Greenbelt plantation with Jhau (Casuarina equisetifolia) (Md. Fazlay Arafat)

Creating green shelter-belt through Jhau (Casuarina equisetifolia) plantation in coastal area (Bangladesh)

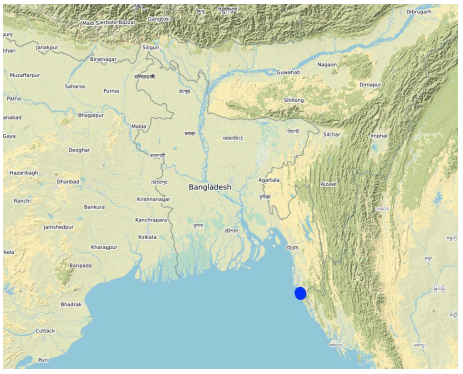
Coastal Greenbelt

DESCRIPTION

Creation of green shelter-belt along the coast line through plantation of Jhau (Casuarina equisetifolia) to reduce vulnerabilities and hazards of extreme weather events like cyclones.

The coastal zone of Bangladesh is extremely vulnerable to the impact of climate change. The coastal populations are mostly poor and some of them are landless with livelihoods connected to agriculture, fishing, shrimp farming, salt farming etc. Past devastating cyclones have killed thousands of people and destroyed homes and infrastructure. Creation of green shelter-belts, including mangrove and non-mangrove plantations, reduces the vulnerabilities and hazards related to extreme weather events like cyclones and storm surges. Afforestation along coastal areas is usually cheaper and ecologically more beneficial than other measures and serves to conserve biodiversity and stabilize newly accreted land. As a general guideline, a shelter-belt protects an area over a distance up to its own height on the windward side and up to 10 times its height on the leeward side, depending on the strength of the wind.
The current sustainable land management practice takes particular account of the Jhau plantation along the coastline of Himchari National Park of Cox's Bazar. Jhau (Casuarina equisetifolia) is one of the most promising non-mangrove species for creating shelter-belts and the Bangladesh Forest Department has been planting them in raised coastal lands and embankments since the 1990s. Casuarina equisetifolia is an evergreen tree with a finely branched, feathery crown and usually growing around 35 meters tall. It is fast growing, salt tolerant, grows in sand and can also tolerate occasional inundation by sea water at extremely high tides. Many areas where the species naturally occurs are susceptible to tropical cyclones, and its general tolerance to strong winds has encouraged its use in protective planting. The most common uses of C. equisetifolia are for coastal sand dune stabilization, shelter-belts, land reclamation and erosion control. The wood is hard and used for house posts, rafters, electric poles, tool handles, etc. It has been called 'the best firewood in the world' and also produces high-quality charcoal.
Coastal plantation with Jhau is a soft adaptation measure that has significantly contributed to reduce the loss of lives and properties against tropical cyclones and storm surges in the coastal areas. This species can be planted in coastline, roadside, embankment and marginal lands for creating dense vegetation, which can function as windbreak and combat tidal surges. The spacing used in this shelter-belt plantation along the coastline of Himchari National Park is 2m x 2m and 2500 trees are planted per hectare area. The examined shelter-belt plantations are approximately 1.5km long and 150m wide. The major activities required to establish the plantation were: nursery development (seed collection, site clearing, leveling and fencing, drainage arrangement, bed preparation, making overhead shed, poly-bag preparation, potting seeds, manuring, irrigation, weed control), site preparation (prepare plantation site map with GPS, weeding, marking pit location with sticks, carrying of seedlings to the site) and tree planting (digging of planting holes, tying up of plants with stick for support, application of fertilizers and compost). Weeding and vacancy filling were the maintenance activities which required up to three years after plantation establishment. All those activities carried out by the forest department with the financial help from world bank project fund. The local communities were involved as paid labour for nursery development, plantation and maintenance activities. Local people can only collect fuel wood from the plantation as its soul purpose is to act as shelter-belt from cyclones and tidal surge.
As the plantation site is on the coastline and beside the Himchari National Park, it turns to a tourist spot now for its scenic beauty. Local people involved with various sorts of tourist oriented small-scale business here e.g. parasailing, boating, restaurant, cottage industries, shops, etc. Though the initial establishment of Jhau stand need intensive care, it is functioning as a good wind breaker and combating with tidal surge along with creating alternate livelihood opportunities for local people.

LOCATION



Location: Hiimchari, Cox's Bazar, Chittagong, Bangladesh

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 92.03183, 21.33515
- 92.03458, 21.32175
- 92.04474, 21.29526

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?: Nee

Date of implementation: 10-50 years ago

Type of introduction
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☑ through projects/ external interventions

Plantation of Jhau along the coast (Md. Fazlay Arafat)

Jhau plantation at young stage (Md. Fazlay Arafat)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- ☐ improve production
- ☑ reduce, prevent, restore land degradation
- ☐ conserve ecosystem
- ☐ protect a watershed/ downstream areas – in combination with other Technologies
- ☐ preserve/ improve biodiversity
- ☑ reduce risk of disasters
- ☐ adapt to climate change/ extremes and its impacts
- ☑ mitigate climate change and its impacts
- ☑ create beneficial economic impact
- ☐ create beneficial social impact

Land use

Land use mixed within the same land unit: Nee

Forest/ woodlands

- Tree plantation, afforestation: tropical rain forest plantation - Pinus spp.. Varieties: Monoculture exotic variety

Tree types (evergreen): Casuarina equisetifolia
Products and services: Fuelwood, Nature conservation/ protection, Recreation/ tourism, Protection against natural hazards

Water supply

- ☑ rainfed
- ☐ mixed rainfed-irrigated
- ☐ full irrigation

Purpose related to land degradation

- ☐ prevent land degradation
- ☑ reduce land degradation
- ☐ restore/ rehabilitate severely degraded land
- ☐ adapt to land degradation
- ☐ not applicable

Degradation addressed

soil erosion by water - Wc: coastal erosion

soil erosion by wind - Et: loss of topsoil

SLM group

- forest plantation management
- windbreak/ shelterbelt
- ecosystem-based disaster risk reduction

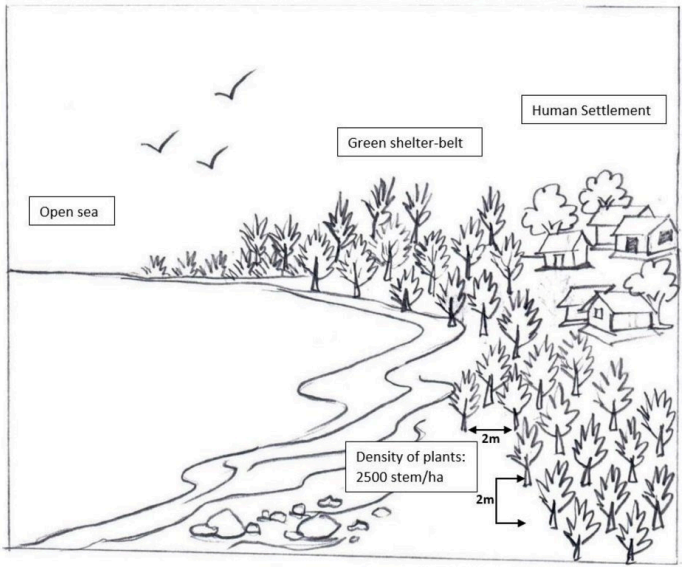
SLM measures

vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

Plant spacing between the Jhau trees is 2mx2m.



ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 hectare**; conversion factor to one hectare: **1 ha = 2.47 acres**)
- Currency used for cost calculation: **BDT**
- Exchange rate (to USD): 1 USD = 83.0 BDT
- Average wage cost of hired labour per day: 500

Most important factors affecting the costs

Labor

Establishment activities

1. Nursery development (seed collection, site clearing, leveling and fencing, drainage arrangement, bed preparation, making overhead shed, poly-bag preparation, potting seeds, manuring, irrigation, weed control) (Timing/ frequency: September-October)
2. Site preparation (prepare plantation site map with GPS, weeding, marking pit location with sticks, carrying of seedlings to the site) (Timing/ frequency: April-May)
3. Tree planting (digging of planting holes, tying up of plants with stick for support, application of fertilizers and compost) (Timing/ frequency: June-July)

Establishment inputs and costs (per 1 hectare)

Specify input	Unit	Quantity	Costs per Unit (BDT)	Total costs per input (BDT)	% of costs borne by land users
Labour					
Nursery preparation	person-days	17.0	500.0	8500.0	
Site preparation	person-days	7.0	500.0	3500.0	
Planting activities	person-days	22.0	500.0	11000.0	
Equipment					
Bucket	pieces	10.0	150.0	1500.0	
Spade	pieces	8.0	300.0	2400.0	
Scissor	pieces	2.0	150.0	300.0	
Knife	pieces	2.0	200.0	400.0	
Fertilizers and biocides					
Cow dung	cubic meter	1.0	1200.0	1200.0	
Urea	kg	6.0	35.0	210.0	
MoP	kg	6.0	30.0	180.0	
TSP	kg	6.0	40.0	240.0	
Compost	kg	1250.0	4.0	5000.0	
Construction material					
Poly bag	pieces	3000.0	0.8	2400.0	
Bamboo stick	pieces	2600.0	2.0	5200.0	
Signboard	Lump sum	1.0	1000.0	1000.0	
Total costs for establishment of the Technology				**43'030.0**	
Total costs for establishment of the Technology in USD				*518.43*	

Maintenance activities

1. weeding (Timing/ frequency: 3 times in a year)
2. vacancy filling (Timing/ frequency: June-July)

Maintenance inputs and costs (per 1 hectare)

Specify input	Unit	Quantity	Costs per Unit (BDT)	Total costs per input	% of costs borne by land

				(BDT)	users
Labour					
1st year Weeding (6 labor/weeding/Ha.) 3 times	person-days	18.0	500.0	9000.0	
2nd year Weeding (5 labor/weeding/Ha.) 3 times	person-days	15.0	500.0	7500.0	
3rd year Weeding (5 labor/weeding/Ha.) 2 times ng and cleaning (5 labor/weeding/Ha.) 1 time	person-days	10.0	500.0	5000.0	
Vacancy filling	person-days	5.0	500.0	2500.0	
Equipment					
Bamboo stick	pieces	1000.0	2.0	2000.0	
Total costs for maintenance of the Technology				**26'000.0**	
Total costs for maintenance of the Technology in USD				*313.25*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [x] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
n.a.

Slope
- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude
- [x] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [x] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [x] excess
- [ ] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [x] unusable

Water quality refers to: both ground and surface water

Is salinity a problem?
- [x] Ja
- [ ] Nee

Occurrence of flooding
- [x] Ja
- [ ] Nee

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [x] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] animal traction
- [ ] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [ ] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [x] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [x] youth
- [x] middle-aged
- [x] elderly

Area used per household

Scale

Land ownership

Land use rights

- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [x] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Water use rights

- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

health	poor	good
education	poor	good
technical assistance	poor	good
employment (e.g. off-farm)	poor	good
markets	poor	good
energy	poor	good
roads and transport	poor	good
drinking water and sanitation	poor	good
financial services	poor	good

IMPACTS

Socio-economic impacts

wood production	decreased	increased	
non-wood forest production	decreased	increased	leaves and fruits are used for ornamental purposes
risk of production failure	increased	decreased	Jhau tree performs better than other trees for stabilization of coastal sand dune
product diversity	decreased	increased	the plantation site now become a picnic spot for its scenic beauty (tourism has been attracted because of the coastal plantation)
production area (new land under cultivation/ use)	decreased	increased	
land management	hindered	simplified	
diversity of income sources	decreased	increased	The area attract more tourists now and local people involved in various type of small scale business here
workload	increased	decreased	The workload reduced due to diversified income source of local community

Socio-cultural impacts

cultural opportunities (eg spiritual, aesthetic, others)	reduced	improved	New year celebration program now organized here every year
recreational opportunities	reduced	improved	This area now become a tourist hotspot
SLM/ land degradation knowledge	reduced	improved	Learn about the stabilization of sand dunes

Ecological impacts

soil cover	reduced	improved	
soil loss	increased	decreased	
soil accumulation	decreased	increased	
soil organic matter/ below ground C	decreased	increased	
vegetation cover	decreased	increased	
biomass/ above ground C	decreased	increased	
beneficial species (predators, earthworms, pollinators)	decreased	increased	The green belt support home for native birds
habitat diversity	decreased	increased	
flood impacts	increased	decreased	
impacts of cyclones, rain storms	increased	decreased	
emission of carbon and greenhouse gases	increased	decreased	
wind velocity	increased	decreased	

Off-site impacts

wind transported sediments — increased ✓ reduced

protection of agricultural land on back side of shelter-belt

impact of greenhouse gases — increased ✓ reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative ✓	very positive
Long-term returns	very negative ✓	very positive

Benefits compared with maintenance costs

Short-term returns	very negative ✓	very positive
Long-term returns	very negative ✓	very positive

CLIMATE CHANGE

Climate-related extremes (disasters)

tropical storm	not well at all ✓	very well
local rainstorm	not well at all ✓	very well
local thunderstorm	not well at all ✓	very well
storm surge/ coastal flood	not well at all ✓	very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 11-50%
- ☐ > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ☐ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☑ 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Ja
- ☑ Nee

To which changing conditions?

- ☐ climatic change/ extremes
- ☐ changing markets
- ☐ labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Function as wind break and combat tidal surges
- Increases the soil fertility of the degraded land through nutrient cycle

Strengths: compiler's or other key resource person's view

- Biodiversity conservation through habitat improvement
- Increase carbon sequestration

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Initial establishment of stand need intensive care and risk of failure is high Increase technical capabilities of forest officials

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- Jhau tree is not a natural vegetation for the sand dunes Introduce other indigenous salinity tolerant plant species in the green shelter belt

REFERENCES

Compiler
Fazlay Arafat

Editors

Reviewer
Nicole Harari
Rima Mekdaschi Studer
Ursula Gaemperli

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Resource persons
Hoq Mahabub Morshed - land user
Dhiman Mondol - land user
Md. Sobur Ali - land user

Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_4333/

Linked SLM data
n.a.

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Key references

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