TECHNICAL AND SOCIAL PROVISOS OF MANGROVE PLANTING IN MUDFLATS

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ABSTRACT

This research aimed to assess feasibility of mangrove afforestation in new mudflats at Mahachai Bay, Samut Sakhon, central Thailand. Seedlings of *Rhizophora mucronata, Sonneratia caseolaris, Avicennia alba and A. marina*, were planted in 40 plots at five distances of 10, 20, 30, 40 and 50 m from the existing mangrove edge. The seedlings were preliminarily established on slabs of rockwool medium for a half year before transplanting to the mudflats. Bamboo fences were constructed surrounding a half of the experimental plots. Survival and growth of the seedlings were recorded. Microtopographic conditions and soil properties were measured and compared with the different distances and plot management. People attitude toward the mangrove planting was determned by using the designed questionnaire interviewed the target group.

The results showed that survival rates of all species tended to decline with ages of seedlings. Six months after planting, *R. mucronata* showed the highest survival rate, followed by *S. caseolaris, A. alba* and *A. marina*, respectively. Bamboo fences supported the survival of the seedlings at a distance from the forest edge especially at 50 m. The survival did not differ for the seedlings planted at the distance ranging 10x40 m either with or without the fences. Height growth of all species except *R. mucronata* tended to decrease with the distance increases. All seedlings planted without bamboo fences, except *A. alba* and *A. marina* at 30 m, had slightly poorer diameter growth when compared with the seedlings planted with fences. Height growth of seedlings at different distances was found to be similar. The seedlings planted without bamboo fences also showed slightly poorer diameter growth in comparison to seedlings planted with fences. Based on the field survey indicated that most of local people agreed to plant mangrove species on mudflats. However, they pointed out that natural stresses brought about by tides and winds may destroy seedlings. Thus, the mangrove afforestation should be established within an appropriate distance of 25 m from the coastal edge.

Key Words : mangrove, afforestation, mudflats, people attitudes

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Received, 19 November 2007 Accepted, 27 November 2007

INTRODUCTION

There are two major goals of the Thai mangrove forests administration. One is to reserve the remaining forests for sustainable management. The other is to re-establish new mangroves both in areas used to be mangrove (reforestation) and those newly developed so-called mudflat areas (afforestation). These approaches are attributed to benefits directly and indirectly to both local people and the coastal environments (Jintana and Piriyayotha, 2000). Many efforts have been made to develop mangroves along the coastal line of Thailand. Some were successful but some not. There were a number of factors affecting survival and growth of mangroves planted in the mudflats (Bamroongrak, 1992; Jintana *et al.*, 1995). Kitaya *et al.* (2002) found that in the early growth stage of some mangroves, *Rhizophora, Sonneratia* and *Avicennia* species showed better tolerance to high tidal level than others. This study therefore introduced these species to areas where the establishment of mangroves is needed.

This research aimed to assess the mangrove planting in the mudflat at Mahachai Bay, Samut Sakhon Province, central Thailand. To understand both technical and social provisos, survival and growth of the pioneer mangrove species were examined. Attitude of local people toward mangrove planting in the mudflats was determined. The existing mangroves in the area comprised 6 plant species. Among these *Avicennia marina* was dominant species with the only exception in the area near the shore that was dominated by *A. alba*. Other species found in the area were *R. mucronata*, *Xylocarpus granatum, Bruguiera cylindrica* and *Nypa fruticans*. Plant community consisted of trees, saplings and seedlings in numbers per ha of 2,819, 3,075 and 149,169 respectively (Wudthikraisriarkom, 2004).

MATERIALS AND METHODS

A field experiment on survival and growth of 4 mangrove species, namely, *Rhizophora mucronata* (*Rm*), *Sonneratia caseolaris* (*Sc*), *Avicennia alba* (*Aa*) and *A. marina* (*Am*), was conducted. Ninety seedlings of each species were prepared in 10x10x20 cm pots made up of rockwool (Fibertex Growool G06 Density 65 kg/m^3). Six months after they were transplanted at different distances from the existing mangrove edge, i. e. 10, 20, 30, 40 and 50 m. At each distance a group of 9 seedlings were planted with spacing of 1x1 m (Figure 1). Bamboo fences were constructed around each group. Nearby area, another set of experiment was conducted without bamboo fences.

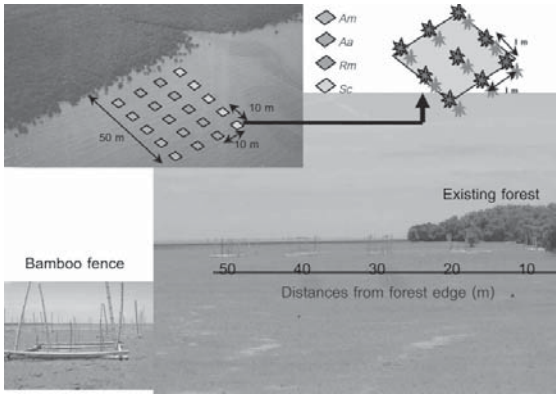

Figure 1 Layout and diagram of experimental plots.

Microtopography of planting areas was studied. Three transect lines (Line1, Line2 and Line3) were selected for leveling survey. Softness of the mud soils was simply tested using an iron pole with the diameter of 1 cm, 1 m length and 1 kg weight. The iron pole was dropped vertically from 75 cm above the soil surface. Depth of the pole penetrated into the soil was measured to determine the softness (Komiyama *et al*. 1996). Three measurements were recorded for each plot. Mean and standard deviation were calculated. Properties of the soil water, e. g., pH and salinity at 5 and 30 cm depth, were measured in the field. Samples of the soil from 0-5 and 25-30 cm depths were collected and brought to a laboratory at the Faculty of Forestry, Kasetsart University for analysis. The plant community beyond the experimental plots was studied. Three transects were marked, each consisting of 10x10 m plots normally aligned from the seashore to inland. Distance between each plot was 20 m. Distributions of solid wastes within the study areas were observed.

Seedling survival and growth performance were recorded in every 2 months. The data was analyzed regarding to the distances from the edge of forest and the plot management (with and without bamboo fences).

In addition, attitude of local people toward mangrove planting on the mudflats was determined by conducting the field survey and the structured questionnaire. The questionnaires composed of 3 parts. It contained both closed- and open-ended questions. The first part was the basic information about socio-economics of the villagers. The second was the attitude toward mangrove planting on the mudflat areas. The third was the opinion and comment relating to mangrove restoration. Two villages (Hua Pong and Bang Ya Praek) close to the study site were selected as the studied areas. The percentage of crusse was ten percent, so 156 households were employed as the respondents. This study was started from May 2003 to June 2004.

RESULTS AND DISCUSSION

The Study Area

Microtopography and softness of the mud soils were illustrated. Figure 2 shows relative elevation of the experimental plots. Difference between the highest and the lowest points was 23 cm, means that the study site was relatively flat (slope < 1%). Softness of the mudflat soil was presented in Table 1. On average, the iron pole penetrated into the soil after being dropped to a depth of 59 cm. No difference was found among distances from the edge of the forest. This indicated that the soils were extremely soft in comparison with the nearby mangrove forest soils where the same pole penetrated into the soil to 24 cm after being dropped (Wudthikraisriarkom, 2004).

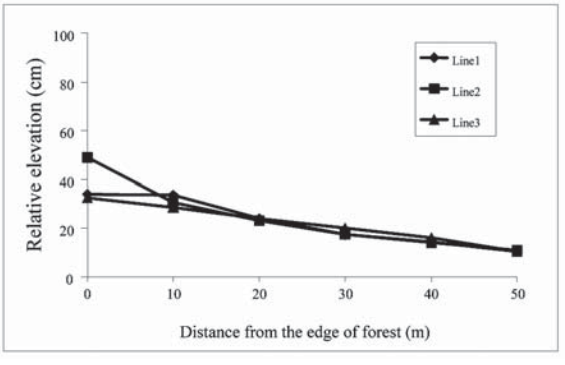

Figure 2 Relative elevations of the experimental plots.

Table 1. Softness of the soils at the experimental plots

Distance from forest edge (m)	Depth of iron pole penetrated into the soil (cm)					Softness
	Line of Am	Line of Aa	Line of Rm	Line of Sc	Mean ± std	
10	63.0±6.9	57.7±5.8	63.7±18.6	55.5±9.3	60.0 ± 4.0	Extremely soft
20	56.7±1.5	51.5±1.5	57.0±2.3	63.3±4.3	57.1 ± 4.8	Extremely soft
30	68.0±5.3	50.2±3.3	64.2±3.3	56.3±0.8	59.7 ± 8.0	Extremely soft
40	59.5±7.0	55.2±6.0	61.3±4.2	56.2±3.3	58.0 ± 2.9	Extremely soft
50	59.2±3.9	57.3±0.6	59.8±5.4	66.7±8.6	60.8 ± 4.1	Extremely soft
Mean ± std					59.1 ± 1.5	Extremely soft

Some soil properties, i. e., pH, salinity (NaCl), soil texture, organic matter, phosphorus, potassium, calcium, and magnesium are shown in Table 2. All sample soils were clay. The soil was rather alkaline. pH at 5 cm depth ranged from 7.8-8.2 and 7.8 at 30 cm depth. Soil salinity and organic matter (OM) at 2 different depths were similar. Salinity ranged from 11-14 PSU (practical salinity unit) and OM ranged from 4-5%. High values of the macronutrients (P, K, Ca and Mg) reflect fertility of the mudflat areas.

Table 2. Soil properties of the mudflats at Mahachai Bay, Samut Sakhon Province

Depth (cm)	Distance from forest edge (m)				
	10	20	30	40	50
			pH		
5	8.1 ± 0.4	8.2 ± 0.5	7.9 ± 0.3	7.9 ± 0.1	7.8 ± 0.0
30	7.8 ± 0.0	7.8 ± 0.1	7.8 ± 0.1	7.8 ± 0.1	7.8 ± 0.0
			NaCl (%)		
5	1.3 ± 0.1	1.3 ± 0.1	1.4 ± 0.1	1.3 ± 0.1	1.3 ± 0.0
30	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.1 ± 0.0
			Soil Texture		
0-5	clay	clay	clay	clay	clay
25-30	clay	clay	clay	clay	clay
			Organic Matter (%)		
0-5	5.08	3.96	4.49	4.69	4.36
25-30	4.75	4.03	4.22	5.21	4.09
			Available Phosphorus (ppm)		
0-5	31	28	29	33	24
25-30	78	85	73	81	86
			Exchangeable Potassium (ppm)		
0-5	1,333	1,039	1,276	1,197	1,369
25-30	1,276	1,340	1,336	1,317	1,225
			Exchangeable Calcium (ppm)		
0-5	3,440	2,530	3,506	3,028	3,480
25-30	2,838	3,338	2,826	2,972	3,024
			Exchangeable Magnesium (ppm)		
0-5	1,942	1,509	1,908	1,818	1,953
25-30	1,795	1,962	1,824	1,878	1,738

Survival and Growth of the Planted Seedlings

The results showed that survival of all species decreased over time (Figure 3). Six months after planting with bamboo fences, *R. mucronata* showed the highest survival rate at 78%, followed by *S. caseolaris* (64%), *A. alba* (42%) and *A. marina* (11%), respectively. The seedlings planted without bamboo fences, *R. mucronata* also showed the highest survival rate at 87%, followed by *S. caseolaris* (62%), *A. alba* (53%) and *A. marina* (22%), respectively. During the study some seedlings were found with uprooting and top damage. Solid wastes especially remnants of fishing nets and plastic bags brought by tidal current were the main cause of damage.

The bamboo fences supported the survival of seedlings at a distance from the forest edge especially at 50 m where the survival of all planted species with the fences was higher than those planted without the fences (Table 3). Height growth of all species, except R. mucronata, tended to decrease with the increase of distance. All seedlings except *A. alba* and *A. marina* of those planted at 30 m without bamboo fences, had a slightly poorer height

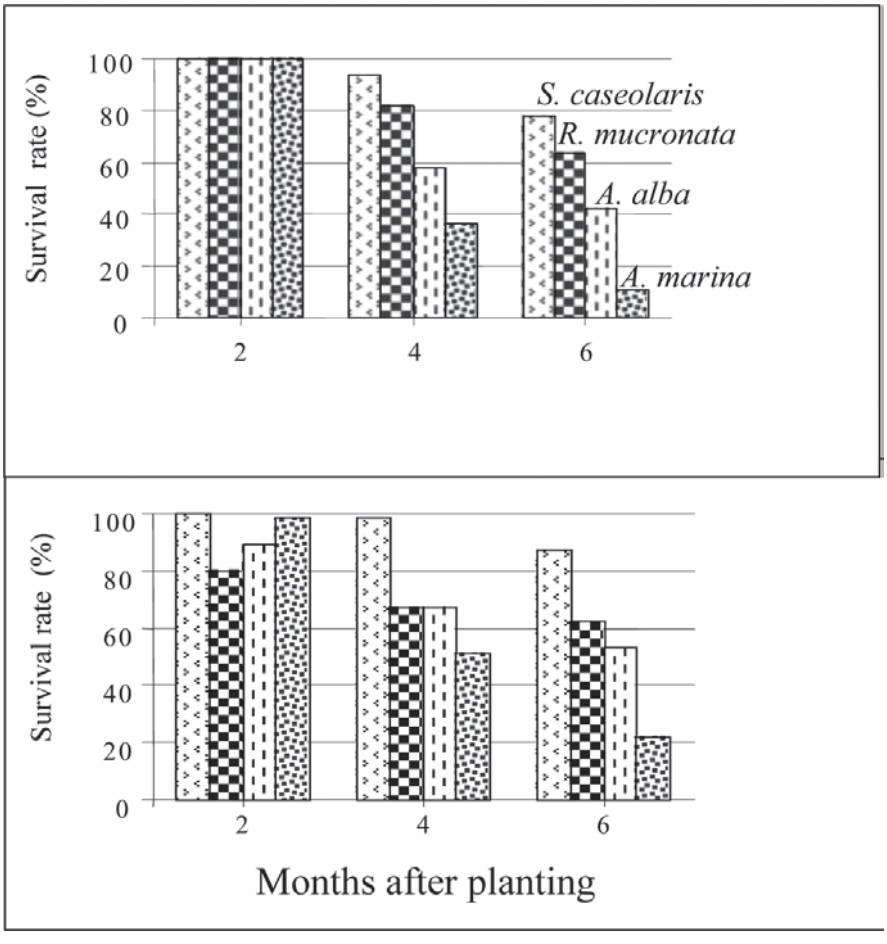

Figure 3. Survival rates of mangrove seedlings after planting with (above) and without (below) bamboo fences.

growth when compared with the seedlings planted with fences (Table 4). Diameter growths of the seedlings at different distances were similar. The seedlings planted without bamboo fences also showed a slightly poorer diameter growth when compared with the seedlings planted with fences (Table 5).

Table 3 . Survival of mangrove seedlings 6 months after planting at different distances with and without bamboo fences

Distance from forest edge (m)	Survivals of mangrove species 6 months after planting (%)							
	S. caseolaris		*R. mucronata*		*A. alba*		*A. marina*	
	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced
10	56	22	89	89	56	89	22	33
20	67	67	67	100	33	78	11	33
30	44	100	78	100	44	44	0	33
40	67	56	89	89	44	22	11	11
50	64	28	78	39	42	24	11	0

Table 4. Height growth of mangrove seedlings 6 months after planting at different distances with and without bamboo fences

Distance from forest edge (m)	Total height of mangrove seedlings 6 months after planting (cm)							
	S. caseolaris		*R. mucronata*		*A. alba*		*A. marina*	
	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced
10	112±20	69±34	99±11	96±5	93±22	78±14	130±6	91±17
20	77±19	77±27	98±8	91±9	103±10	76±17	110*	108±6
30	83±23	62±21	104±5	94±11	61±23	78±12	0**	102±18
40	72±26	83±16	99±7	94±12	81±24	59±13	114*	90*
50	72±32	67±32	98±6	98±7	60±38	61±25	86*	0**

* only one seedling survived, ** no seedling survived

Table 5 . Diameter growth of mangrove seedlings 6 months after planting at different distances with and without bamboo fences

Distance from forest edge (m)	Diameter of mangrove seedlings 6 months after planting (mm)							
	S. caseolaris		*R. mucronata*		*A. alba*		*A. marina*	
	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced	Fenced	Unfenced
10	16±3	10±4	10±1	9±1	11±2	9±1	11±1	10±0
20	11±3	11±4	10±1	8±1	10±1	9±1	10*	10±2
30	11±2	9±3	11±2	9±1	8±2	9±2	0**	10±1
40	11±3	11±1	10±1	10±1	8±1	8±2	8*	14*
50	11±2	9±3	9±1	9±2	8±2	7±2	6*	0**

* only one seedling survived, ** no seedling survived

Attitudes of Local People on Mangrove Afforestation

Demography of the respondents were as follows: 44% were male, and the average age was 37 years (mostly ranged from 25-55 years). Nearly a half (48%) finished primary school, 32% finished junior- high-school levels, 19% graduated from college or university and the rest were illiterate. One-fifth of the respondents worked in fishery sectors; 16% marine fishery, 4% small-scale coastal fishery, and 1% aquaculture. Thirty-four percent were hired workers, and 29% were traders and businessmen. Less than 20% of the respondents had moved from various parts of the country.

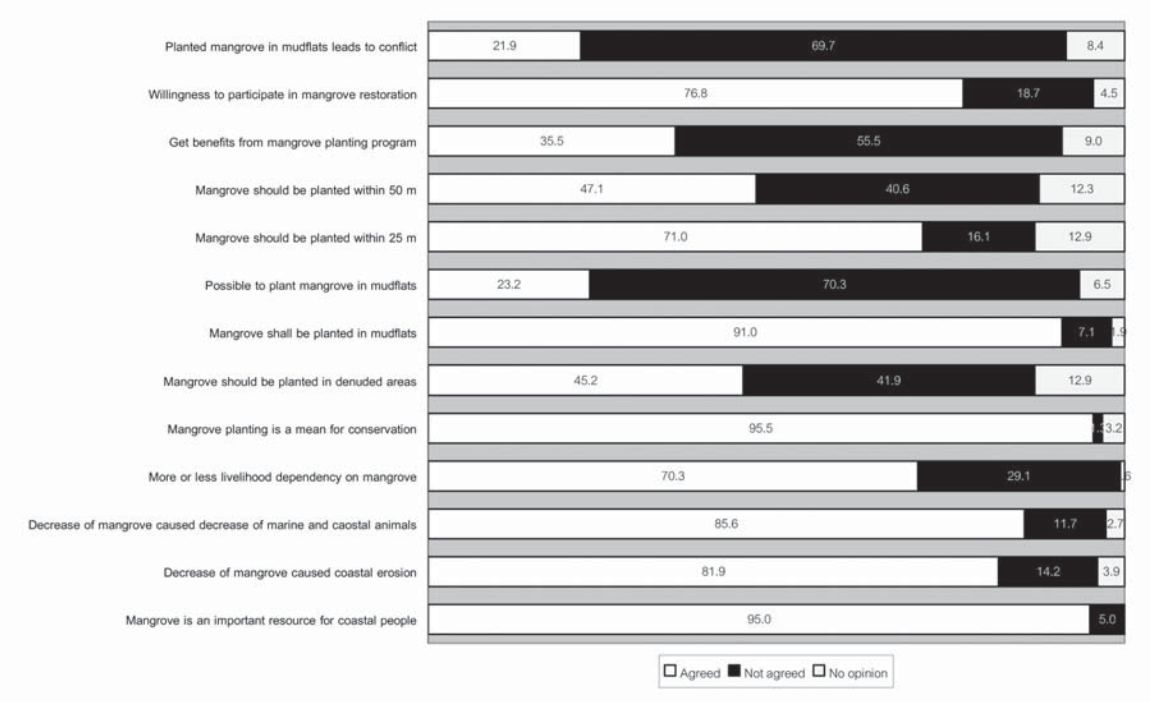

Figure 4. Attitudes of local people toward mangrove conservation and planting on the mudflats.

From Figure 4, most of the respondents (95%) considered mangroves as an important resource for local people living in the coastal areas. Seventy percent expressed that their livelihoods more or less related with the mangroves. They realized that the decreasing in mangrove forest had resulted in coastal erosion (82%), and also reduced marine and brackish animals (86%). Seventy-seven percent expressed their willingness to participate in mangrove rehabilitation at least in sharing their opinions.

It was found from the field survey that most of the respondents (91%) agreed to plant mangrove species on the mudflats. However, they pointed out that natural stresses brought about by the tidal current and wind may destroy the seedlings. Interestingly, 22% of the respondents indicated that planting mangroves on the mudflats may lead to a conflict between small-scale coastal fishermen and the planters. Thus, the planting mangrove species in the

mudflat should be limited at an appropriate distance. For instance, 71% agreed to plant up to 25 m from the mangrove edge whereas less than a half of the respondents (47%) agreed to plant up to 50 m.

CONCLUSIONS

Regarding to possibility of mangrove planting on the mudflats, it may be concluded technically that, *R. mucronata* and *S. caseolaris* are suitable species to be planted in Mahachai Bay. Both species showed a higher survival and a better growth than the other species. In social aspect, most local people agreed to establish mangrove afforestation within the area. However, they pointed out that the planting areas should not be too far from the existing mangrove edge. Findings from this study were consistent and indicated that under the proper management, it is possible to establish mangrove afforestation on the mudflats at Mahachai Bay, Samut Sakhon.

ACKNOWLEDGEMENTS

We would like to thank Professor Yoshiaki Kitaya (Osaka Prefecture University, Japan), Mr. Somsak Piriyayota, Ms. Jutamas Sudsawang (Department of Marine and Coastal Resources) for their continuing assistances to this study. Also, thanks are given to Mr. Adrian Hillman of the Graduate School, Kasetsart University for his kindness in checking English. This research was financially supported by the Kansai Electric Power Company (KEPCO), Japan.

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