



Global Re-introduction Perspectives: 2013

Further case-studies from around the globe
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IUCN/SSC Re-introduction Specialist Group (RSG)





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Twenty years of Indus Delta mangroves development and rehabilitation by Sindh Forests Department, Pakistan

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Introduction

The Indus Delta mangroves represent the sixth largest mangrove block worldwide. The Delta stretches over 348 km from Karachi, Sindh, Pakistan to the India-Pakistan border. The delta is a typical fan-shaped and spread over about 617,470 ha and is characterized by 17 major creeks, innumerable minor creeks, mud flats and fringing mangroves (Qureshi, 1999). At present, 280,470 hectares mangrove forests are managed by Sindh Forest Department, 64,400 hectares by Port Qasim Authority and are declared as "Protected Forests". Some 272,600 ha are under the control of Sindh Board of Revenue, Pakistan (Vistro, 1999). Mangroves are playing a vital role in the economy of Pakistan, besides environmental, in the shape of fisheries they harbor. Some 81,000 people living along the coastal belt use *Avicennia marina* as a major source of fuel. It is estimated that about 18,000 tons of mangrove wood is burnt annually for cooking and heating purposes. Some 6,000 camels are also herded into the mangrove forests for browsing *A. marina* leaves (Hoekstra, 1998).

The Indus Delta mangrove ecosystems is dominated by a single species;



Avicennia marina in the Indus Delta

Avicennia marina (over 95%) followed by *Rhizophora mucronata*, *Ceriops tagal* and *Aegiceras corniculatum*. At present, Indus delta mangroves are under severe stress on account of a combination of natural and human induced factors. These factors are the drastic reduction of fresh water flow to the Delta, less addition and deposition of silt load, a tremendous increase in population along the

coastal belt resulting in the illegal cutting of mangroves for constructing residential buildings, cooking and heating. A large number of camels, cows and buffalos are also grazing within the mangroves. Seawater pollution is another major threat to mangroves. Untreated domestic sewage of Karachi city along with significant volume of untreated discharges from about 6,000



Planting mangroves in the Indus Delta

industrial units is drained in to the mangrove area. Besides, oil spills from ships, dredging of shipping channels and thermal pollution from industrial mills and thermal power plants are causing great damage to existing mangroves and also hindering the natural regeneration process.

The quality and area under mangrove forests has deteriorated and declined during the last five decades. The satellite imageries taken and surveys done at periodical intervals shows that mangrove forest have shrunk from 344,870 ha to 86,727 ha. The first survey was done by Khan in 1966 shows that some 344,870 ha were under mangrove forests. Another survey conducted by Amjad and Khan (1983) estimated about 283,000 ha mangrove forests in the Indus delta. A survey done during 1983 - 1984 by Tahir Qureshi estimated about 280,470 ha under mangrove cover. After an interval of 20 years in 2003, SUPARCO prepared a mangrove vegetation map by using SPOT imageries. It was reported that area under mangrove forests have drastically shrunk to about 86,727 ha (IUCN, 2005).

Realizing an alarming situation of depletion of mangrove vegetation, Sindh Forests and Wildlife Department, Government of Sindh, Pakistan initiated nine mangrove rehabilitation/development projects from the year 1993 to 2012 with the assistance and partnership of "The World Bank, Asian Development Bank, Government of Pakistan and Government of Sindh" to mitigate the degradation process and loss of mangrove habitat. As per data compiled by the Office of Chief Conservator of Forests, Sindh, Pakistan, some 70,300 hectares have been rehabilitated/planted with local mangrove species during the last 20 years period from the year 1993 to 2012. The most fascinating aspect of these projects besides rehabilitating huge degraded areas is; setting of two new "Guinness World Records" during the year 2009 and 2013.

Goals

- Goal 1: To rehabilitate and develop mangrove habitats impacted by natural and human induced factors.
- Goal 2: To transform sparse mangrove forests into dense forests.
- Goal 3: To increase diversity of local mangrove species.
- Goal 4: To halt/minimize mangrove degradation process.
- Goal 5: To introduce social forestry in the coastal belt.
- Goal 6: To maintain plantation areas with minimum mortality.
- Goal 7: To encourage and insure participation of local communities in mangrove rehabilitation, plantation and protection activities.

Success indicators

- Indicator 1: Establish mangrove plantations on blank mudflats.
- Indicator 2: Convert sparse mangrove forests into dense forests.
- Indicator 3: Increase diversity of mangrove species.
- Indicator 4: Mortality of planted mangroves below 20%.

Project summary

Feasibility: The first mega-mangrove rehabilitation project was started during the year 1993. The project was jointly sponsored by “The World Bank and Government of Sindh”. Keeping in view the success stories of this project, Sindh Forest Department launched eight more mangrove conservation and development follow on projects from the year 2000 to 2011 with the cooperation and funding of “Asian Development Bank, Government of Pakistan and Government of Sindh”. Detailed field surveys of Indus delta falling in Karachi, Keti Bandar and Shah Bandar Forest Ranges were conducted by the Sindh Forest Department’s staff to identify and demarcate the most suitable areas for establishing plantations.

The criteria for selecting the plantation sites were as follows:



Avicennia marina nursery

- Tidal flats with muddy substratum and natural channels where regular tidal inundations occur.
- Bare, non-vegetated areas where mangroves occurred in the past.
- Sparse natural mangrove areas.

After critical evaluation, potential sites were selected for planting and rehabilitation. The procurement of “quality planting stock” was the second most important

step to execute the projects. The required planting stock was made available by three ways as follows:

- Selection and collection of healthy propagules of *R. mucronata* and *A. marina*.
- Establishment of intertidal container plants nurseries of *R. mucronata*, *A. marina*, *C. tagal* and *A. corniculatum*.
- Collecting wildings of *A. marina* from the donor sites.



Rhizophora mucronata nursery

The propagules and container plants were transported from nurseries to plantation sites by motor boats.

Implementation: This massive rehabilitation/plantation initiative was implemented through nine development projects sponsored by World Bank, Asian Development Bank, Government of Pakistan and Government of Sindh from the year 1993 to 2013. The selected areas for planting were carefully demarcated by fixing flags on the outer boundaries. Temporary holding nurseries were established near the planting sites for the storage of propagules and container plants. Before shifting of propagules and container plants from the nurseries to planting sites, each propagule and container plant was evaluated, and only healthy propagules and container plants were selected for planting. The selected propagules and container plants were put in the plastic boxes for safe handling and transportation up to temporary holding nurseries by boats. The plantation operations were carried out during low tide periods in the day time. The location of each plant was demarcated on the site. The labor and the labor supervisors were provided adequate training and knowledge on handling and planting seedlings before start of plantation operations. The plantations were established in a square shape at 3 m x 3 m spacing. Against the plantation target of 117,632 ha, 70,300 ha have been planted at various plantation sites of Karachi, Keti Bunder and Shah Bunder forest ranges from the year 1993 to 2012. Some 44,000 ha will be planted/rehabilitated within coming five years time up to year 2017.

Another milestone of these rehabilitation/plantation projects is that: two times “Guinness World Records” have been achieved during the year 2009 and 2013. On 15th July 2009, a team of 300 volunteers belonging to adjoining local communities planted 541,176 seedlings of *Rhizophora mucronata* within 24 hours time (day time) in Keti Bandar Forest Range. Once again, after a lapse of four years, a new “Guinness Record” was set on 22nd June 2013 by planting 847,275



Volunteers after setting the Guinness World Record

R. mucronata seedlings within 24 hours time (day time) by a team of 300 volunteers of local communities in Kharo Chan/Keti Bandar coastal area.

Post-planting monitoring: All the plantations established at various sites were monitored at regular basis after six months of plantation. The survival data was recorded from the permanent randomly selected plots. The

survival percentage of plantations ranges from minimum 50% to as high as 90%.

Major difficulties faced

- Less and late release of funds.
- Stormy and rainy weather conditions.
- Rough high tides.
- Muddy site conditions difficult to work.
- Daily change in planting time due to change in low and high tide time.
- Limited planting season.
- Transport of saplings to planting sites during low tide period.
- Lack of adequate skilled/trained labor force.

Major lessons learned

- Site selection for mangroves plantations is most important. Survival and growth of plants depends on proper site selection.
- Predominantly bare sandy soils should not be selected for plantations.
- Plantations should not be established on high tidal mud flats.
- The survival rate is more when planting is done during the low tide period and there is no wave action.
- Involvement of local Jat community leaders is essential. Without their help and cooperation, it is very difficult task to protect young mangrove plantations.
- Local communities prefer *A. marina* plantations to *R. mucronata* plantations due to its fodder and fuel value.
- Survival and growth rate is affected by selection of planting material and site suitability of the mangrove species.
- Planting of *R. mucronata* propagules give better results as compared to container plants.
- Inbuilt mechanism of monitoring and evaluation system is the key for achieving high plantation success rate.

- Plantation maintenance funds are vital for successful establishment of mangrove plantations. Government of Sindh/Pakistan must provide adequate maintenance funds after completion of the development projects.

Success of Project

Highly Successful	Successful	Partially Successful	Failure
	√		

Reason(s) for success/failure:

- Selection of most suitable plantation sites.
- Selection of healthy and proper sized planting stock.
- Planting operations at the correct time and planting season.
- Care in handling and transportation of plants from nursery to plantation sites.
- Effective technical guidance and supervision.
- Regular monitoring.
- Involvement and cooperation of local communities.
- Building teamwork and ownership among the labor and field staff.

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