Extension of community based mangrove restoration model focusing on fallow shrimp-farming ponds in Cam Ranh, Khanh Hoa

ABSTRACT

The project was supported by Rufford Small Grant (British), carried out based on co-management principles with participation of My Thanh community. The project sites with total areas of 10 ha, which could not be reused for shrimp culture, were selected at My Thanh Village, Cam Thinh Dong commune, Cam Ranh, Khanh Hoa. The project's time ranged from 9/2008 to 9/2009.

The working team was formulated including members of Institute of Oceanography (IO), Research Institute of Aquaculture (RIA) of Nha Trang University and My Thanh volunteer participants. Sources of *Rhizophora apiculata* Bl. propagules from Can Gio mangrove forest. The mangroves were replanted 3 times. The mangroves were regularly taken care of by the working team. The growth rate and survival of the mangroves were recorded monthly.

The results showed that, after nine months of replanting, the mangroves ranged from 39.62 ± 8.21 to 58.30 ± 5.11 cm in height and from 1.45 ± 0.19 to 1.52 ± 0.13cm in diameter. The survival of the mangroves ranged between 30-80% with average of 56,22 ± 26,35%. The success of the project is thanks to mainly the high volunteer participation of the local community.Through the project's activities, awareness of the local communities of the long term benefits of mangrove ecosystem was significantly improved. The newly replanted mangrove areas have been handed over to the Research Institute of Aquaculture and My Thanh communities for management.

I. INTRODUCTION

Mangrove forests are considered a natural valuable common property resource supporting livelihoods of coastal communities both directly and indirectly. In 1975, Khanh Hoa had 3000 ha of mangrove forest. However, as a result of ineffectively implemented local

authority conservation principles combined with limited awareness of local communities on the long term benefits of the mangrove ecosystem, many such areas in Khanh Hoa province have been destroyed for agriculture, urbanization and frequently shrimp aquaculture.

According to Khanh Hoa Agriculture and Rural Development Department, in 2000, the total area of mangrove forest in Khanh Hoa remained about 100 ha. In fact, mangrove destroyed areas are not ideally suited to shrimp farming because of acid sulfate soils. On the other hand, the spontaneous development of intensive shrimp culture has produced large amounts of waste water and solids which caused water pollution and outbreaks of disease. The biggest lost in Khanh Hoa, at 2 million USD, was in 2001. Many local farmers are now in debt and have to cease culture. Consequently, hundreds of shrimp farms in the mangrove destroyed areas are now fallow. The local authorities are aware the negative impacts on environment and the long term benefits of mangrove ecosystem management. In 2004, there was 2ha of mangroves replanted with a local budget in Van Tho commune, Van Ninh, Khanh Hoa. However, after 6 months of replanting, the survival of mangroves was low (20-30%). In 2006, with support of Rufford Small Grant, 5ha of mangroves was replanted in Tuan Le Village, Van Tho commune, Van Ninh district. After 7months of replanting, the survival of mangroves was 60-70%. The project's area was handed over the Van Tho Commune for management.

The overall aim of the project is to extend the model of community based mangrove restoration focusing on fallow shrimp-farming areas to utilize the areas for the extension of shrimp culture.

II. MATERIALS AND METHODS

1. Duration and organization principles of the project

The project was carried out from September 2008 to September 2009 based on co-management principles and community participation.

A Working team was formulated including members of institute of Oceanography, Research Institute of Aquaculture of Nha Trang University and My Thanh volunteer participants.

2. Project sites

The project sites were selected at My Thanh Village, Cam Thinh Dong commune, Cam Ranh Town, Khanh Hoa province, based on the field trip surveys and the local planning to 2020.

The project sites include 4 fallow shrimp farming areas with total areas of 10ha:

- Area 1 (1ha): strongly affected by wave and flood
- Area 2 (3ha): strongly affected by waves and flood during raining season
- Area 3 (4ha): slight affect by waves and flood
- Area 4 (2ha): not affected by waves and flood but hot weather during dry season.

Project's sites in Cam Ranh Bay – Khanh Hoa

3. Source of propagules and pretreatment for replanting

Rhizophora apiculata Bl. propagules, with sizes of 0.95 ± 0.17cm in diameter and 20.5 ± 6.50cm in height, originally from Can Gio mangrove forest were transported to the project sites for replanting.

4. Planting techniques

Time for replanting the *Rhizophora apiculata* Bl. propagules was at low tide so that the bottom could be seen for making holes to fix mangrove propagules.
The density of *Rhizophora apiculata* Bl. propagules for replanting was 15,000 propagules/ha. The volunteer participants had experience in mangrove replanting.

5. Management and taking care of the mangroves

The new mangrove propagules were regularly taken care of by volunteer participants.
The growth rate and survival rate of *Rhizophora apiculata* Bl. propagules were monthly recorded by the working team.

Each site, 30 propagules were measured for estimating average diameter and height. Survival rate of the propagules was estimated by counting 100 propagules/site (10 x 10m) in which missing or dead propagules were estimated based on the gap between propagules (1x 1m).

III. RESULT AND DISCUSSION

1. Improving awareness of the local communities

Before implementation of the project, a meeting was organized with target beneficiaries focusing on My Thanh communities to inform them of the purpose of the project and have them acknowledge the long term benefits of mangrove eco-systems and necessity of mangrove protection. Therefore, the volunteer participants have understood why mangroves should be replanted, especially at the fallow shrimp farming areas.

The volunteer participants are mainly poor people living nearby the project's areas. Particularly, some of the volunteer participants belong to the ethnic group, who are poorly educated and their livelihoods rely mainly on the exploitation of aquatic benthos in the areas. The local authority can not ban or stop them exploiting benthos in the project's sites. However, after participating in the project's activities, the volunteer participants try to avoid damaging new mangroves while catching benthos in the project's areas. This

resulted in the survival of new mangroves being high, especially at the area 3 (Table 1). However, the survival of mangroves was low at the area 4 and area 2 because the mangroves were affected by waves and flood (area 2) during high tide and hot weather during dry season (area 4).

2. Survival of mangroves in the project's sites

The unforeseen difficulty of the project was facing with storm and flood during the first months of project's activities. As a consequence, almost all the new mangrove propagules replanted in November 2008 were swept away by a storm and flood. The mangroves were replanted twice in February 2009. After three times of replanting, the survival of mangroves was shown in Table 1.

Table 1. Survival rate of mangroves *Rhizophora apiculata* Bl. according to time in My Thanh Village, Cam Thinh Dong, Cam Ranh, Khanh Hoa.

Months after replanting	Replanting times	Area 1 (1ha)	Area 2 (3ha)	Area 3 (4ha)	Area 4 (2ha)
		%	%	%	%
11 -2008	1st replanting	100	100	100	100
12 -2008		15	20	50	60
1-2009		0	20	50	60
2-2009	2nd & 3rd replanting	-	100	100	50
3 -2009		-	90	90	50
4 -2009		-	80	90	50
5-2009		-	30	80	30
6 -2009		-	30	80	30
7-2009		-	30	80	30
8-2009		-	30	80	30
9-2009			30	80	30
	Average		**56,22 ± 26,35 %**		

The results from Table 1 showed that, after nine months of replanting, the survival of mangroves ranged from 30 to 80% with average of 56,22 ± 26,35 %.

In area 1, the mangroves were strongly affected by waves and flood during rainy season and high tide. So, after 1 month of replanting, the survival of mangroves was very low (15%) and after two months, the remaining were totally swept away. Therefore, area 1 was not replanted with mangroves in February 2009.

In area 2, the mangroves were affected by waves and flood, especially during high tide. Therefore, after nine months of replanting, the survival of mangroves was still low (30%).

In area 3, the mangroves have grown well as this area is less affected by waves and flood. Therefore, after replanting the third time, the survival of mangroves was high (80%).

In area 4, mangroves were not affected by waves and flood but hot weather during the dry season. Therefore, the area was not replanted in February 2009. After nine months of replanting, the survival of mangroves was low (30%).

3. The growth rate of the mangroves at the project sites

The growth rate of mangroves in term of diameter and height was shown in Table 2.

Table 2. Growth rate of *Rhizophora apiculata* Bl. according to time in My Thanh Village, Cam Thinh Dong, Cam Ranh, Khanh Hoa.

Months after replanting	Area 2		Area 3		Area 4	
	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)	Diameter (cm)	Height
	0.95 ± 0.17	20.5 ± 6.50	0.95 ± 0.17	20.5 ± 6.50	0.95 ± 0.17	20.5 ± 6.50
1	1.20 ± 0.22	22.54 ± 0.34	1.28 ± 0.1	19.52± 1.28	1.28 ± 0.1	19.52 ± 1.28
2	1.29 ± 0.15	22.73 ± 4.21	1.19 ± 0.11	19.85 ± 8.66	1.34 ± 0.11	25.15 ± 3.62
3	1.32 ± 0.12	23.21 ± 4.10	1.18 ± 0.2	30.87 ± 8.04	1.37 ± 0.11	25.08 ± 5.71
4	1.35 ± 0.11	35.30 ± 5.60	1.27 ± 0.18	39.69 ± 5.40	1.25 ± 0.15	25.93 ± 6.17
5	1.41 ±	48.22 ±	1.19 ±	40.96 ±	1.37 ±	26.55 ±

	0.07	3.68	0.20	6.02	0.13	5.40
6	1.48 ± 0.11	48.26 ± 3.45	1.35 ± 0.17	45.58 ± 8.59	1.39 ± 0.11	29.74 ± 4.80
7	1.40 ± 0.13	54.12 ± 4.25	1.36 ± 0.17	49.26 ± 4.90	1.31 ± 0.21	35.91 ± 7.5
8			1.50 ± 0.11	55.65 ± 4.78	1.42 ± 0.21	38.31 ± 8.33
9			1.52 ± 0.13	58.30 ± 5.11	1.45 ± 0.19	39.62 ± 8.21

The results show that there was a significant difference in height of the mangroves between area 3 and 4. After nine months of replanting the mangroves at the area 3 reached 1.52 ± 0.13cm in diameter and 58.30 ± 5.11cm in height. Whereas, the mangroves at area 4 reached 1.45 ± 0.19 in diameter and 39.62 ± 8.21cm in height. The difference in growth rate of mangroves between the two areas are because the mangroves at area 4 were affected by hot weather during the dry season (May to August), in addition, during this time the tidal level was low leading mangroves dried out and died. On the other hand, area 4 is in a high tidal zone, exposed for more time to open air, and the mangroves were eaten by insects during low tide, especially night time. Therefore, the survival and growth of the mangroves was low at area 4.

At area 2, although the survival of mangroves was low as at area 4, the growth of the mangroves was higher than that at the area 4. After replanting the third time, the height of seven month old mangroves was 54.12 ± 4.25cm, which was higher than that of nine month old mangroves in the area 4 (39.62 ± 8.21cm).

The results proved that, it is very important to select a suitable area for replanting mangroves in the mangrove destroyed areas. In fact, the mangrove areas after destroyed became degenerated and eroded. The bottom soil became acidic because of mangrove root remains, resulting in it is not being suitable for shrimp culture and difficult to re-establish mangroves too. Therefore, the best way is conservation of mangrove ecosystem.

IV. CONCLUSION

The success of the project confirmed that replanting mangroves in the fallow shrimp farming areas is a feasible solution. In the long term, the mangrove replanted areas can improve environmental quality, biodiversity of aquatic animals and give the farmers chances to reuse the areas for extension culture in the future.

Management of the mangroves restoration should be considered by the local authorities and communes. However, protection and conservation of the mangrove ecosystem should be the concern of multiple organizations and communities.

V. SUGGESTIONS FOR FUTURE WORK

Intensive shrimp and semi-intensive shrimp cultures in Khanh Hoa are challenging an out break of diseases because of polluted environments; hence many fallow shrimp farming areas remain. Therefore restoration of mangroves in the fallow areas should be continued in Khanh Hoa.

ACKNOWLEDGEMENT

The project was funded by Rufford Small Grant and carried out by Institute of Oceanography, Research Institute of Aquaculture and My Thanh People's Committees.