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PERFORMANCE OF SOME MAINLAND TREES AND PALM SPECIES PLANTED IN THE COASTAL ISLANDS OF BANGLADESH

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Abstract

Considering the sustainability of coastal forests, a trial with 13 mainland tree species was conducted at Rangabali island of Patuakhali district and Char Kukri-Mukri island of Bhola district to observe the site-suitability and growth performance of the species. Another experiment of 4 palm species was conducted in a foreshore area at Char Kukri-Mukri island. On the basis of survival, height and diameter growth, *Samanea saman* (Jacq.) Merr. (rain tree), *Casuarina equisetifolia* Forst. (jhao), *Pithecellobium dulce* Benth. (payra), *Albizia lebbeck* (L.) Benth. (kala koroi) and *Albizia procera* (Roxb.) Benth. (sada koroi) at Rangabali; and *P. dulce*, *Acacia nilotica* (L.) Willd. (babla), *S. saman* and *C. equisetifolia* at Char Kukri-Mukri were found promising. Among the palm species, *Cocos nucifera* L. (coconut), *Phoenix sylvestris* Roxb. (date palm) and *Borassus flabellifer* L. (palmyra palm) showed good growth performance in the foreshore area. Therefore, these promising mainland trees and palm species are suitable for raising large scale plantations in the raised coastal lands of Bangladesh.

Key words: Coastline, Afforestation, Mainland tree, Palm species, Growth performance

Introduction

The coastline of Bangladesh extends over 710 km long along the Bay of Bengal. There are numerous *char* and offshore islands of different sizes in the coastal belt. The Forest Department started coastal afforestation programme in 1966 with the primary objective to protect the lives and properties of the coastal people from cyclone and tidal bores (Das and Siddiqi 1985). Simultaneously the other objectives were to reclaim and stabilize the newly accreted *char* lands and production of timber for fuel wood (Saenger 1987). Later on the Forest Department carried out massive afforestation in all over the coastal areas under different development projects. Approximately 0.19 million hectares of accreted land have been brought under mangrove plantations till 2010 (Nandy 2010). *Sonneratia apetala* Buch. Ham. (keora) was the most successful in all along the coastline consisting 94.4%, while *Avicennia officinalis* L. (baen) was successful only in the eastern belt consisting 4.8% of the existing mangrove plantations (Siddiqi and Khan 2004).

The coastal ecosystem is highly dynamic ecosystem. *S. apetala* and *A. officinalis* are the pioneer species in the succession (McChonchie 1990). Massive development of pneumatophores in planted species causes increase in the deposition of silts and rapidly rises of the forest floor. Heavy siltation in the plantation sites, species succession and

insect infestation are threatening the sustainability of the established *S. apetala* plantations under the traditional management practices (Siddiqi *et al*. 1992). The geomorphic changes affected regular inundation in the forest floor and growth of *S. apetala* plantation. As a result the growth of *S. apetala* is stunted and finally gaps were created due to mortality (Serajuddoula *et al.* 1995). The raised lands become unsuitable for the optimum growth of *S. apetala* and *A. officinalis* species. Other mangrove species does not grow and survive in this situation (Siddiqi 2001). So, the feasibility of non-mangrove species in the raised but vacant lands was highly desirable. Therefore, an elimination trial of 13 mainland tree species and another trial of 4 palm species were carried out in the central coastline of Bangladesh. The objective of this study was to find out suitable species for coastal raised lands for the continuous establishment of forest cover in the coastal belt. There were some interim reports on non-mangrove species trial which showed the initial success of the trial plantations (Siddiqi 2001 and Moula 2010). This paper describes a comprehensive report on suitability and growth performance of some mainland tree and palm species planted in the coastal islands.

Materials and Methods

The Plantation Trial Unit Division of Bangladesh Forest Research Institute carried out an elimination trial of some mainland tree species in 1994 along the central coastline at two offshore islands, Rangabali under Patuakhali district and Char Kukri-Mukri under Bhola district. Rangabali is located at latitude $21^0$92′ N and longitude $90^0$45′ E. Char Kukri-Mukri is located at latitude $21^0$85′ N and longitude $90^0$72′ E (Fig.1). Both islands are offshore of Bangladesh. The site condition of these two islands was more or less similar. Soil of the sites was silt-clay-loam. Soil salinity in the monsoon and dry season was remarkable varying between 1.5-4.0 dS/m. Soil pH was slightly alkaline and varying between 7.5-8.0 (Siddiqi and Khan, 2000).

Thirteen mainland tree species namely, *Albizia lebbeck* (L.) Benth. (kala koroi), *A. procera* (Roxb.) Benth. (sada koroi), *Samanea saman* (Jacq.) Merr. (rain tree), *Acacia nilotica* (L.) Willd. (babla), *Thespesia populnea* (L.) Soland. (sonboloi), *Swietenia macrophylla* King. (mehogoni), *Leucaena leucocephala* (Lam.) de Wit (ipil-ipil), *Azadirachta indica* A. Juss. (neem), *Pithecellobium dulce* Benth. (payra), *Syzygium cumini* (L.) Skeels (kalojam), *Casuarina equisetifolia* Forst. (jhao), *Dalbergia sissoo* Roxb. (sisoo) and *Lagerstroemia speciosa* (L.) Pers. (jarul) were included in this trial at both Rangabali and Char Kukri-Mukri islands. These species generally grow in the coastal homesteads and its surroundings. Some of these species also grow in the low lying areas of the coastal belt. The seeds/fruits were collected from phenotypically superior trees. Seeds were sown in polybags of size 15 cm × 25 cm which were filled with powdered loamy soil and cowdung at 3:1 ratio. Seedlings were raised in the nursery

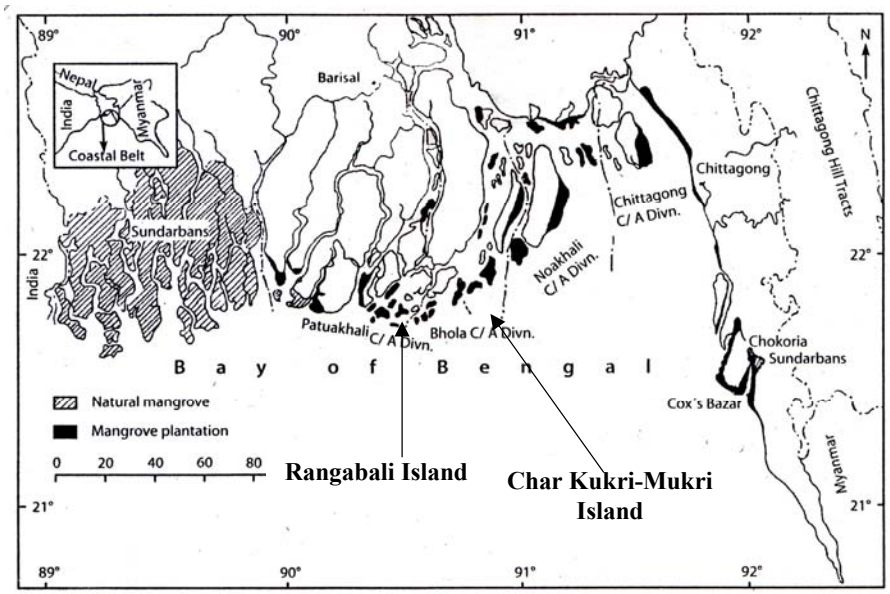

Fig. 1. Coastline of Bangladesh showing the locations of natural, planted mangroves and the study areas (Source: Siddiqi 2004).

and were kept for six months. The experimental sites were prepared by cutting jungles, burning and removing of debris. The sites were prepared by making heaps of size 60cm × 60cm wide and 40cm high. In each plot, 81 (9 × 9) seedlings were planted at 2.0m × 2.0m spacing. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Six to seven months old seedlings were planted by digging pits on heaps to minimize the impact of inundation during the monsoon spring tide. Planting was done in the late monsoon (August-September) allowing the seedlings to avoid the impact of tidal inundation and wave action. The experimental plots were fenced with barbed wire to protect the plants from biotic interference. Weeding was made up to five years after out planting.

Another experiment was laid out with 4 palm species in the foreshore areas under Char Kukri-Mukri island in 1999. These species are namely *Cocos nucifera* L. (coconut), *Borassus flabellifer* L. (palmyra palm), *Phoenix sylvestris* Roxb. (date palm), *Areca catechu* L. (betel nut). Seedlings of these species except *C. nucifera* were raised in polybags and kept in the nursery for about 10-12 months. The sites were prepared by making mini-mound of 7.3m × 1.8m × 0.5m/ 7.3m × 1.5m × 0.5m in the foreshore lands. Ten to twelve months old seedlings were planted on the top of the mounds. The spacings were 5.48 m from seedlings to seedlings for *B. flabellifer*, *C. nucifera* and *P. sylvestris* and 1.82m for *A. catechu*. The data in relation to survival, height and diameter growth

were collected from both of these experiments in June, 2011. Data were computed and analyzed using MINITAB statistical package.

Results and Discussion

Mainland tree species: The average survival percentage, height and diameter at breast height (DBH) from 17 years old stands were analyzed separately for Rangabali and Char Kukri-Mukri. Out of 13 species tried, 7 species were successful and 6 species were failed at Rangabali but 6 species were successful and other 7 species were failed to survive at Char Kukri-Mukri (Tables 1 and 2). The result showed that the highest survival was recorded for *P. dulce* (81%) followed by *S. saman* (80%), *A. lebbeck* (73%), *C. equisetifolia* (69%) and *A. procera* (59%) at Rangabali (Table 1). In Char Kukri-Mukri, the highest survival was found for *A. nilotica* (66%) followed by *P. dulce* (63%), *S. saman* (32%) and *C. equisetifolia* (25%) (Table 2). Siddiqi (2001) published an interim report on the growth performance of some non-mangrove species at the age of six years planted at Char Kukri-Mukri. He found more than 60% survival for *A. lebbeck*, *S. saman*, *A. nilotica*, *P. dulce*, *C. equisetifolia*, *T. populnea* and *D. sissoo*. Moula (2010) reported the growth performance of some non-mangrove species at the age of seven years in an experiment performed in Char Kashem under Rangabali island. He found the highest survival percentage for *A. lebbeck* (98%) followed by *P. dulce*, *C. equisetifolia*, *S. saman*, *A. procera*, *A. nilotica* and *T. populnea* with above 80% survival. Sirajuddullah *et al.* (1995) reported four years growth performance of some non-mangrove species from another experiment at Rangabali and Char Kukri-Mukri. They found more than 80% survival for *A. nilotica*, *C. equisetifolia*, *S. saman* at Rangabali, and more than 65% survival for *S. saman*, *P. dulce*, *A. lebbeck*, *A. nilotica* and *S. cumini* at Char Kukri-Mukri.

Table 1. Growth performance of some mainland tree species at the age of 17 years planted at Rangabali island (n= 3, mean ± standard error) (DBH= diameter at breast height).

Vernacular name	Scientific name	Survival (%)	Mean height (m)	Mean DBH (cm)
Payra	*Pithecellobium dulce*	81	10.49 ± 0.24	12.94 ± 0.29
Rain tree	*Samanea saman*	80	13.21 ± 0.30	24.34 ± 1.25
Jhao	*Casuarina equisetifolia*	69	15.26 ± 0.38	19.45 ± 0.33
Babla	*Acacia nilotica*	32	11.69 ± 0.19	11.66 ± 0.18
Kala koroi	*Albizia lebbeck*	73	9.90 ± 0.22	13.97 ± 0.46
Sada koroi	*Albizia procera*	59	11.28 ± 0.44	16.52 ± 0.68
Sonboloi	*Thespesia populnea*	52	7.19 ± 0.29	13.77 ± 0.35

Table 2. Growth performance of some mainland tree species at the age of 17 years planted at Char Kukri-Mukri island (n= 3, mean ± standard error) (DBH= diameter at breast height).

Vernacular name	Scientific name	Survival (%)	Mean height (m)	Mean DBH (cm)
Payra	*Pithecellobium dulce*	63	9.99 ± 0.26	17.24 ± 0.73
Rain tree	*Samanea saman*	32	11.11 ± 0.40	19.74 ± 0.98
Jhao	*Casuarina equisetifolia*	25	11.64 ± 0.61	15.23 ± 0.80
Babla	*Acacia nilotica*	66	7.87 ± 0.18	14.02 ± 0.26
Kala koroi	*Albizia lebbeck*	14	8.48 ± 0.59	14.75 ± 0.98
Sada koroi	*Albizia procera*	14	11.27 ± 0.80	14.13 ± 1.54

In this study, the highest height was recorded for *C. equisetifolia* (15.26 m) followed by *S. saman* (13.21m), *A. nilotica* (11.69m), *A. procera* (11.28m) and *P. dulce* (10.49m) at Rangabali (Table 1). The highest height was also recorded for *C. equisetifolia* (11.64m) followed by *A. procera* (11.27m), *S. saman* (11.11m) and *P. dulce* (9.99m) at Char Kukri-Mukri (Table 2). The highest mean diameter at breast height (DBH) was recorded for *S. saman* (24.34cm) followed by *C. equisetifolia* (19.45cm), *A. procera* (16.52cm), *A. lebbeck* (13.97cm), *T. populnea* (13.77cm) and *P. dulce* (12.94cm) at Rangabali (Table 1). The highest mean DBH was also recorded for *S. saman* (19.74cm) followed by *P. dulce* (17.24cm), *C. equisetifolia* (15.23cm), *A. lebbeck* (14.75cm) and *A. procera* (14.13cm) at Char Kukri-Mukri (Table 2). Siddiqi (2001) found the highest height growth for *A. nilotica* (7.90m), followed by *S. saman* (6.74m), *P. dulce* (6.71m) and *C. equisetifolia* (6.54m); and the highest DBH for *P. dulce* (10.63cm) followed by *S. saman* (9.71cm), *A. nilotica* (6.92cm) *C. equisetifolia* (6.60cm) and *A. procera* (6.40cm) in six years plantation at Char Kukri-Mukri. Moula (2010) found the highest height growth for *C. equisetifolia* (13.17m) followed by *S. saman* (10.70m) and *A. procera* (10.65m) and the highest DBH for *S. saman* (13.17cm) followed by *C. equisetifolia* (12.15cm) and *A. procera* (11.24cm) in seven years old stand at Rangabali. The growth pattern of some promising species showed that the higher height were recorded for *C. equisetifolia* (15.26m) in the present study after 17 years and it was also higher for *C. equisetifolia* (13.17m) after 7 years (Moula 2010) in the same study at Rangabali site. In Char kukri-Mukri site, the higher height were recorded for *C. equisetifolia* (11.64m) in the present study after 17 years but it was higher for *A. nilotica* (7.90m) after 6 years (Siddiqi 2001). The highest DBH was recorded for *S. saman* (24.34cm) at the age of 17 years in the present study and it was also higher for *S. saman* (13.17cm) at the age of 7 years (Moula 2010) in the same study at Rangabali site. In the Char Kukri-Mukri site, the highest DBH was recorded for *S. saman* (19.74cm) at the age of 17 years in the present study but it was higher for *P. dulce* (10.63cm) at the age of 6 years (Siddiqi 2001) in the same experiment. Sirajuddullah *et al.* (1995) recorded the highest height growth for *C. equisetifolia* (8.43m) followed by *A. nilotica* (6.04m), *S. saman* (4.23) and *P. dulce* (4.19m); and the highest DBH for *S. saman* (6.56cm) followed by *A. nilotica* (6.35cm),

A. procera (5.28 cm), *P. dulce* (4.25 cm) and *A. lebbeck* (4.06 cm) in another four years old stands at Rangabali. Siddiqi *et al.* (1994) found that *S. saman*, *A. nilotica*, *L. speciosa* and *A. procera* showed promising growth performance in the raised lands of the Sundarbans. Islam (2004) found the highest height growth for *S. saman* (11.87 m) followed by *A. procera* (10.40 m) and *L. speciosa* (5.55 m), and the highest DBH for *S. saman* (17.81 cm) followed by *A. procera* (15.95 cm) and *L. speciosa* (8.17cm) in 9 years old experiment at Bogi of the Sundarbans.

On the basis of survival and growth performance, the species like *C. equisetifolia*, *S. saman*, *P. dulce*, *A. procera* and *A. lebbeck* were found to be promising at Rangabali whereas *P. dulce*, *C. equisetifolia*, *S. saman* and *A. nilotica* were found to be promising at Char kukri-mukri 17 years after planting. *S. macrophylla*, *L. leucocephala*, *A. indica*, *S. cumini*, *D. sissoo* and *L. speciosa* were failed in both study areas. In Char Kukri-Mukri, the survival of almost all species was poor in comparison to Rangabali site. The grazing of animal and human interferences was high at Char Kukri-Mukri than Rangabali. Grazing of domestic animal like buffalos and cattle has high detrimental impact on the successful establishment of plantations. Moreover, human interferences and illicit felling of good form of trees in the experimental plots were observed in the coastal areas and it was high at Char Kukri-Mukri because the human settlements were close to trial plantation. So, the survival of the species has been decreased over time. If proper management and supervision can be ensured, the plantation of the promising mainland tree species in the coastal areas is likely to offer sustained yield and render a permanent forest cover in the coastal belt.

Palm species: The average survival percentage, height and DBH from 12 years old palm species were analyzed in the year 2011.

Table 3. Growth performance of some palm species at the age of 12 years planted in a foreshore area at Char Kukri-Mukri island.

Vernacular name	Scientific name	Survival %	Mean height (m)	Mean DBH (cm)
Coconut	*Cocos nucifera*	81	10.98 ± 0.31	32.44 ± 0.47
Palmyra palm	*Borassus flabellifer*	65	8.38 ± 0.33	58.62 ± 1.24
Date palm	*Phoenix sylvestris*	82	7.74 ± 0.38	36.21 ± 0.79
Betel-nut	*Areca catechu*	60	10.07 ± 0.31	11.37 ± 0.23

The survival of *P. sylvestris* and *C. nucifera* was found more than 80% while *B. flabellifer* and *A. catechu* were found more than 60%. Among these palm species, the greater height growth was found for *C. nucifera* (10.98 m) followed by *Areca catechu* (10.07 m), *B. flabellifer* (8.38m) and *P. sylvestris* (7.74 m). The highest DBH was found in *B. flabellifer* (58.62 cm) followed by *P. sylvestris* (36.21 cm) and *C. nucifera* (32.44 cm). Generally *C. nucifera* trees attain a height of 10 to 30m, *B. flabellifer* up to 30 m, *P.*

sylvestris 10 to 14 m tall and up to 50 cm diameter, and *A. catechu* 10 to 30 m tall and up to 15 cm diameter (Siddiqui *et al*. (2007). In this study, the planted palm species showed good growth performance at the early stage in the foreshore coastal lands.

These palms are economically and ecologically important species in Bangladesh. It can provide valuable fruits and juice for human being. Palm plantations can also serve as a strong shelterbelt against the cyclonic storms. Therefore, large scale plantation programme with these palm species can be initiated in the coastal areas.

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