

DEVELOPMENT OF AN INTERTIDAL MANGROVE NURSERY AND AFFORESTATION TECHNIQUES

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INTRODUCTION

Indiscriminate over-exploitation of the mangrove resources without any coastal land-use plan, has degraded this fragile Intertidal ecosystem in India (Krishnamurthy *et al.*, 1987). Some of the major pressures are abiotic and biotic with special reference to the population pressure. All such activities, aptly called 'human interferences', have denuded the mangrove forests along the East as well as West coasts for the last few centuries (Blasco, 1975, 1977). Some of the impacts are depleting fishery resources, increased coastal erosion and harmful pollution levels (Untawale, 1986).

Silvicultural techniques like regeneration, restoration and afforestation of mangroves can be the only answers to these otherwise serious problems (Hamilton and Snedaker, 1984). Efforts have been made earlier in several countries to use various methods for improving the ecological balance of these degraded areas (Karim *et al.*, 1984; Kogo, 1985, 1986; Kogo *et al.*, 1986). In India also similar efforts were made but on limited scale and on short term basis (Mathauda, 1959; Untawale, 1986a, 1987; Jagtap, 1985). It has been estimated that approximately 100,000 ha of barren Intertidal mangrove area is available for afforestation programme along the Indian coast (Untawale, 1987a). Recently, Space Application Centre (SAC), Ahmedabad and Forest Survey of India have also studied such areas with remote sensing techniques.

Ecological studies for different mangrove regions along the East and West coasts of India have been made (Krishnamurthy *et al.*, 1989; Untawale, 1986; Blasco, 1975, 1977; Wafar, 1987; Jagtap, 1985). Climatology, hydrology, e.g., tidal amplitude and inundation play an important role in the distribution and growth of mangroves. The zonation of species depend mainly on the salinity of the water. These data are of great significance in undertaking afforestation work. Very good case studies have been presented by Dexter, *et al.* (1986) and by Mohmad Nor *et al.* (1986) on the community based mangrove afforestation and the forest management.

MANGROVE NURSERY

Earlier attempts of restoration, regeneration and afforestation have been with direct planting of mangrove propagules or seeds (Kogo, 1985, 1986; Karim *et al.*, 1984; Hamilton and Snedaker, 1984). There was, however, no attempt growing the seeds or propagules in an Intertidal nursery. Taking into consideration the non-availability of seedlings, distance of the transplantation sites and also the size of afforestation area, it was thought appropriate to develop an Intertidal mangrove nursery.

Following criteria were used for the site selection of a mangrove nursery:

1. Upper or middle intertidal region with gentle gradient, generally protected from the strong waves as well as currents,

2. Silty-Clayey substratum, and
3. Areas with daily tidal inundation and exposure.

After the site selection, necessary studies on water quality, sediment, tidal amplitude and the biota, etc., were made. This was followed by making a plan of the nursery like footpaths (or the wallboard raised above the water level), laying of beds with bamboo support, and working out other details. The beds were slightly raised with platforms of different sizes and supported with split bamboo on the sides to prevent possible drifting of the polybags. The polybags (20 cm x 10 cm) were kept ready with holes at the base, filled with mangrove soil and kept in upright position close to each other inside the bamboo-supported beds for plantation.

SOURCE OF PLANTING MATERIAL

There are different sources for collecting the mature propagules, seeds, etc. for largescale plantation. For collecting material at proper maturity, studies were undertaken for their distribution and fruiting season. This material was then collected from :

1. Naturally growing young (2 to 3 months old) seedlings. These can be directly transplanted at a permanent site.
2. Fully mature propagules, fruits or seeds from the trees, and
3. Nursery raised seedlings for transplantation.

NURSERY PLANTATION

Once the plantation material was carefully collected and transported to the nursery site, it was further sorted out to avoid injured, infected or tender propagules and seeds. Even the naturally grown seedlings with disturbed or broken root system were discarded. This precaution decreased the mortality rate and increased the survival percentage with good healthy growth. Even seedlings with insect borers' or foulers' attack were avoided.

Such selected plantation material was taken to the beds. The mature propagules with tapering ends were gently pushed in the polybags up to 1/3rd or 1/4th of their length, while *Avicennia* fruits were pressed in the polybags filled with mud. Separate beds for different mangrove species were used. The number of polybags in each bed varied, depending on the area available and the requirement of the plantation material. A moderate mangrove developed nursery at Chorao Island, Goa had approximately 40,000 to 50,000 seedlings at a time.

Normally, all the seeds and propagules were found germinating with 95 to 100% success. However, different mangrove species showed variable dormancy periods. Rhizophoraceae propagules and *Avicennia* seeds grew quite rapidly, however, seeds of *Sonneratia*, *Heritiera*, and *Xylocarpus* took long time for germination. Many times it was found economical and time saving to pick up tiny seedlings of such species available in plenty in the mangrove swamps, during low tide, than waiting for their germination, artificially. There was no need for much aftercare of the seedlings in the nursery till they were transplanted.

TRANSPLANTING SEASON

Although the mangrove propagules and the seedlings can be transplanted throughout the year, it has been noticed that the seedlings transplanted during the rainy season, when salinity of water and soil is low, grow better with high survival rate. Attempts of afforestation made in the mesohaline and oligohaline regions with more freshwater influence and low salinity were successful. Use of appropriate species with suitable salinity tolerance range, was found to be the key to this success.

TRANSPLANTATION TECHNIQUE

Transplantation of mature propagules or nursery raised seedlings was comparatively easier in the soft, muddy substratum. However, the entire operation has to be completed during the short period of exposure, i.e., low tide. Before actual transplantation, the site was studied for its profile, tidal inundation levels, and substratum. The plantation pattern was then prepared on the basis of natural zonation and germination according to the tidal inundation. Simultaneously, field workers were taken to the site, and with the suitable low tide, transplantation work was undertaken.

The distance between both, rows and seedlings was maintained at 1 to 1.5 m. Holes were made with bamboo wherein the seedlings or propagules were pushed and the mud was strengthened. After completing about 15 rows, a gap of 10 m was left for future forestry operations or even fishing.

FINANCIAL ESTIMATES

There are different components involved in this programme as indicated below :

1. Research and Development work,
2. Salary of the staff (including labour cost),
3. Material cost,
4. Transportation cost (boat/vehicle), and
5. Maintenance cost.

Since the mangrove research and management is normally handled by the Government agencies, the expenditure can be reduced with long-term planning and the benefits expected. The entire programme can be a part of the Coastal Zone Management.

PROJECT IMPLEMENTATION AND EXTENSION

Once the basic concepts of the model mangrove nursery was planned, it was implemented with the help of the Forest Department of Goa Government at Chorao Island in the Mandovi estuary. Afforestation was with 85 to 90% success. Similar mangrove nurseries and afforestation programmes were extended to other adjacent States like Maharashtra under the social forestry activities.

PROBLEMS

Although there are no major problems envisaged at present, however, some minor problems were found to creep in for which solutions were found. Some of the problems experienced are described below :

MORTALITY DUE TO THE AFFECTED MATERIAL

The mortality was mainly because of selection or collection of injured, infected or tender seeds and seedlings. Needs proper care and training of staff.

ALGAL GROWTH

Dense mats of marine algae prevented growth or chokes the young mangrove seedlings. This can be solved either by manual clearing of algal mat or using 1 or 2 year old nursery raised seedlings, whose foliage would be beyond water column and prevent the seedlings from choking.

EFFECT OF SILTATION

Excessive siltation or turbidity resulted in sediments getting deposited on the foliage of young seedlings and thus prevented photorespiration. Gastropods eventually attacked and destroyed such seedlings. 1 or 2 year old nursery raised seedlings might minimise the problem.

AREAS WITH PROBLEM OF EROSION

On an open mud-flat where heavy erosion was observed, suckers of wild grass *Porteresia coarctata* was tried with great success for stabilisation of mud-flats. This can be followed by planting regular mangrove seedlings.

CATTLE GRAZING

This problem can be solved with regular patrolling by the supervisory staff.

FISHING ACTIVITIES

Operation of fishing nets usually damage the young seedlings. Education to the fisher folks can minimise the problem.

CYCLONES

The storms and cyclones with strong waves and winds can damage the mangrove nursery. It is therefore, advisable to have mangrove nurseries within mangrove forests. More studies are needed on this aspect.

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