, in year *t,* tCO_2-e
$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*, t CO_2-e
$GHG_{E,t}$	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, t CO_2-e

Further:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$	= Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	= Change in carbon stock in tree biomass in project in year t; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	= Change in carbon stock in shrub biomass in project in year t; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	= Change in carbon stock in dead wood in project in year t; t CO_2-e
$\Delta C_{LI\_PROJ,t}$	=Change in carbon stock in litter in project in year t; t CO_2-e **No litter biomass** will be accounted in this project
$\Delta SOC_{AL,t}$	= Change in carbon stock in SOC in project, in year t; t CO_2-e

Estimation of the changes in carbon stocks in tree biomass: $\Delta C_{TREE\_PROJ,t}$

The change in carbon stock in tree biomass in this grouped project within the project boundary is estimated using the A/R methodological tool "estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1). Based on the tool the stock difference method is applied and the ex-ante tree biomass is estimated using the method of "Estimation by modelling of tree growth and stand development, presented in section 8 of the tool. For the estimation of the changes in carbon stocks in tree biomass ex-post, field measurements in permanent sample plot at two points of time will be realized, and the

calculations will be done following the "difference of two independent stock estimations" method, available in section 6 of the tool.

The ex-ante estimation of carbon stock changes is based on an average growth assumption for the entire project area.

The ex-ante growth model was developed based on the following assumptions:

The diameter growth of the mangrove plantations for this project are estimated based on Ray et al. (2011)[23]. Based on the mean annual increase for the different diameter classes ranging from 0-30 cm of Ray et al. the diameter growth of the project is estimated. This growth estimation is reflecting the multi-species plantations since the share of the major mangrove species contributing to the biomass in the study sites of Ray et al. are comparable to the planting plan of this project, e.g. 80% Avicennia spp. And 20% other species.

The following allometric biomass equation is used to convert the diameter (DBH) and height (H) into aboveground biomass:

$AGB = 1.3799H^{0.687}DBH^{0.955}$ (Ray et al. 2011).

Again, this equation reflects the multi-species condition in the Indian Sundarbans with Avicennia spp. being the most dominant species.

Also total annual growth of mangroves was estimated based on mean increase DBH and height available on the same study. For the ex-ante estimation of growth, the following values were selected:

Table 5 Annual growth of mangroves according to Ray et al. (2011)

Range (yr)	Mean increase DBH (cm/yr)	Mean increase H (m/yr)
0-10	0.65	0.47
10-20	0.86	0.36
20-30	0.76	0.31

For belowground tree biomass, the default equation of the Appendix 1 of the tool is used:

$$R_j = \frac{e^{(-1.085+0.9256*lnb)}}{b}$$

Where:

b = Above-ground tree biomass per hectare (in t d.m. ha^{-1})

[23] R. Ray, D. Ganguly, C. Chowdhury, M. Dey, S. Das, M.K. Dutta, S.K. Mandal, N. Majumder, T.K. De, S.K. Mukhopadhyay, T.K. Jana, Carbon sequestration and annual increase of carbon stock in a mangrove forest, Atmospheric Environment, Volume 45, Issue 28, September 2011, Pages 5016-5024, ISSN 1352-2310, 10.1016/j.atmosenv.2011.04.074. (http://www.sciencedirect.com/science/article/pii/S1352231011004638)

The equation was applied for each year and then the average R/S values for three age classes were used for the ER calculations since the WB TARAM Tool was used:

Table 6 Table 7 Estimated ex-ante root-shoot ratio

Range of years (yr)	Average R/S
0-10	0.30
10-20	0.26
20-30	0.24

The assumed ex-ante planting density is 5,000 plants ha^{-1} which is reduced to 2,500 after year 5 due to natural mortality. Default carbon fraction: 0.47 as per A/R methodological tool

Table 7 Ex-ante tree biomass growth model per ha

Age (year)	DBH (cm)	Mean Height (m)	AGB (kg)	Mortality	N/ha	Total AGB (t/ha)	R/S ratio
1	0.2	0.47	0.18	30%	3500	0.6	0.35
2	0.4	0.94	0.57	15%	2975	1.7	0.32
3	0.6	1.41	1.11	10%	2678	3.0	0.31
4	0.8	1.88	1.78	3%	2597	4.6	0.30
5	1.0	2.35	2.56	3%	2519	6.5	0.29
6	1.2	2.82	3.46	0%	2519	8.7	0.29
7	1.4	3.29	4.45	0%	2519	11.2	0.28
8	1.7	3.76	5.55	0%	2519	14.0	0.28
9	1.9	4.23	6.73	0%	2519	17.0	0.27
10	2.1	4.59	8.11	0%	2519	20.4	0.27
11	2.4	4.95	9.59	0%	2519	24.2	0.27
12	2.7	5.31	11.15	0%	2519	28.1	0.26
13	3.0	5.67	12.80	0%	2519	32.2	0.26
14	3.2	6.03	14.53	0%	2519	36.6	0.26
15	3.5	6.39	16.34	0%	2519	41.2	0.26
16	3.8	6.75	18.23	0%	2519	45.9	0.25
17	4.1	7.11	20.20	0%	2519	50.9	0.25
18	4.3	7.47	22.25	0%	2519	56.0	0.25
19	4.6	7.83	24.36	0%	2519	61.4	0.25
20	4.8	8.14	26.28	0%	2519	66.2	0.25

The following planting strata are assumed when applying the average mangrove growth model:

Table 8 Ex-ante plantation and NEWS activity strata

Year of plantation/ restoration start	Zero Baseline stratum (ha)	Dwarf mangrove baseline (ha)
2010	200	161
2011	377	52
2012	707	188
2013	985	162
2014	1,054	442

2015	220	
Total	3,545	1,005
Total project instances	4,550	

The total annual estimation of tree biomass GHG removals by sinks is shown below.

Table 9 Annual estimation of tree biomass GHG removals by sinks in the project scenario for the first project instances

Year	Annual estimation of tree biomass GHG removals by sinks; tCO_2-e
Year 1	550
Year 2	1,563
Year 3	3,541
Year 4	6,723
Year 5	11,156
Year 6	14,927
Year 7	18,004
Year 8	21,336
Year 9	24,341
Year 10	27,796
Year 11	30,150
Year 12	33,056
Year 13	35,333
Year 14	38,041
Year 15	39,597
Year 16	43,704
Year 17	46,223
Year 18	48,357
Year 19	50,442
Year 20	51,899
Total estimated actual GHG removals by sinks; t CO_2-e	546,741

Estimation of the changes in carbon stocks in shrub biomass: $\Delta C_{SHRUB\_PROJ,t}$

As no shrubs are planted as part of this grouped project this carbon stock will be accounted as zero for the ex-ante and ex-post estimations.

Estimation of the changes in carbon stocks in dead wood: $\Delta C_{DW\_PROJ,t}$

Change in carbon stocks in dead wood in the project is estimated based on the A/R Methodological Tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” (Version 03.0).

The method selected for the calculation of this carbon pool is the conservative default-factor based method for estimation of carbon stock in dead wood. In each strata it is required to use equation 9 of section 6 of this tool for the calculation of dead wood:

$$C_{DW,i,t} = C_{TREE,i,t} * DF_{DW}$$

Where:

$C_{DW,i,t}$ = Carbon stock in dead wood in stratum I at a givewn point of time in year t; t CO_2-e

$C_{TREE,i,t}$ = Carbon stock in trees biomass in stratum I at a point of time in year t; t CO_2-e

DF_{DW} = Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; per cent

According to the tool, DF_{DW} is selected from table 5 of section 8 of the tool. Based on biome, elevation and precipitation data, a value of 6% for DF_{DW} is chosen.

Table 10 Annual estimation of dead wood GHG removals by sinks in the project scenario for the first instance project

Year	**Annual estimation of dead wood GHG removals by sinks; tCO_2-e**
Year 1	25
Year 2	72
Year 3	163
Year 4	310
Year 5	515
Year 6	689
Year 7	831
Year 8	985
Year 9	1,123
Year 10	1,283
Year 11	1,421
Year 12	1,566
Year 13	1,715
Year 14	1,873
Year 15	1,990
Year 16	2,097
Year 17	2,201
Year 18	2,303
Year 19	2,402
Year 20	2,471
Total estimated actual GHG removals by sinks; t CO_2-e	26,035

Estimation of the changes in carbon stocks in soil organic carbon (SOC): $\Delta SOC_{PROJ,t}$

Changes in carbon stocks in the SOC pool is calculated as indicate in the Methodology AR-AM0014:

$$\Delta SOC_{PROJ,t} = \frac{44}{12} * \sum_{t=1}^{t} A_{PLANT,t} * dSOC_t * 1year$$

Where:

$\Delta SOC_{PROJ,t}$ = Change in SOC sotck within the project boundary, in year t; t CO_2-e

$A_{PLANT,t}$ = Area planted in year t, ha

$dSOC_t$ = The rate of change in SOC stocks within the project boundary, in year t, $tCha^{-1}yr^{-1}$.

A number of scientific studies on SOC and SOC change are available for the Indian Sundarbans which justifies using a more site-specific default value of dSOC compared to the value provided in the Methodology. Mitra et al (2012)[24] estimates in his study that mangroves soils in the Western zone of the Indian Sundarbans where most of the NEWS project areas are located, contain an average soil organic carbon density of 1.19 kg/m² for every 10 cm soil depth until 40 cm. Assuming conservatively already mature mangrove forests of 30 years for all research sites (most forests are reported to be around 12 years) a dSOC value of 1.59 $tCha^{-1}yr^{-1}$ for a soil depth of 40 cm is assumed for all project areas within the zero baseline stratum.

In the dwarf baseline biomass stratum, it is conservative to assume a lower dSOC rate attributable to the project activities. Assuming these sites to be already more stabilized by mangrove vegetation, the average value of the same study for the Eastern Zone is used (0.74 kg/m^2). The Eastern Zone are most often protected undisturbed mangrove sites and the study found a clear correction between undisturbed sites and lower SOC values. Assuming the same default period of 30 years, dSOC for this stratum is 0.99 $tCha^{-1}yr^{-1}$ for a soil depth of 40 cm.

Table 11 Annual estimation of soil organic carbon GHG removals by sinks in the project scenario for the first instance project

Year	Annual estimation of soil organic carbon GHG removals by sinks; tCO_2-e
Year 1	1,748
Year 2	4,132
Year 3	8,930
Year 4	15,247
Year 5	22,979
Year 6	24,259

[24] Mitra,A; Banerjee,K. & Sett, S. (2012). Spatial variation in organic carbon density of mangrove soil in Indian Sundarbans. National Academy of Science letters.

Year 7	24,259
Year 8	24,259
Year 9	24,259
Year 10	24,259
Year 11	24,259
Year 12	24,259
Year 13	24,259
Year 14	24,259
Year 15	24,259
Year 16	24,259
Year 17	24,259
Year 18	24,259
Year 19	24,259
Year 20	24,259
Total estimated actual GHG removals by sinks; t CO_2-e	416,930

3.3 Leakage

According to the methodology AR-AM0014 (Version 03.0), the leakage emission has to be assessed with the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02). This tool evaluates the displacement of crop cultivation and grazing activities. Section 6 of this tool indicates that leakage emissions can be considered insignificant if they meet the following requirements:

1. Leakage emission attributable to the displacement of agricultural activities due to implementation of an A/R CDM project activity is estimated as the decrease in carbon stocks in the affected carbon pools of the land receiving the displaced activity.

2. Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:

   (a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;

   (b) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;

   (c) Animals are displaced to cropland that has been abandoned within the last five years;

   (d) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;

   (e) Animals are displaced to zero-grazing system.

Most of the project areas are emerged salty mudflats either blank (with no vegetation) or with shrubby mangrove vegetation. These sites are legally protected and no agricultural activities including grazing are allowed within these areas. The protection and management of illegal

grazing on mangrove sites is part of the NEWS project activities including the promotion of alternative livestock fodder sources outside the project areas. Therefore, leakage in the whole project area can be assumed as zero for the duration of the project.

3.4 Net GHG Emission Reductions and Removals

The ex-ante net anthropogenic GHG emission reductions and removals are calculated using equation 6 of the methodology AR-AM0014:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where:

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year t; t CO_2-e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year t; t CO_2-e

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks, in year t; t CO_2-e

LK_t = GHG emissions due to leakage, in year t; t CO_2-e

The results for the first project activity instance are shown below.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
1	4,092	2,324	0,00	-1,768
2	4,092	5,768	0,00	1,676
3	4,092	12,635	0,00	8,542
4	4,092	22,281	0,00	18,188
5	4,092	34,650	0,00	30,558
6	4,092	39,876	0,00	35,783
7	4,092	43,094	0,00	39,002
8	4,092	46,581	0,00	42,488
9	4,092	49,724	0,00	45,632
10	4,092	53,338	0,00	49,246
11	4,092	55,830	0,00	51,738
12	4,092	58,881	0,00	54,789
13	4,092	61,307	0,00	57,215

14	4,092	64,173	0,00	60,081
15	4,092	65,847	0,00	61,754
16	4,092	70,060	0,00	65,968
17	4,092	72,683	0,00	68,591
18	4,092	74,920	0,00	70,827
19	4,092	77,103	0,00	73,011
20	4,092	78,630	0,00	74,538
Total	42,604	989,706	0,00	907,861

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,t}$
Data unit	t CO2-e
Description	Baseline net GHG removals by sinks in year t
Source of data	N/A
Value applied:	42,602
Justification of choice of data or description of measurement methods and procedures applied	Value based on section 5 of AR-TOOL14 as described in section 3.1. of this document.
Purpose of Data	Calculation of ex-ante and ex-post baseline emissions
Comments	-

Data / Parameter	CF_{TREE}
Data unit	t C $(t\ d.m.)^{-1}$
Description	Carbon fraction of tree biomass
Source of data	Default value of AR CDM tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”
Value applied:	0.47
Justification of choice of data or description of measurement methods	Default value of AR-TOOL14 is used unless transparent and verifiable information can be provided to justify a different value.

and procedures applied	
Purpose of Data	Determination of project emission/removals
Comments	-

Data / Parameter	R_j
Data unit	dimensionless
Description	Root-shoot ratio for tree species j
Source of data	AR-TOOL14
Value applied:	Result of the application of the following equation: R_j=exp[-1.085+0.9256*ln(AGB)]/AGB Where AGB is the above-ground tree biomass per hectare (in t d.m. ha^{-1}) For EX-ante calculations the values have been simplified into three groups:
Justification of choice of data or description of measurement methods and procedures applied	According to AR-TOOL14, root-shoot ratio for tree species shall be calculated with the followed formula: Rj=exp[-1.085+0.9256*ln(AGB)]/AGB
Purpose of Data	Calculation of project emission removals
Comments	-

AGB (t d.m. ha^{-1})	**Rj** (dimensionless)
AGB < 21	0.3
21<= AGB < 70	0.26
AGB >= 70	0.24

Data / Parameter	$f_j(x_{1,I},x_{2,I},x_{3,I},...)$
Data unit	t d.m.
Description	Above-ground biomass of the tree returned by the allometric equation for species *j* relating the measurements of tree *I* to the above-ground biomass of the tree
Source of data	For ex-ante: Ray et al. (2011)[25] For ex-post: more accuracy equations according to the location and the high of the trees will be used

[25] Ray, R. Ganguly, D., Chowdhury, C., Dey, M., Das, S., Dutta, M.K., Mandal, S.K. (1011). Carbon sequestration and annual increase of carbon stock in a mangrove forest. Atmospheric Environment 45 (2011) 5016-5024.

Value applied:	$AGB = 1.3799*(H)^{0.687}*(DBH)^{0.955}$ Where: DBH = Diameter at breast height; cm H = Height (m)
Justification of choice of data or description of measurement methods and procedures applied	Equation used in ex-ante estimation
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	$dSOC_t$
Data unit	t C ha^{-1} yr^{-1}
Description	The rate of change in SOC stocks within the project boundary, in year t.
Source of data	AR-AM0014
Value applied:	Strata 1-3: 1.59 Strata 4: 0.99
Justification of choice of data or description of measurement methods and procedures applied	Value derived from Mitra et al (2012).
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	$EF_{CH4,i}$
Data unit	g CH_4 (kg dry matter burnt)$^{-1}$
Description	Emission factor for CH_4 in stratum *i*
Source of data	CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
Value applied:	6.8 (unless transparent and verifiable information can be provided to justify a different value)
Justification of choice of data or description of measurement methods and procedures applied	Default emission factor for tropical forest from the CDM A/R tool. If transparent and verifiable information can be provided, the different values may be selected from the following sources, in order of preference; a. Regional/national inventories e.g. national forest inventory, national GHG inventory;

	b. Inventory from neighbouring countries with similar conditions; c. Globally available data applicable to the project site or to the region/country where the site is located;
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	$EF_{N2O,i}$
Data unit	g N_2O (kg dry matter burnt)$^{-1}$
Description	Emission factor for N_2O in stratum *i*
Source of data	CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
Value applied:	0.2 (unless transparent and verifiable information can be provided to justify a different value)
Justification of choice of data or description of measurement methods and procedures applied	Default emission factor for tropical forest from the CDM A/R tool. If transparent and verifiable information can be provided, then different values may be selected from the following sources, in order of preference; a. Regional/national inventories e.g. national forest inventory, national GHG inventory; b. Inventory from neighbouring countries with similar conditions; c. Globally available data applicable to the project site or to the region/country where the site is located;
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	dimensionless
Description	Global warming potential for CH_4
Source of data	CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
Value applied:	21
Justification of choice of data or description of measurement methods	Default value

and procedures applied	
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	GWP_{N2O}
Data unit	dimensionless
Description	Global warming potential for N_2O
Source of data	CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
Value applied:	310
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	$COMF_i$
Data unit	dimensionless
Description	Combustion factor for stratum *i*
Source of data	CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
Value applied:	Default value depending on the age, unless transparent and verifiable information can be provided to justify a different value:

Mean age (years)	**Default value**
3-5	0.46
6-10	0.67
11-17	0.50
18 and above	0.32

Justification of choice of data or description of measurement methods and procedures applied	Default emission factor for tropical forest from the CDM A/R tool. If transparent and verifiable information can be provided, then different values may be selected from the following sources, in order of preference; a. Project-specific calculation, regional/national inventories e.g. national forest inventory, national GHG inventory;

	b. Inventory from neighbouring countries with similar conditions; c. Globally available data applicable to the project site or to the region/country where the site is located
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	E
Data unit	t d.m. (or t d.m. ha^{-1})
Description	Acceptable margin of error (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary
Source of data	AR-TOOL14
Value applied:	10% of the mean value of biomass stock
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of ex-post project emissions
Comments	-

Data / Parameter	t_{val}
Data unit	Dimensionless
Description	Two-sided Student's t-value at infinite degrees of freedom for the required confidence level
Source of data	AR-TOOL14
Value applied:	According to the student's t-distribution table, 1.645 for confidence level 90% and infinite degrees of freedom
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of ex-post project emissions
Comments	Use the 90% confidence level for determination of biomass stock in A/R CDM project activities, unless a different confidence level is prescribed in a methodology

4.2 Data and Parameters Monitored

Data / Parameter	A_i
Data unit	Ha
Description	Area of tree biomass stratum *i*
Source of data	GIS and GPS
Description of measurement methods and procedures to be applied	Areas in project area will be tracked in the field using the GPS. Each plot which will be subject to planting is tracked - a standard procedure of the baseline and monitoring inventory
Frequency of monitoring/recording	Before the start of the project (planting) and adjusted thereafter every three years since the year of the initial verification
Value applied:	See project database
Monitoring equipment	GPS (Garmin), GPS Smartphones, QGIS software
QA/QC procedures to be applied	Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application
Purpose of data	Calculation of project emissions
Calculation method	GIS tool
Comments	-

Data / Parameter	n_i
Data unit	Dimensionless
Description	Number of sample plots in stratum *i*
Source of data	Calculated
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	n_i is calculated for each monitoring event, at least every five years
Value applied:	For ex ante situation the following values are estimated from the first project instance:

Stratum	**n_i**
1	(Pending)
2	(Pending)
3	(Pending)
4	(Pending)

Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions/removals
Calculation method	The calculation method is described in the tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (version 02.1.0)[26]
Comments	-

Data / Parameter	w_i
Data unit	Dimensionless
Description	Relative weight of the area of stratum i, the area of the stratum i divided by the project area.
Source of data	Calculated
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Calculated for each monitoring event, at least every five years
Value applied:	For ex ante situation the following values are estimated from the first project instance:

Stratum	w_i
1	(Pending)
2	(Pending)
3	(Pending)
4	(Pending)

Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions/removals
Calculation method	Area of the stratum i divided by the project area
Comments	-

[26] Annex 15 of the Executive Board report at its 58th meeting.

Data / Parameter	s_i
Data unit	t d.m. (or t d.m. ha^{-1})
Description	Estimated standard deviation of biomass stock in stratum i
Source of data	Pre-sampling or default value
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	s_i is calculated for each monitoring event, at least every five years
Value applied:	For ex ante situation the following values are estimated from the first project instance:

Stratum	s_i
1	(Pending)
2	(Pending)
3	(Pending)
4	(Pending)

Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions/removals
Calculation method	Excel or tool available to calculate standard deviation
Comments	-

Data / Parameter	$A_{PLOT,i}$
Data unit	Ha
Description	Size of sample plot in stratum i
Source of data	Field measurement
Description of measurement methods and procedures to be applied	After calculating the No of sample plots required to achieve the desired precision level (90/10) a stratified random selection is carried out. A circular plot design (r = 11m) is chosen.
Frequency of monitoring/recording	Every three years since the year of the initial verification
Value applied:	0.0028 (3m radius)
Monitoring equipment	N/A

QA/QC procedures to be applied	Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application
Purpose of data	Calculation of project emission removals
Calculation method	It will be calculated depending on the expected density (trees/ha) in each stratum, with the objective of having around 15 trees per sample plot
Comments	-

Data / Parameter	$A_{BURN,i,t}$
Data unit	Ha
Description	Area burnt in stratum i
Source of data	Field measurement, remote sensing measurement or any other spatial information available
Description of measurement methods and procedures to be applied	The area shall be delineated either on the ground using GPS, from georeferenced remote sensing data or from any other spatial information available
Frequency of monitoring/recording	This area is measured whenever forest fire has occurred
Value applied:	N/A
Monitoring equipment	GPS (if applied)
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of project emissions/removals
Calculation method	N/A
Comments	Only used in case wild fires occur.

Data / Parameter	X_i
Data unit	Variable
Description	Variables measured per tree for the calculation of above-ground biomass an allometric equation for species: DBH, height, D_{30},
Source of data	Measured
Description of measurement methods and procedures to be	Depending on the variable

applied	
Frequency of monitoring/recording	Measured every monitoring event, at least every five years
Value applied:	n.a.
Monitoring equipment	Depending on the variable (tape, calliper, etc)
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of project emissions/removals
Calculation method	n.a.
Comments	D_{30}, only for the first verification

Data / Parameter	*T*
Data unit	Year
Description	Time period elapsed between two successive estimations of carbon stock in a carbon pool
Source of data	Recorded time
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value applied:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission removals
Calculation method	N/A
Comments	If the two successive estimations of carbon stock in a carbon pool are carried out at different points of time in year t_2 and t_1, (e.g. in the month of April in year t_1 and in the month of September in year t_2), then a fractional value will be assigned to *T*

4.3 Monitoring Plan

Organizational structure

Institutionally, a permanent NEWS Carbon Survey Team has been set up consisting of 4 field team consisting of 2-3 zonal field officers and under the supervision of the project coordinator (Mrs Ajanta Dey) and carbon monitoring coordinator (Mr. Dibyajyoti Chatterjee). This team will undertake all boundary demarcation surveys in the project to ensure consistency in measurements and will implement the carbon monitoring inventory of permanent sampling points (PSPs). Further, NEWS and Livelihoods have set up a stringent verification system with external tree audits including annual boundary verification and revision, if required.

The organizational structure of the monitoring is divided into two layers. The first layer is represented by the NEWS field staff which are trained in all necessary activities to perform the forest inventory, boundary tracking with GPS, socio-economic monitoring and forest establishment monitoring (survival rate, nursery monitoring, etc.). More than 20 field officers of NEWS are responsible for the different zones of the project areas ranging from the western region to the central parts of the Indian Sundarbans. Generally they are part of the communities and are well acquainted with the specific conditions within the different planting areas. The forest inventory and monitoring surveys are conducted by them in the field (as part of the carbon survey teams). All results are directly brought to the main office of NEWS in Kolkata; the second layer of the project. Ajanta Dey and the NEWS technical program coordinators are responsible for the technical implementation of the whole project. In the main office the data are processed, analyzed and archived following standard operation procedures and good practice guidelines. To guarantee high level of certainty of the results, the NEWS technical program coordinators will periodically crosscheck the data in the field as an independent survey. It is envisaged to at least verify 10% of the data after each inventory or survey conducted.

The project implementation is based on the local presence of NEWS staff in project area. The main role of the field officers is to manage the reforestation/ restoration activity in close cooperation with NEWS technical program coordinators.

Establishment of survival counts and replanting

The establishment and management of the mangrove plantations will be monitored as part of the carbon monitoring plan. Regular plantation audits are conducted by NEWS and an external auditor which includes the following tasks:

- Selecting randomly and verify the GPS location of at least 10% of the plots planted during a particular planting season.
- Comparing the trees planted with the trees recorded in the planting plans
- Assessing the degree (in %) of the survival of the mangrove seedlings and preparation of a report with the findings considering a minimum precision of 10% at the 90% confidence level. Replanting of mangroves is only necessary if the optimal tree density of 2,500 trees

per ha cannot be achieved due to very high natural mortality. This has to be decided on a site-by-site basis due to the varying local tidal and ecological conditions.

- Area verification. Project parcels will be verified using GPS in the field as well as through Google Earth imagery analysis.

Annual tree audit reports are provided as supporting documentation.

Livelihoods Standard Monitoring

The Livelihoods Fund has established a standard monitoring process for all Livelihoods projects. An extensive monitoring training has been conducted in October 2013 on Standard Operating Procedures (SOPs) for monitoring carbon in land based carbon projects. Generic SOP documents related to various procedures throughout the whole monitoring process have been elaborated from which a **sampling and monitoring plan** for this project has been compiled. The full monitoring SOP is available as supporting documentation; a short summary is given below.

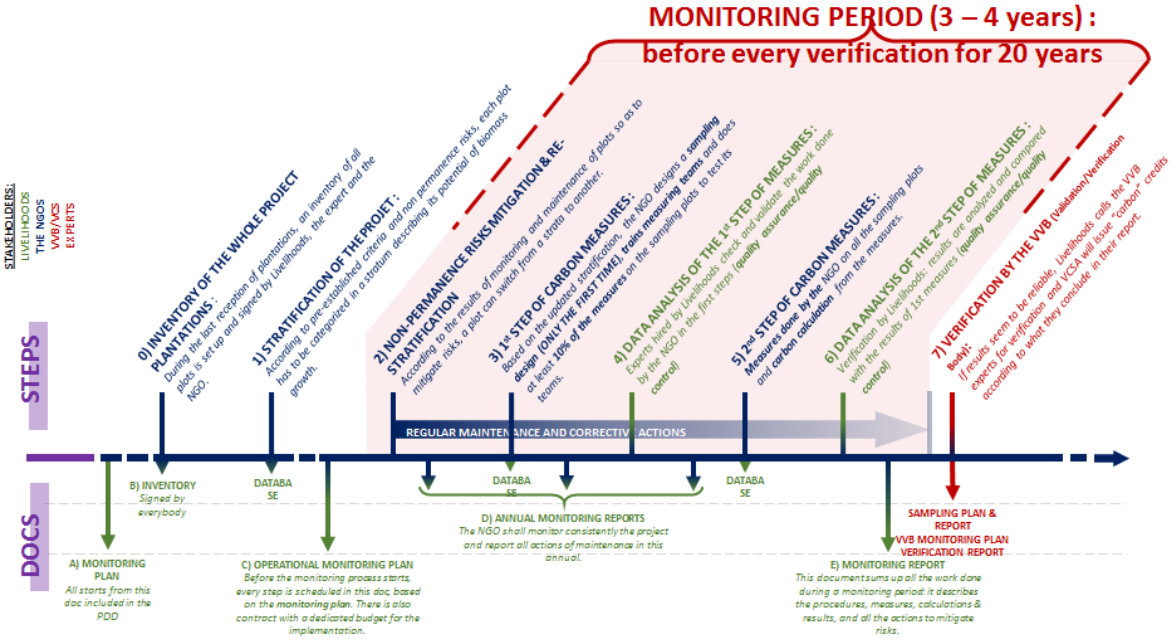


Figure 12 Standard monitoring process for Livelihoods proejcts

Establishment of geographic coordinates of the project boundary

All project areas subject to mangrove plantations and restoration under this project activity will be delineated using GPS tracking function. For this, an extensive training has been conducted and up-to-date GPS portable devices purchased (e.g. Garmin etrex). Each planting plot, having assigned a unique ID, is tracked and the tracks are downloaded and recorded as Google Earth .kml file, and as Gpx file. This allows for further processing the tracks via GIS applications.

The activities that allow for proper management and monitoring of the project areas are:

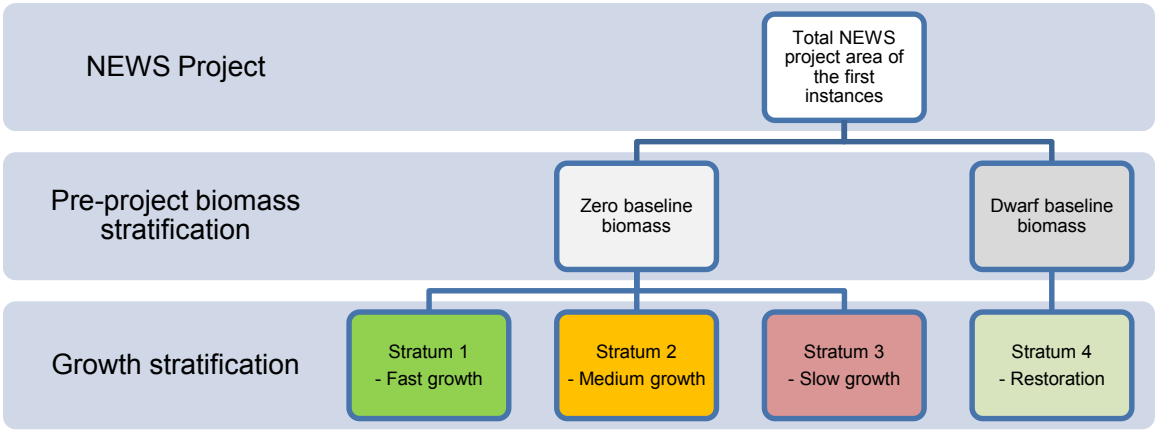
- Review of all project boundaries to assess potentially on-going afforestation activities, site by site.
- Geo-referencing (latitude and longitude) of each land parcel, which is part of the NEWS project, making use of the GPS.
- Periodic verification that the project boundaries correspond to the defined boundaries and are consistent with the eligibility analysis.
- There will be periodic verifications of the project area boundaries during the crediting period. If the boundaries present changes within this period due to natural (pests, diseases, fire, etc.) or anthropogenic damages (harvests or deforestation), these areas will be located and their extent determined, making an assessment of the carbon loss. These areas will be treated as different strata from those initially established. The modified boundaries will be reported to the VVB during the subsequent verification, the deforested lands will be excluded from the project and the VCSUs issued for these areas will be deducted.
- Similarly, the areas where planting fails, or the use of the land changes, will be documented.
- Analysis of the field information obtained using a GIS system (QGIS), calculating the areas incorporated tree planting plan, and those affected by disturbances will be carried out.

All NEWS staff members have received a 3-days training in GPS boundary demarcation (GPS tracking) in the field, data processing, data analyzing and data archiving. During this training, a standard operating procedure in geographic boundary demarcation was elaborated and the report 'GPS data collection, downloading, processing and management report: Sundarbans mangrove project, NEWS, Kolkata' is available upon request.

Identification and monitoring of strata

Stratification of the areas is first based on the ex-ante stratification. It has to be kept in mind that the Sundarbans is a dynamic region, with short- and long-term changes in forest cover and biomass occurring due to changes in hydrology, sedimentation, disease, and human factors. Thus, a stratification employed today may not make sense in the future as vegetation communities and lands shift spatially. Therefore, final factors considered for the stratification will be the differences in the estimated sinks for each mangrove species species/ species group as the project develops. For this reason, strata will be monitored periodically. If a change in the number and area of the project strata occurs, the sampling framework will be adjusted accordingly through the following procedure for monitoring strata and the sampling framework.

The ex-ante stratification is based on the growth and survival performance of mangroves after the first 4 years of project implementation as well as the two different baseline strata.



The growth and survival performance was assessed during several tree audits and each NEWS project parcel was categorized according to when the planted mangroves are established and significantly commence to grow. This is not necessarily depending on the year of the initial planation.

Stratum 1 – Fast growth: This stratum represents plantation areas with observed higher rates of growth, with plantation dated between 2010 and 2012, where the growth has taken up in the same year of the planting. No baseline pre-project biomass was present at project start date.

Stratum 2 – Medium growth: This stratum represents plantation areas which were established within the first four years, however. Due to higher mortality and replanting activities growth significantly started between 2013 and 2014. No baseline pre-project biomass was present at project start date.

Stratum 3 – **Slow growth**: This stratum includes plantation areas with a low rate of growth, where many of the planted trees were initially not surviving well and the growth is slow in comparison with the first two strata. For the first verification, tree biomass in this stratum will be accounted as zero carbon, due the insignificant increase of biomass. No baseline pre-project biomass was present at project start date.

Strata 4 – Restoration: This stratum comprises all areas where NEWS is promoting and managing the regeneration and restoration of existing degraded mangroves patches. It includes both plantation of gaps to create larger mangrove corridors as well as protection and management of natural regeneration and poorly surviving community plantations. For stratum 4, pre-project shrubby vegetation is included in the baseline (after exclusion of all areas already representing a mangrove forest).

Table 12 NEWS project area stratification

Stratum	Total area (ha)	No of plots
Stratum 1 – Fast growth	330.9	Pending
Stratum 2 – Medium growth	1565.43	Pending
Stratum 3 – Slow growth	1435.35	Pending
Stratum 4 – Restoration	1005.85	Pending

Total	4550.25	Pending

A re-stratification might be necessary after each monitoring of the project, as a function of the carbon sinks and disturbances identified.

Since this project activity is designed as phased approach with planting multi-species mangrove trees over a period of 3-5 years since 2010 the database shall be updated periodically capturing the following information:

- Unexpected disturbance occurring during the crediting period
- Unexpected disturbances occurring during the crediting period (changes in hydrology, sedimentation, disease, and human factors), affecting differently different parts of an originally homogeneous stratum or stand;
- Forest establishment (planting, re-replanting) may be implemented at different intensities, dates and spatial locations than mentioned in the PD;

Mangrove carbon inventory

Sampling design and sampling size

The sampling design is first of all driven by the precision requirements as outlined in the methodology. The targeted precision level for biomass estimation shall be ± 10% of the mean at a 90% confidence level.

The Mangrove Forest Management Guidelines (FAO 1994)[27] and the Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forest (CIFOR, 2012) [28] are used as a guidance to establish the sampling design of a continuous mangrove forest inventory with permanent sample plots.

The basic sampling design chosen is in view of the high within-plot variability along a typical gradient from lower to upper mudflats. This requires a cluster sampling approach with 3 sub-plots per plot of 2-3 m radius randomly laid out within the NEWS mangrove restoration plots.

Random sampling is recommended as good practice in forest inventory when land parcels enrolled in a project are small, irregularly shaped, or narrow which is the case in this project. The size of the circular plots is determined bearing in mind that the optimum size of the sampling units is an area which contains an average of 15 to 25 trees to be measured. The calculation is based on the latest tree audit which captures the planting densities in the project. Based on this the average area occupied per tree is calculated (m²/ha), from which the area for 15 trees required in sample point (3 sub-plots) can be calculated.

[27] http://www.archive.org/details/mangroveforestma034845mbp
[28] http://www.bluecarbonportal.org/wp-content/uploads/2012/08/USDA_Protocols_measurement-monitoring-reporting_carbon-stocks_2011.pdf

However, given the large variability in tree density in the project, two circles have been defined. The first circle with 2 m of radius will be selected for measurement if more than 15 trees are found inside. If the tree number is smaller, a circle of 3 m radius around the point center will be measured. More detailed guidance how this selection is done in standardized way, can be found in the SOPs 'Pilot Inventory, Sampling & Monitoring Plan' available as supporting documentation.

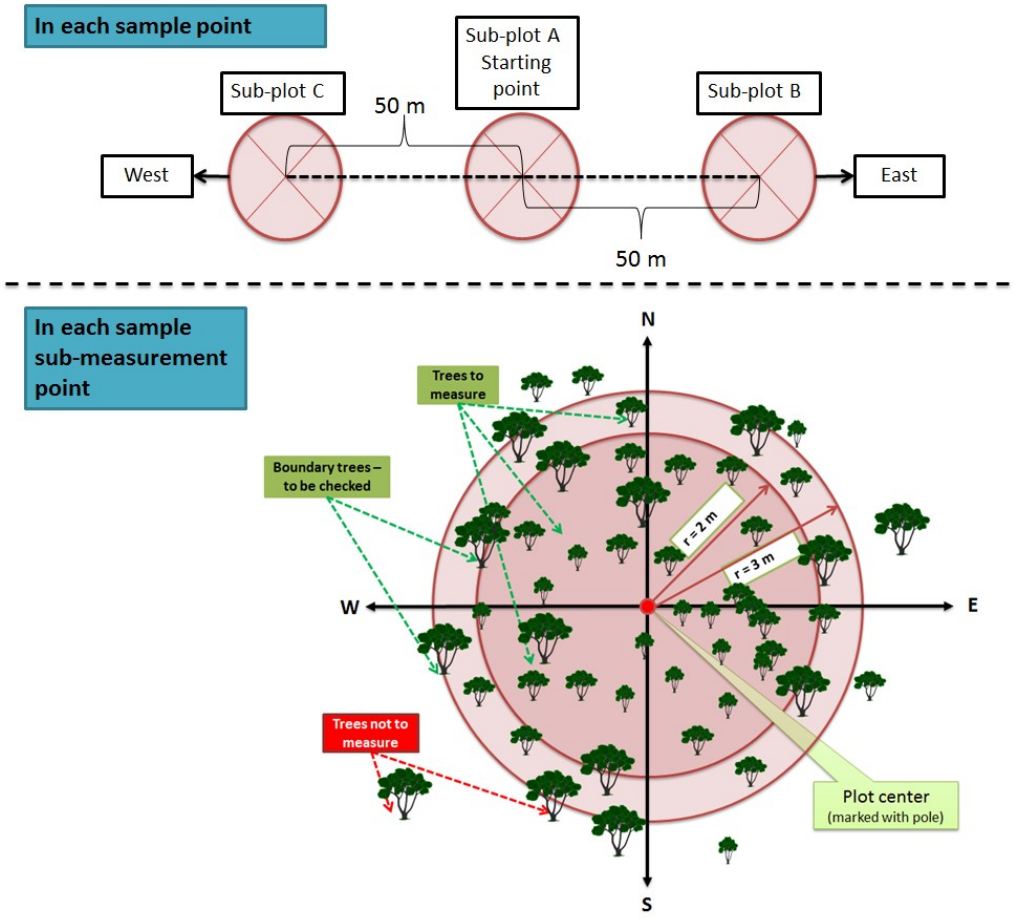


Figure 13 NEWS Carbon inventory plot layout

The sampling design is stratified. In the first stage, all planting plots subject to monitoring are assigned to the project specific strata. In the second stage from each stratum a representative No of sample plots is picked randomly. Once established, the sample of planting plots is permanent throughout the lifetime of the project.

The survey sample size is determined by the variability of biomass within the samples and the precision level required in the methodology (90/10 precision level). In other words, this means that a sampling strategy will be designed to achieve an error with a mean value of 10% or less and that there is a 90% level of statistical confidence that the true amount of carbon sequestered is at least the claimed amount.

The tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 01)[29] as well as the Winrock Sampling Calculator (Walker et al. 2007, supporting documentation) is used to estimate the number of permanent sample plots needed (project total as well as No plots per stratum i) for monitoring changes in carbon pools at a desired precision level and to determine the plot locations. The sample size follows method I (samples drawn without replacement) of the tool and considers no information on costs is available or the costs are assumed as constant for all strata.

Plot selection & location

The sample plot selection and location equally follows the guidance of the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 01) to ensure that

- The planting plots assigned as permanent sample plots are evenly distributed in the stratum. This is done by weighting the sample plots according to the shares of that stratum compared to the total project area, and

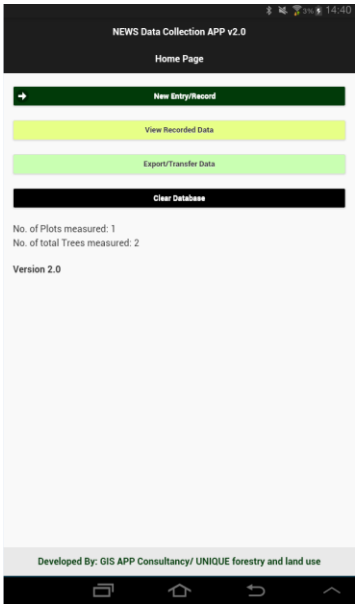
- The sample plots will be located randomly in each stratum. To ensure that the process of random selection is unbiased, GIS software is used to randomly select the location of sample plots in each plantation area.

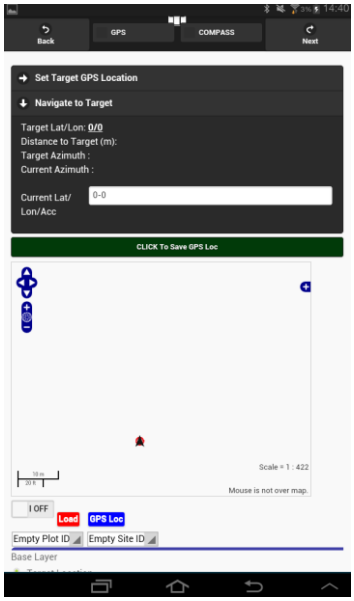
Data collection

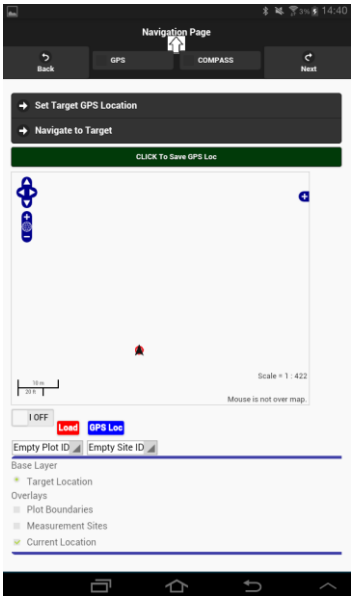
A detailed description of the NEWS carbon inventory procedures can be found in the SOPs (supporting documentation) including standard operating procedures on work syfety, field measurement planning and organization, navigating in the field, and tree measurement procedures.

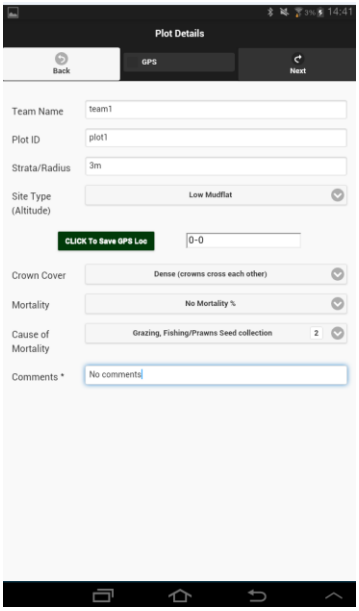
For navigation and data entry of tree and plot variables, a smartphone based inventory application was specifically designed for this project.

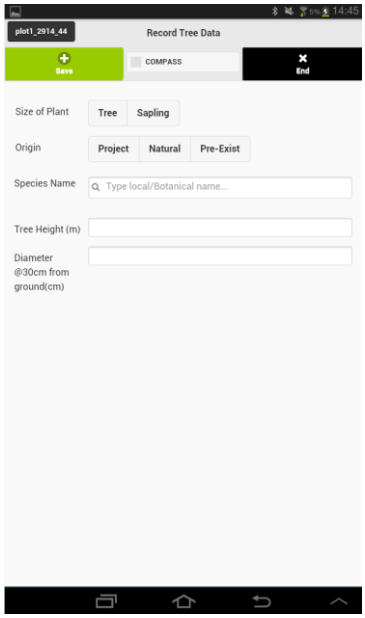
[29] http://cdm.unfccc.int/EB/031/eb31_repan15.pdf

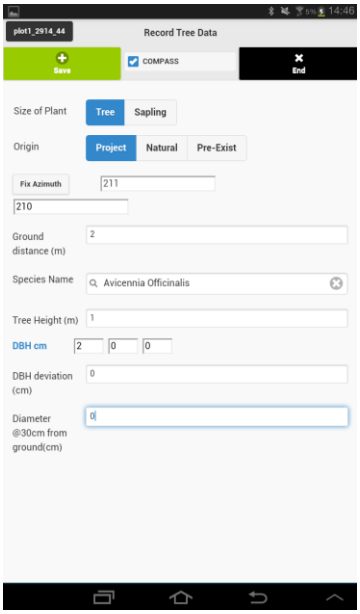

NEWS Data Collection APP v2.0
Home Page
New Entry/Record
View Recorded Data
Export/Transfer Data
Clear Database
No. of Plots measured: 1
No. of total Trees measured: 2
Version 2.0
Developed By: GIS APP Consultancy/ UNIQUE forestry and land use

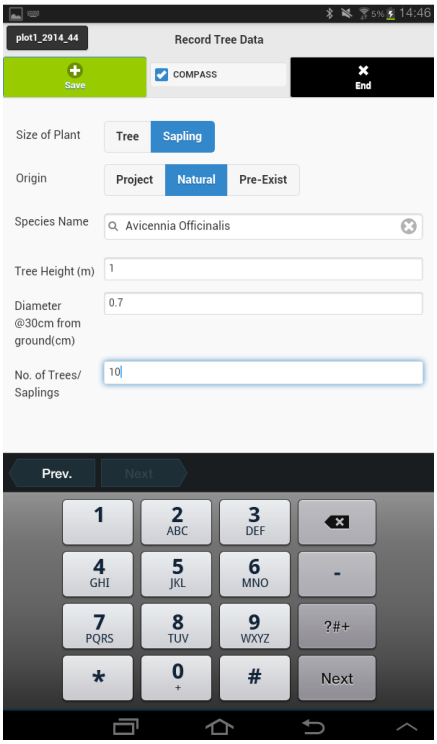

Back
GPS
COMPASS
Next
Set Target GPS Location
Navigate to Target
Target Lat/Lon: 0/0
Distance to Target (m):
Target Azimuth :
Current Azimuth :
Current Lat/ Lon/Acc
0-0
CLICK To Save GPS Loc
Scale = 1 : 422
Mouse is not over map.
I OFF
Load
GPS Loc
Empty Plot ID
Empty Site ID
Base Layer


Navigation Page
Back
GPS
COMPASS
Next
Set Target GPS Location
Navigate to Target
CLICK To Save GPS Loc
Scale = 1 : 422
Mouse is not over map.
I OFF
Load
GPS Loc
Empty Plot ID
Empty Site ID
Base Layer
Target Location
Overlays
Plot Boundaries
Measurement Sites
Current Location

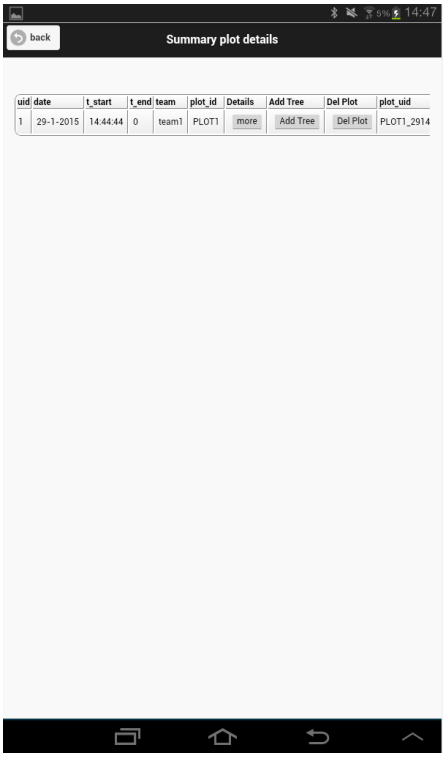

Plot Details
Back
GPS
Next
Team Name
team1
Plot ID
plot1
Strata/Radius
3m
Site Type (Altitude)
Low Mudflat
CLICK To Save GPS Loc
0-0
Crown Cover
Dense (crowns cross each other)
Mortality
No Mortality %
Cause of Mortality
Grazing, Fishing/Prawns Seed collection
Comments *
No comments

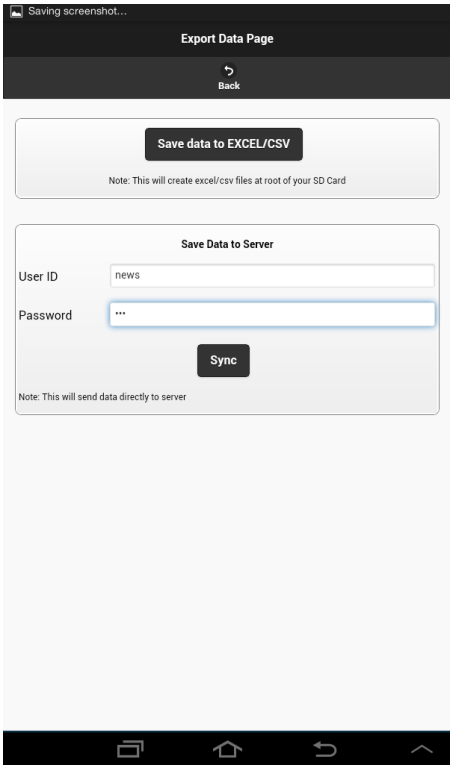

plot1_2914_44
Record Tree Data
Save
COMPASS
End
Size of Plant
Tree
Sapling
Origin
Project
Natural
Pre-Exist
Species Name
Type local/Botanical name...
Tree Height (m)
Diameter @30cm from ground(cm)


plot1_2914_44
Record Tree Data
Save
COMPASS
End
Size of Plant
Tree
Sapling
Origin
Project
Natural
Pre-Exist
Fix Azimuth
211
210
Ground distance (m)
2
Species Name
Avicennia Officinalis
Tree Height (m)
1
DBH cm
2
0
0
DBH deviation (cm)
0
Diameter @30cm from ground(cm)
0


plot1_2914_44
Record Tree Data
Save
COMPASS
End
Size of Plant
Tree
Sapling
Origin
Project
Natural
Pre-Exist
Species Name
Avicennia Officinalis
Tree Height (m)
1
Diameter @30cm from ground(cm)
0.7
No. of Trees/ Saplings
10
Prev.
Next
1
2 ABC
3 DEF
4 GHI
5 JKL
6 MNO
-
7 PQRS
8 TUV
9 WXYZ
?#+
*
0 +
#
Next


back
Tree Data of Selected Plot
Home
PLOT1_2914_44
Azimuth: 211
COMPASS
Uid Plot_Uid Azimuth Hori_Distance_M Species_Name Delete Origin Size
1 PLOT1_2914_44 210 2 Avicennia Officinalis Delete Project Tree
2 PLOT1_2914_44 Avicennia Officinalis Delete Natural Sapling


back
Summary plot details
uid date t_start t_end team plot_id Details Add Tree Del Plot plot_uid
1 29-1-2015 14:44:44 0 team1 PLOT1 more Add Tree Del Plot PLOT1_2914


Saving screenshot...
Export Data Page
Back
Save data to EXCEL/CSV
Note: This will create excel/csv files at root of your SD Card
Save Data to Server
User ID
news
Password
Sync
Note: This will send data directly to server

Procedures for internal auditing and QA/QC

As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan will be part of project documentation and cover procedures as described below for:

- Collecting reliable field measurements;
- Verifying methods used to collect field data;
- Verifying data entry and analysis techniques; and
- Data maintenance and archiving.

Procedures to ensure reliable field measurements

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work are trained in all aspects of the field data collection and data analyses. It is good practice for all Livelihoods Projects to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which should be adhered to at all times. These SOPs describe in detail all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data:

- Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
- Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
- The document will list all names of the field team and the project leader will certify that the team is trained;
- New staff adequately trained.

A monitoring training where all relevant monitoring SOPs have been introduced and extensively trained was held as part of the pilot inventory. A standard training agenda was used which can be found in the annex of the SOPs.

Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, it is good practice to re-measure independently every 10 plots and to compare the measurements. The following quality targets should be achieved for the re-measurements, compared to the original measurements:

- Missed or extra trees → no error within the plot

- Tree species or groups → no error
- DBH of tree measurements →< ± 0.5 cm or 3 % whichever is greater
- Height measurements → < ± 10/ and -20%

At the end of the field work independently 10-20% of the plots will be checked. Field data collected at this stage will be compared with the original data. Any errors found will be corrected and recorded. Any errors discovered will be expressed as a percentage of all plots that have been re-checked to provide an estimate of the measurement error.

Data maintenance and storage

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant.

Copies (electronic) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite.

Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application. Copies of all raw data, reports of analysis and supporting spreadsheets will be stored in a dedicated long-term electronic archive for at least 2 years following the end of the last crediting period in 2030.

5 ENVIRONMENTAL IMPACT

Analysis of environmental impacts

The candidate sites selected promote on site biodiversity primarily through introduction of multi-species planting models. These models differ from those used by Forest Department that rely on monoculture and generally do not reach full maturity nor involve the community (these plantations do, however, provide the desired service of wave attenuation and therefore protect embankments). The models proposed can be applied both to the islands and to the char and are normally Avicennia dominant (80–90%) with other species including Rhizophora, Bruguiera, Ceriops, Xylocarpus, Excoecaria, Aegiceras and Aegialitis. Offsite biodiversity benefits are positive and include increased natural regeneration of mangrove species (especially seed dispersal by currents of Avicennia), as well as reestablishment of inter-tidal and sub-tidal productive zones supporting various fisheries. The restoration of these wetlands will also increase habitat for birdlife; there exists a distinct difference between the birdlife within the (natural) reserve areas and the inhabited areas being considered for restoration activities.

Environmental impact assessment
Under current environmental legislation as well as India's new Coastal Regulation Zone (CRZ) Notification 2011 is that such community based mangrove planting of this A/R project activity does not require any form of Environmental Impact Assessment (EIA). No significant negative impacts have been envisaged by the project activity

6 STAKEHOLDER COMMENTS

Solicitation of comments from local stakeholders
The community living in the adjacent villages have been thoroughly briefed and meetings at levels organized to understand the procedure of carbon credits transfer to the Livelihoods Fund, to be used only for offsetting their GHG emissions and shall not take part in sales proceeds in the carbon market. The community has been involved in the process of collection of seedlings, nursery raising, plantation and livelihood activities to be undertaken to distribute the direct economic benefits of the project to them.

Land and Forest Protection Committee, who are responsible for the delegation of land to various boards/organizations for plantation/fishing and other usage has been consulted and relevant permission of the land use and the transfer of carbon credits by the local community to the Livelihoods Fund for the above mentioned purpose has been discussed and also obtained in writing.

Local Panchayats , Panchayat Pradhan or the Sabhadhipati has been consulted, briefed and their letter of permission for the same has been obtained.

The District Magistrate (South 24 Pgs) with special reference to Addll District Magistrate (Land Acquisition) ; Office of the PCCF , Wildlife – Deptt of Forests , Govt of West Bengal; Director , Sunderban Biosphere Reserve ; Jt Director, Sunderban Development Board; Jt Director, Fisheries Department have been briefed and informed ., Addll Jt Secy, MoEF – Govt of India has been briefed of the project.

Summary of the comments received
During the participatory process of project implementation, comments some of which are critical received from the village people during various consultations, meetings, trainings, etc. are briefly listed:

- Sabitri Mondal from the village Rudranagar of Sagar block said “one of our major problems is our domestic animals. As we have some cows, goats in our houses and we have to provide them with plants and grasses as their food, so if we feeding them on mudflats, from where we will get their food? And they also graze in the char lands for their food.”

- Saraswati Jana from the village Nikarighata of Canning I block had a complaint about fuelwoods, she said “Sometimes, we cook with the help of dry plants and their branches.

We collect fuel woods from the forests adjacent to the villages. If we stop cutting them then from where we will get our fuel wood?"

- In the parts of Rudranagar, Ramkarchar, Krishnagar, Patibonia in Sagar and Namkhana block respectively, the women of those villages were demanding higher rates for digging up pits as the soil in these regions were very hard in nature and it took more time and effort to conduct the job.

- Tapashi Mondal from the village Harekrishnapur in Sagar block asked, "Who will have the rights over the plants that we have planted in the region, will the plants be cut by them?"

- Women from different villages like Jotishpur, Ramganga, Bharatgarh, Jharkhali, Rudranagar, Ramkorchar demanded for more work after the plantation programme is over.

- Subhadra Das from the village Krishnagar raised a point that "Who will bear the responsibility of damaged saplings in the nursery?"

- Villagers from Rudranagar, Ramkorchar, Muriganga under Sagar block raised their concern over the tidal surges which are destroying their plantation.

- Champa Malik pointed out that the crabs, barnacles are destroying the nursery and she is worried about the problem.

- Increasing siltation is a serious problem in various parts of the plantation work addressed by Chandi Mondal in Joytispur.

- Concerns were raised in Ramganga block: During winter days gathering of huge algae over the saplings in the chars which creates serious damages within the plantation area of Kantamari and many other places under Kultoli block and Sagar block

- "Avicennia species are quite common, but if you insist on other species, they are not that common in Sagar block" – Gour Mondal in Rudranagar

- "Just after the winter, the spring winds take away some of the silts, we must build barricades to contain the silt"- Tarapada Mondal in Dakshin Surendraganj

- General comments throughout the project: "We have seen many agencies come and plant for one year and then they never come again".

- General comments throughout the project: "We are happy with NEWS activities but more livelihoods programmes should be taken to support the plantation activities in the coming years."

Report on consideration of comments received

Since most of the plantation plots are located on degraded wetlands, all farmers showed great

interest in the new land use activity under this project. Therefore, there were no concerns expressed by the stakeholders which required an action to be taken by NEWS during the project.

With regard to the occasional grazing of livestock on mudflats, it is generally not allowed as per Panchayat regulations. Panchayat as part of its own activity announces “catch and deposit” (locally called –khnowar) where one assigned person from Panchayat takes hold of the goats and cows that are found loitering on the mudflats and impose fine on the owner for doing so. NEWS as part of its activities within the communities:

- Sensitized the villagers and local community on the importance of these young shoots on the mudflats, as they will grow into big mangroves that will protect the embankments and bring sources of livelihoods for them.

- Identified the villagers who graze goats and cows on the mudflats and provide them with seeds of grasses like napier grass, Guinea grass , Bidhan rice beans, fodder maize, cowpea, coix, sorghum that grows very fast and can be grown in small land areas adjacent to their houses tp provide sufficient fodder for the livestock.

- Encouraged and implemented ways to the identified villagers to use the residues of paddy, vegetable stalk as fodder for the animals.

This has generated good response and in most cases beside the panchayats’ own ways of tackling this issue, NEWS awareness programs have left a strong impression.

APPENDIX: LIST OF SUPPORTING DOCUMENTATION

The following table is listing all supporting documentation available for this project on request.

NEWS – PILOT INVENTORY SAMPLING MONITORING PLAN
Mitra,A.; Zaman,S (2014). Carbon sequestration by coastal Floral Community. Teri - Hardcopy
2015-01-27 TARAM Ex-ante S1-3
2015-01-27 TARAM Ex-ante S4
2015-01-27 Summary Ex-ante
Third party audits – audit reports
Community agreement
Pending