UNDERPLANTING--A MEANS TO ENSURE SUSTAINABLE MANGROVE PLANTATIONS IN BANGLADESH

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ABSTRACT

The mangrove plantations mainly with *Sonneratia apetala* and *Avicennia officinalis* along the coastal belt and offshore islands of Bangladesh encounter a number of problems. Of these, geomorphological changes, species succession and insect infestation are threatening to the continuity of the established plantations under the traditional management practices. New management strategy has to be developed for the sustainability of mangrove forests. Research in this direction is in progress and it appears that underplanting with suitable species in the existing plantations may be a solution to the problem. Commercially important species like *Excoecaria agallocha, Heritiera fomes* and *Xylocarpus mekongensis* appear promising for their inclusion in the proposed large scale underplanting programmme.

সারসংক্ষেপ

উপকূল ও দীপাঞ্চলে প্রধানতঃ কেওড়া ও বাইন দ্বারা সৃজিত ম্যানগ্রোভ বন অনেক সমস্যার সম্মুখীন। ভূগঠন প্রকৃতিতে পরিবর্তন, প্রজাতির ক্রমাগমন এবং কীট পতঙ্গের আক্রমণ ইহাদের মধ্যে উল্লেখযোগ্য। এই সকল সমস্যার কারণে প্রচলিত বন ব্যবস্থাপনা পদ্ধতিতে সৃজিত ম্যানগ্রোভ বনের অস্তিত্ব হুমকীর সম্মুখীন। এমতাবস্থায় নূতন ব্যবস্থাপনা কৌশল উদ্ভাবন আবশ্যক। এই লক্ষ্যে বর্তমানে গবেষণা চলিতেছে। উপযুক্ত বৃক্ষ প্রজাতির সাহায্যে প্রতিষ্ঠিত ম্যানগ্রোভ বনের আন্ডারপ্লানটিং উল্লেখিত সমস্যার সমাধান হইতে পারে। প্রস্তাবিত ব্যাপক আন্ডারপ্লানটিং কর্মসূচীর জন্য গুরুত্বপূর্ণ গেওয়া, সুন্দরী ও পশুর গাছ বিশেষ উপযোগী বলিয়া প্রতীয়মান হয়।

INTRODUCTION

Background

The coastal areas of Bangladesh experience cyclonic ravages almost every year. The Forest Department initiated mangrove afforestation in 1966 with the primary objective of saving life and properties of the people living in the area from cyclone and tidal bore (Das and Siddiqi

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1985). Subsequently, the objectives of coastal afforestation were expanded to (i) reclamation and stabilization of newly accreted land and acceleration of further accretion, (ii) production of timber for fuel wood, and (iii) creation of employment opportunity in remote rural areas (Saenger 1987).

The project gained momentum with the involvement of the World Bank in 1975 (Imam 1982). A total of 115,424 hectares mangrove plantation was raised till 1991 (Dalmacio *et al* 1991).

Species planted and their status

No systematic studies were carried out for selecting suitable mangrove species for the massive planting programme. However, most of the commercially important mangrove species were tried at the initial stage (Choudhury 19971, Alim 1974, Siddiqi and Khan 1990). Of the various species tried, *S. apetala* and *A. officinalis* proved to be most successful by their higher survival and growth performance. According to Drigo *et al.* (1987), *S. apetala* constitutes 67% of the planted areas while 18% is planted with *Acacia nilotica*, a non-mangrove species. *Avicennia* is the principal species in the eastern part and forms 68% of the plantations of Chittagong coastal areas.

Problems encountered

The coastal environment is a highly dynamic. Unlike the natural mangroves, the mangrove plantations are encountered with a number of serious problems. These include (i) geomorphological change, (ii) ecological succession and (iii) insect infestation.

Geomorphological change - Frequently there is so much accretion that the area becomes unfavourable for continued growth of *S. apetala* and *A. officinalis* (McChonchie 1991), the pioneer species in the ecological succession. These species prefer higher degree of inundation. But with the rapid rise of forest floor they appear to be in a physiologically stressed condition in different parts of the coastal area.

Ecological succession - Usually successional changes occur when the environmental condition is unsuitable for the pioneer or existing species. Thus in the Sundarbans natural forest, *E. agallocha* or *H. fomes* occupies the area by replacing the pioneer species. In the coastal belt, due to non-availability of seed source and bahaviour of the tidal current such natural succession can not occur in order to ensure sustainable yield and continuity of the forest.

Insect infestation - Already stem borer infestation in *S. apetala* plantations has caused a serious threat for maintenance of sustainable plantations (Saenger and Siddiqi, 1993). In 1988, a mean of 52% trees was affected due to stem borer, *Zeuzera conferate* (Cossidae ; Lepideptera) as reporter by Islam *et al.* (1989). Usually, intensity of infestations is higher in monospecific crop. Research is underway to investigate the possibility of mixed crops on newly accreted lands. A positive result is yet to achieve (Anon 1991). No measure has been formulated to control the pest. Dalmacio *et al.* (1991) pointed out that natural regenerations was sparce or absent. It is therefore, necessary to plant up the species appearing in the later successional stages under the canopy cover of existing plantations. It may however be mentioned that unlike the pioneer species, such species can flourish under an optimal light condition (Troup 1921, Sasaki and Mori 1981, Hutchings and Saenger 1987), inundation level, and on relatively matured soil. It was therefore, necessary to conduct underplanting trial in different parts of the coastal belt to study the feasibility of raising other, preferably more

valuable species for replacement of existing declining plantations.

Underplanting trial

As the maturity is reached and harvesting of *S. apetala* takes place, some of the coastal areas will have no vegetation cover. In order to maintain a continuous forest cover in the coastal areas and to enhance the production of the coastal forest while *S. apetala* is maturing, underplanting is highly desirable. With this in view, the Plantaion Trial Unit (PTU) under Bangladesh Forest Research Institute (BFRI) has been conducting underplanting trial in different parts of the coastal belts and offshore islands.

Locations of the experimental plots

The experiments were laid out at Rangabali and Char Kukri Islands of Patuakhali and Bhola Coastal Afforestation Divisions respectively during 1990 and 1991. Currently the experiment is being extended to Noakhali and Chittagong coastal areas covering more areas.

MATERIALS AND METHODS

Nursery raising

The seeds or propagules were collected from the Sundarbans, and nursery in polybags was raised at Rangabali. In course of raising nursery, various information relating to seed morphology, viability, germination success, seedling growth were recorded for 13 mangrove species (Siddiqi *et al.* 1991).

Species tried

Most of the commercially important species namely *H. fomes, X. mekongensis, Ceriops decandra, Bruquiera sexangula, Aeqiceras corniculatum, E. agallocha, X. grantum, Cynometra ramiflora, Phoenix paludosa and Lumnitzera racemosa* were underplanted for observing their performances in consecutive two years (1990 and 1991) at four places.

Method of planting

Ten months old seedlings were planted in the 9-12 years old thinned *S. apetala* plantations. The experiment was laid out in Randomised Complete Block Design with three replications. Each plot was planted with 100-121 seedlings at a spacing of 1.2 m x 1.2 m. Subsequently, data on survivals and height increments were recorded at every three months interval. Some of the planted species were found prospective. But to make a firm recommendation, data are to be collected for a longer period and from more representative areas. As regards performance of the species, survival was considered as more dependable basis for the time being as the seedling growth rate is different at various stages of development for various species. Some mangroves, *H. fomes* for example, has higher initial growth in root system and subsequently there is increase in the shoot (Rahman 1990).

RESULTS AND DISCUSSION

Underplanting on experimental basis was carried out in four places at Rangabali and Kukri during 1990 and 1991. Data on the survival and growth of the outplanted seedlings were collected in June 1992. The experiment is being extended to Chittagong and Noakhali coastal belt to cover more representative areas. Besides, in order to obtain a dependable result based on sound statistical analysis, it is desirable to collect information from the established experimental plots for a longer time. However, from the available data (Tables 1 & 2), it appears that *E. agallocha, X. mekongensis* and *H. fomes* may be included in the underplanting programme. Average survivals of these species were 98, 78 and 89 percent respectively. Their annual height increments were 104, 38 and 26 cm respectively.

Table 1 **Performance of mangrove species in the underplanting trial at Rangabali of Patuakhali Coastal Afforestation Division.**

Name of species	Two-year old plantation			One-year old plantation		
	Mean Seedling ht. (cm) at planting time	Annual ht. increment (cm)	average survival %	Mean seedling ht. (cm) at planting time	Annual ht. increment (cm)	average survival %
Heritiera fomes	60	37	90	46	36	73
Xylocarpus mekongensis	73	52	87	84	57	73
Excoecaria agallocha	33	121	98	45	97	99
Ceriops decandra	16	21	68	30	10	71
Bruquiera sexanqula	34	20	35	43	15	95
Aeqiceras corniculatum	22	68	83	50	70	97
Cynometra ramiflora	40	31	67	37	14	48
Phoenix paluodosa	28	44	94	32	32	96
Xylocarpus granatum	—	—	—	86	27	64
Lumnitzera racemosa	—	—	—	29	38	81

It may be noted that *B. sexangula, X. mekongensis C. decandra* were browsed by the spotted deer *(Axis axis)* at Kukri. Deer was introduced only in this island. So the animal is not a problem in other coastal areas. However, cattle grazing causes considerable damage to new plantation. Therefore, at the time of initiating an underplanting programme the area must be kept free from domestic harbivores.

Phonix paludosa is a thorny palm. The trunk is used as post and is of considerable demand. It showed good success, average survival being 95 percent. This species can be planted in mixture with other trees as understory. A mixed crop is also desirable from the silvicultural point of view.

Table 2 Performance of mangrove species in the underplanting trial at Char Kukri Mukri of Bhola Coastal Afforestation Division.

Name of species	Two-year old plantation			One-year old plantation		
	Mean Seedling ht. (cm) at planting time	Annual ht. increment (cm)	average survival %	Mean seedling ht. (cm) at planting time	Annual ht. increment (cm)	average survival %
Heritiera fomes	60	23	95	46	09	97
Xylocarpus mekongensis	73	04	52	84	39	99
Excoecaria agallocha	33	123	95	45	73	100
Ceriops decandra	16	16 *	58	30	06	97
Bruquiera sexangula	34	04 *	01	43	09 *	93
Aeqiceras corniculatum	22	44 *	70	50	24	97
Cynometra ramiflora	40	28	71	37	09	93
Phoenix paludosa	28	44 *	89	32	57	100
Xylocarpus granatum	—	—	—	86	13	97
Lumnitzera racemosa	—	—	—	—	—	—

* Browsed by the spotted deer *(Axis axis)*

CONCLUSION

One of the objectives of the coastal afforestation is transforming a large part of the newly accreted area to agricultural land. Though the protective benefits of coastal plantation against cyclone and wave action have not been quantified, its importace is well-recognized. Maintenance of a permanent mangrove plantation all along the long coastal belt of Bangladesh is of immense importance. Underplanting with suitable species namely *E. agallocha*, *X. mekongensis* and *H. fomes* in the established plantations is likely to offer sustained yield and continuity of a permanent forest cover in the coastal region. This is however, an interim report and the final one will be available after a few years.

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