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LESSON LEARNED FROM MANGROVE REHABILITATION PROGRAM IN INDONESIA

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Abstract. *Indonesia as an archipelagic country more than 17,504 islands with the length of coastline estimated at 95,181 km bears mangroves from several meters to several kilometers. They grow extensively in the five big islands (Jawa, Sumatra, Kalimantan, Sulawesi, Papua). At the year of 2009, Agency of Survey Coordination and National Mapping (Bakosurtanal) of Indonesia reported the existing mangrove forest area in Indonesia of about 3,244,018 ha, however Directorate General of Land Rehabilitation and Social Forestry, Ministry of Forestry (Ditjen RLPS MoF) of Indonesia at 2007 reported about 7,758,411 ha of mangrove area in Indonesia (including existing vegetated mangrove area). It was further reported that those mangroves were 30.7% in good condition, 27.4% moderate-destroyed, and 41.9% heavy-destroyed. In order to rehabilitate destroyed mangrove ecosystems, Indonesia applies at least three type of planting designs (square planting design, zig zag planting design, and cluster planting design) and eight planting techniques ("banjar harian" technique, bamboo pole technique, guludan technique, water break technique, huge polybag technique, ditch muddy technique, huge mole technique, cluster technique). Generally, in Indonesia Rhizophora spp. are used for mangrove rehabilitation and/or restoration with the spacing of 1x1 m spending varied planting cost based on the site local condition and planting technique used. The mangrove planting ranged from about Rp. 14.2 million using propagules to Rp. 18.5 million using cultured seedlings. Recently, local community used to utilizing associated mangrove aquatic fauna for supporting their daily life as well as utilizing mangrove habitat for multipurpose uses through agroforestry techniques (silvofishery, agrosilvofishery, agrosilvopastoralfishery systems). So that, the good mangrove ecosystem serves luxurious both flora and fauna species (biodiversity) as well as their abundance for significantly supporting the welfare of coastal community.*

Keywords: *agroforestry technique, local community, mangrove rehabilitation, planting design, planting technique*

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1. Introduction

Mangroves are a group of salt tolerant plants inhabiting inter-tidal zone between the high-water mark of spring tides and a level close to but above mean sea level in the tropical and sub-tropical regions, mostly well developed in the sheltered coast, deltas, lagoons, and estuaries. These plants and the associated microbes, fungi, plants, and animal constitute the mangrove community, in which it intercorrelated with abiotic factors constitute mangrove ecosystem. If those mangrove ecosystems are dominated by trees, we called mangrove forests. The term "mangrove" itself describes both the plants inhabiting inter-tidal zone and the community itself (Tomlinson, 1986), even ecosystem (FAO, 2005; Kusmana, 1993).

Mangrove ecosystem is an interface unique ecosystem between marine and terrestrial ecosystems characterized by high productivity and rapid cycling of nutrients (Snedaker, 1978) that contribute a major share of the energy requirements offshore ecosystems (Harger, 1982). Therefore, they are considered as important natural resource for multiple reasons, especially for the tropical countries.

The rate of disturbance and variety of the human-induced influences on the mangrove ecosystems have been steadily increasing, so a large proportion of the World's mangrove is threatened with destruction. The main cause of the mangrove destruction as currently underway in the world can be broadly distinguished as: (1) over exploitation by the traditional users (e.g. for charcoal, pole and firewood) and uncontrolled forest concessionairs, (2) destructive actions resulting from activities generally unrelated to sustained uses of mangroves (e.g. conversion to agriculture, mining/mineral extraction, aquaculture, urban infrastructures, resettlements, etc.) (Saenger et al., 1983), and (3) pollution and natural disaster (Kusmana, 2010). So that, the conversion of mangrove areas to other uses over the past decades has been alarming.

In the developing countries, short-term economic gains in the mangrove areas (e.g. oil mining, resettlement, industrial estate, etc.) have taken precedence over the long-term generation of benefits which have both economic and natural values. However, mangroves are sensitive to outside influences and are increasingly subjected to stress or disappearance through reclamation and pollution (Snedaker, 1978).

As an archipelagic country, Indonesia consists of more than 17,504 islands (28 big islands and 17,475 small islands) with the length of coastline estimated at 95,181 km, which bears mangroves from several meters to several kilometers. According to the latest information, the mangrove vegetated area in Indonesia is amounted to 3.2 million hectares (Bakosurtanal, 2009). On the other hand, at the year of 2007 Ministry

of Forestry reported that potential area to be planted by mangrove (including mangrove vegetated area) is estimated at 7.8 million hectares (30.7% in good condition, 27.4% moderate-destroyed, 41.9% heavy-destroyed). The destroyed of them are caused by several kind of causes, mainly by conversion to the other uses.

For centuries the Indonesian people have traditionally utilized mangroves, mainly for firewood, charcoal, tannin, dyes, food and beverages, medicine, pole and timber. The main genera used are Rhizophora, Bruguiera, Ceriops, Avicennia, Nypa and Oncosperma (Soegiarto, 1984). At the beginning, the fishing and charcoal making are generally the basic economic activities in the mangrove areas. However, in the following period a commercial scale of mangrove exploitation in Indonesia has been begun with a production of logs, charcoal and chip-woods. In the same time, the increasing of population growth and economic development in this country resulted in the destruction even disappearance of many mangroves through conversion of them to fishponds, industrial estates, transportation and recreation infrastructure, resettlement, tin mining, agricultural activities, and other uses.

The multiple role of the mangroves as a renewable resources in the coastal area in relation to serving valuable forest products and environmental services for the coastal population is well recognized in Indonesia, so that degraded mangroves must be rehabilitated and mangrove plantation should be established in some intertidal areas to enrich land productivity as well as environmental quality of the ecosystem.

1.1. Mangrove Rehabilitation and Restoration in Indonesia and Other Countries

Mangrove rehabilitation or restoration is becaming important in Souteast Asia, mainly as the effect of mangrove destruction becames apparent in the form of loss of coastal fisheries productivity, loss of livelihood of coastal communities, and loss of live and proverty in the wake of storms and tsunamis. Promotions of regeration of mangroves has been the goal of mangrove foresters in South Asia (Giesen et al., 2006). It is reported also that as a general rule, mangrove seedlings should be planted with 1 metre spacing, i.e. at a density of 10,000 per hectare. High initial mortality is not unsual, but survival rates of at least 50 percent should be expected. Typical forest density of mature mortality of planted saplings should not lead to an unsually sparse forest (Lewis and Streever, 2000). Indeed , a round of thinning may be required in years 5-10 to prevent the establishment of 'pole forests', i.e dense stands of thin, tall trees, as these may be particularly susceptible to storm demage. According to Lewis (2001), the cost of mangrove restoration usually varies from US$225 per hectare to US$216 000 per hectare, depending on the location and technique used.

Almost all countries in Southeast Asia executed mangrove rehabilitation/restoration in improving and recovering mangrove ecosystem function in their region (Table 1).

Table 1. Some mangrove rehabilitation/restoration activities in Southeast Asian countries

No	Country	Mangrove Rehabilitation Activity
1	Indonesia	• Mangrove rehabilitaion at Angke Kapuk coastal area Jakarta using Guludan Technique (± 25,000 seedlings of *Rhizophora* spp) and Rouble Mould Water Break Model at the coastaline of Muara Angke Mangrove protection forest by Faculty of Forestry IPB founded by Pertamina, AEON, PGN, KNI, Bank Mandiri, etc. • Mangrove rehabilitation by Ministry of Forestry all over the country (more then 30,000 ha) through Gerhan One Man One Tree, OBIT (One Billion Indonesia Tree) and Kebun Bibit Rakyat (KBR) programs, sponsored by JICA,KOICA, etc, beside founded by internal fanding allocation by MoF • Mangrove rehabilitation by Pertamina through the program of "Pertamina Sobat Bumi" at 22 regions all over the country totalled 884,360 seedlings • Mangrove rehabilitaion by NGO i,e Wetlands Indonesia in Serang, Java; OISCA in Jakarta, Indramayu, South Sulawesi, etc; Yamamoto Foundation in Riau 500 ha, Jambi 20,000 ha, South Sumatra 20,000 ha, Bangka Belitung 10,000 ha • Mangrove rehabilitation by International Institution and Donors, i.e. JICA in NTB and Bali; KOIKA in Aceh UNDP-IUCN through the program of Mangrove for the Future (MFF); ADB; ITTO, etc • Mangrove rehabilitation by local communities i.e Tuban Mangrove Center in Central Java, Sinjai South Sulawesi, silvofishery-agro-pastoral system in Deli Serdang North Sumatra, silvofishery system in Pemalang Central Java, etc • Mangrove rehabilitation by Perhutani at northern coast of Java through empang parit silvofishery systems and komplangan system • South China Sea project in West Kalimantan
2	Malaysia	• Mangrove rehabilitation sponsored by UNDP-GEF Project Entitle Reversing Environmental Degradation Trends in The South China Sea and Gulf of Thailand • Mangrove rehabilitation by various parties, i.e JICA, UNDP, etc
3	Myanmar	• Mangrove rehabilitation in the Irrawaddy Delta; 3 234 ha in Lapputta Township, 1 158 ha in Bogalay, and 200 ha in Moulmying yun
4	Thailand	• Mangrove rehabilitation sponsored by UNDP-GEF Project Entitle Reversing Environmental Degradation Trends in The South China Sea and Gulf of Thailand • Abandoned shrimp ponds mangrove restoration of 800 ha in Surat Thani by Royal Forest Departement

No	Country	Mangrove Rehabilitation Activity
		• A pilot project working with local communities in the Pattani Bay area and carried out by the Prince of Songkla University and Wetland International (100 ha) in over-logged forest area and abandoned shrimp ponds • Mangrove forest rehabilitation by local community in Ban Prednai, Trat Province, in Bang Khunsai Phetchaburi Province, in Ban Bang Tip, Phang Nga Province and in Ko Kham Community Samut Sakhon Province
5	Vietnam	• Mangrove rehabilitation sponsored by UNDP-GEF Project Entitle Reversing Environmental Degradation Trends in The South China Sea and Gulf Thailand • In the 1990 mangrove restoration in the Ca Mau Peninsula (6,600 ha) in replanting program together with five state forestry/fishery enterprises • Mangrove rehabilitation of almost 1,000 ha in Northern Vietnam at Thiong Long, Thai Thuy, and Tinh Gio • Degraded mangrove area rehabilitation in the Mekong Delta region (± 20,638 ha during 1977-1997)
6	Philippina	• Mangrove rehabilitation sponsored by UNDP-GEF Project Entitle Reversing Environmental Degradation Trends in The South China Sea and Gulf Thailand • Mangrove reforestation in Banacon by local community since 1957
7	Cambodia	• Mangrove rehabilitation sponsored by UNDP-GEF Project Entitle Reversing Environmental Degradation Trends in The South China Sea and Gulf Thailand • Mangrove forestation in Sihanoukville by local community

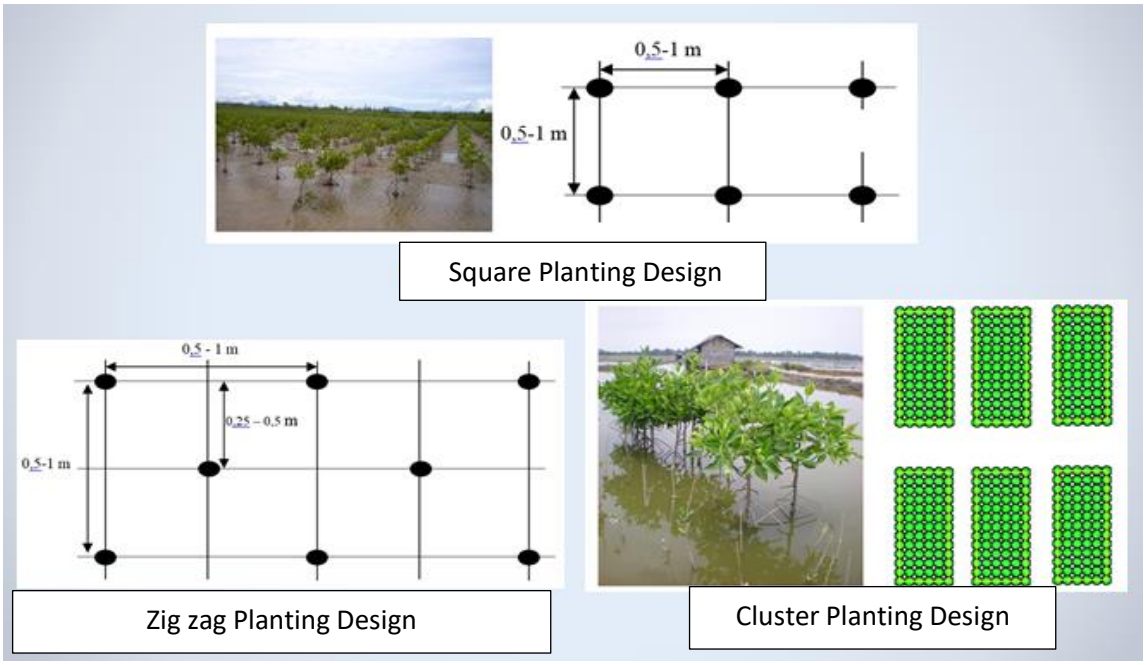

Figure 1. Mangrove planting design have been applied in Indonesia

2. Methods

2.1. Planting Design and Tehnique

Regarding to the mangrove rehabilitation and restoration, there are three planting design commonly applied in Indonesia (Figure 1) with the spacing of 1x1 m, 1x2 m, 1.5x1.5 m, 2x2 m, and 2x3m depending on the goal of planting and local specific habitats condition. Beside at least eight planting techniques haven been applied by the various parties in planting mangrove in Indonesia (Figure 2).

2.2. Budget for Mangrove Rehabilitation

As an archipelagic country, Indonesia has the largest mangrove areas in the world (about 3,2 million ha), but about 70 % of them are destroyed. Because of the paramount important function of mangrove ecosystems, Indonesia has been spent high efforts to rehabilitate and restore degraded mangroves using several techniques to guarantee the success of planting. In oder to serve general guidance for stakeholders to participate in executing the mangrove rehabilitation/restoration, mainly for internal need institution in allocating budget, Ministry of Forestry enacted the Decree of Director General of Watershed Management and Social Forestry No. P.05/V-SET/2014 on estimate Unit Price Standard for Mangrove Rehabilitation. In general its regulation giving information such as shown on Table 2.

Beside a technical aspect (knowledge of an autecology and silvicultural technique of species to be planted), the cost budget for mangrove rehabiliation or restoration should be considered firmly. According to our experiences, there is a variation cost budget for

both producing seedling in the nursery (Rp 900- Rp 1,500) and seedling planting (Rp 18 Million to Rp 22 Million) based on the region. In the average the cost for mangrove planting using propagules is amounted to Rp 1,420 per an individual propagule or about Rp 14,200,000 per hectare and about Rp 1,845 per an individual seedling or about Rp 18,450,000 per hectare using seedling planting (Table 3 and 4). Regarding to seedling production in the nursery, the cost budget is about Rp 1,350 per an individual seedling (Table 5). In this event, I want to describe experience for three difference cases of mangrove rehabilitation in Indonesia.

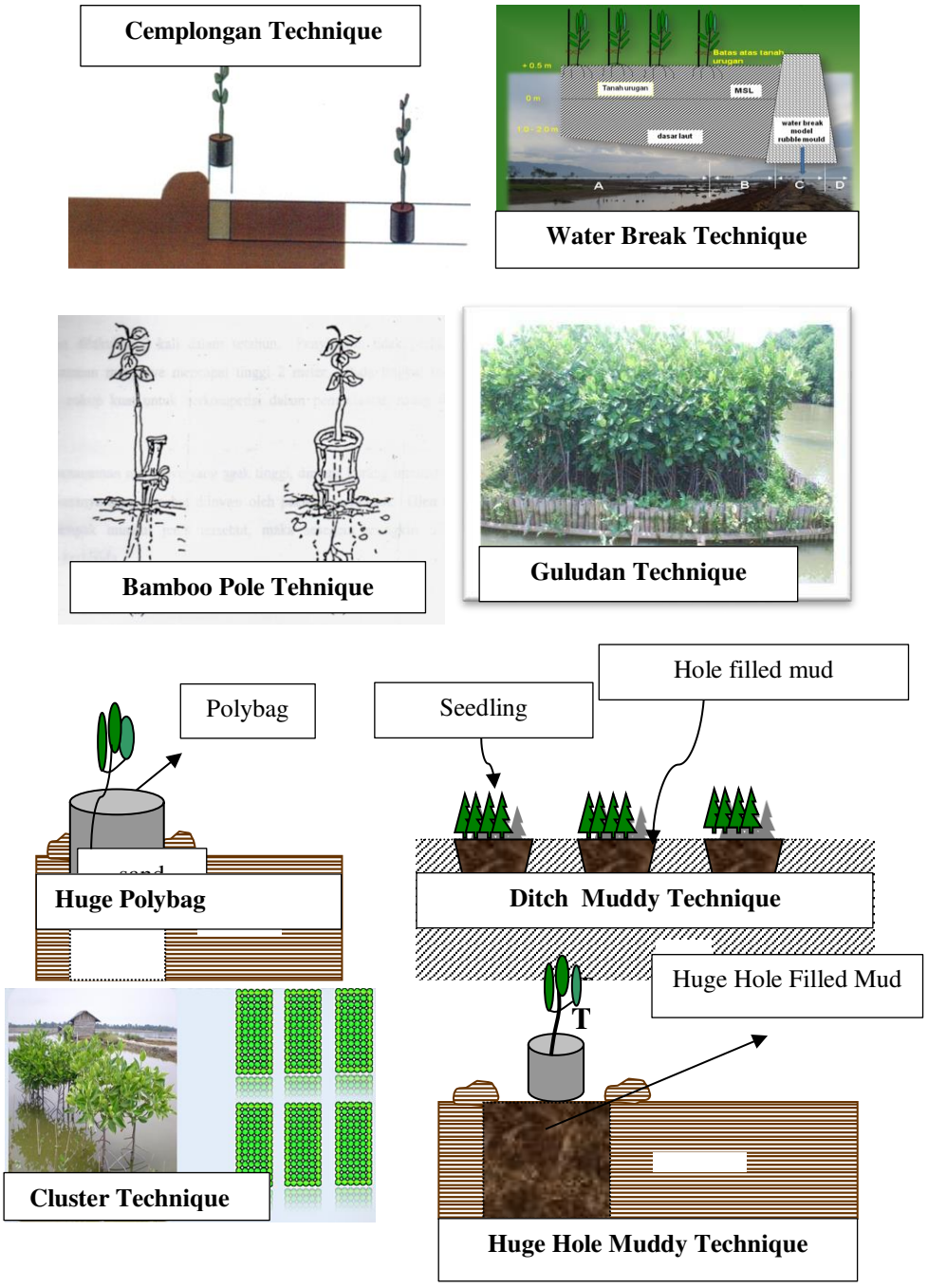

Figure 2. Mangrove planting techniques have been applied in Indonesia.

Table 2. Estimate standard unit price for mangrove rehabilitation

No	Activity	Unit Price (Rp/ha)				
		A	B	C	D	E
I.	Mangrove Rehabilitation Planning Design					
1.	Insentive for worker in measuring the project area	36,000	40,000	44,000	48,000	52,000
2.	Material for executing the project	100,100	100,100	100,100	100,100	100,100
3.	Mobilization/transfortation	235,000	235,000	235,000	235,000	235,000
4.	Data processing map, report writing, and report multiplicating	36,650	38,150	39,150	40,150	41.150
Sub Total I (rounded)		408,000	439,000	469,000	499,000	529,000
II.	Seedling Planting					
1.	Inseentive for seedling planting and maintenance workers	2,115,000	2,330,000	2,545,000	2,760,000	2,975,000
2.	Material for seedling planting and maintenance	5,959,000	6,166,000	6,372,500	6,579,000	6,785,500
Sub Total II		8,074,500	8,496,000	8,917,500	9,339,000	9,760,500
1.	Profit and overhead	807,450	849,600	891,750	933,900	976,050
2.	Cost after profit and overhead	8,881,950	9,345,600	9,809,205	10,272,900	10,736,550
Sub Total II (rounded)		8,882,000	9,346,000	9,810,000	10,273,000	10,737,000
III.	Maintenance					
1.	Insentive for maintenance workers	1,035,000	1,130,000	1,060,000	1,320,000	1,415,000
2.	Materials for maintenance activities	1,024,000	1,082,000	1,140,000	1,198,000	1,250,000
Sub Total III		2,059,000	2,112,000	2,200,000	2,518,000	2,671,000
3.	Profit and overhead	205,900	211,200	220,000	251,800	267,100
4.	Cost after profit and overhead	2,264,900	2,323,200	2,420,000	2,769,800	2,938,100
Sub Total III (Rounded)		2,265,000	2,324,000	2,420,000	2,770,000	2,939,000

Note :
Number of planting seedling 3,300 ind/ha
A : Region of Sumatra, Java, and Bali
B : Region of Kalimantan
C : Region of Sulawesi
D : Region of Nusa Tenggara Timur (NTT) and Nusa Tenggara Barat
E : Region of Maluku and Papua

Table 3. Cost budget for one hectar propagule planting using a spacing of 1x1 m

No.	Activity	Volume	Unit	Price (Rp)	Total (Rp)
1	2	3	4	5	6
I	**MATERIALS**				**3,148,000**
1.	Stake area borderline	6	Stem	3,000	18,000
2.	Stake planting line	220	Stem	1,000	220,000
3.	Seedling stake	10,000	Stem	250	2,500,000
4.	Rope binded seedling to stake	8	Roll	5,000	40,000
5.	Rope signed planting line	120	Meter	1,000	120,000
6.	Bamboo basket	10	Unit	25,000	250,000
II	**INSENTIVE**				**11,050,000**
1.	Wage for land clearing	12	Man day	50,000	600,000
2.	Wage for stake assembling of row planting area	75	Man day	50,000	3,750,000
3.	Wage for seedling stake assembling	4	Man day	50,000	200,000
4.	Wage for seedling transportation	35	Man day	50,000	1,750,000
5.	Wage for seedling planting	55	Man day	50,000	2,750,000
6.	Wage for maintenance	40	Man day	50,000	2,000,000
Cost of planting for one propagule					1,419.8 (rounded to 1,420)

Table 4. Cost budget for one hectar mangrove planting using seedling with the spacing of 1x1 m

No.	Activity	Volume	Unit	Price (Rp)	Total (Rp)
1	2	3	4	5	6
I	**MATERIALS**				**3,148,000**
1.	Seedling production and 20% seedling stocking	12,000	Stem	1,350	16,200,000
2.	Stake area borderline	6	Stem	3,000	18,000
3.	Stake planting line	220	Stem	1,000	220,000
4.	Seedling stake	10,000	Stem	250	2,500,000
5.	Rope binded seedling to stake	8	Roll	5,000	40,000
6.	Rope signed planting line	120	Meter	1,000	120,000
7.	Bamboo basket	10	Unit	25,000	250,000
II	**INSENTIVE**				**15,300,000**
1.	Wage for land clearing	12	Man day	50,000	600,000
2.	Wage for stake assembling of row planting area	4	Man day	50,000	200,000
3.	Wage for seedling stake plant assembling	35	Man day	50,000	1,750,000
4.	Wage for seedling transportation	110	Man day	50,000	5,500,000
5.	Wage for seedling planting	85	Man day	50,000	4,250,000
6.	Wage for maintenance	60	Man day	50,000	3,000,000
Cost of planting for one seedling					1,844.8 (rounded to 1,845)

Table 5. Cost budget for producing 50,000 seedlings in the nursery

NO	Activity	Volume	Unit	Price (Rp)	Total (Rp)
1	2	3	4	5	6
I	**MATERIALS**				**32,132,500**
1	Polybag	272	Kg	30,000	8,160,000
2	Paranet	900	m^2	10,000	9,000,000
3	Bamboo stem	275	Stem	12,000	3,300,000
4	Wire, spike, etc	1	Paket	500,000	500,000
5	Soils	40	m^3	100,000	4,000,000
6	Organic fertilization	10	m^3	100,000	1,000,000
7	Identity board	1	Unit	1,000,000	1,000,000
8	Board of planting row	1	Unit	5,000	5,000
9	Mica plastic	300	Meter	8,000	2,400,000
10	Seedling transport tools	1	Unit	500,000	500,000
11	mat stock	1	Unit	65,000	65,000
12	Skop	1	Unit	52,500	52,500
13	Sieve tools	1	Unit	150,000	150,000
14	Water shower	1	Paket	2,000,000	2,000,000
II	**INSENTIVE**				**35,300,000**
1	Nursery land clearing	20	Man day	50,000	1,000,000
2	Seedling area line	50	Man day	50,000	2,500,000
3	Putting soil to the polybag	144	Man day	50,000	7,200,000
4	Seed collection	180	Man day	50,000	9,000,000
5	Seed planting	40	Man day	50,000	2,000,000
6	Maintenance	272	Man day	50,000	13,600,000
Cost for producing one seedling in the nursery					1,349 (rounded to 1,350)

Table 6. Cost budget for constructing one unit Guludan of 4.5 m x 6 m x 1 m

No.	Materials	Volume		Unit Price (Rp)	Total Cost (Rp)
1	Bamboo	145	Stam	18,000	2,610,000
2	Rope	16	Kg	20,000	320,000
3	Soil	27	M3	80,000	2,160,000
4	Plastic sack	1,674	Sack	1,000	1,674,000
5	Filled soil to plastic sack	1,674	Sack	1,000	1,674,000
6	Insentive for workers	25	Man day	100,000	2,500,000
Total Cost					10,938,000

Note : for the spacing 0.5x0.5 m, cost for planting one seedling using Guludan Technique is Rp 101,000

3. Result and discussion

3.1. Cases of Mangrove Rehabilitation Programs in Indonesia

a. Case (1): Mangrove planting using Guludan Technique in coastal area of Angke Kapuk, North Jakarta

Angke Kapuk coastal area lost of about 70 % mangrove area in the periode between 1977 – now, because of conversion to airport, high way, urban facilities, resettlements, and fish ponds. Now, those conversion of mangrove remain only 372 hectares of degraded mangrove – vegetated – land, in which about 95 hectares mainly covered by neglected fish ponds submerged by deep water ranging from one to four meters.

Some mangrove planting techniques have been applied for rehabiliting the area, i.e bamboo basket, big can or drum filled soil as a media for growing seedlings, but those techniques fail in growing seedlings. So that, at 2005 Faculty of Forestry IPB introduced Guludan Techniques (Figure 3) for mangrove planting using four to six months seedlings of bakau (Rhizophora spp) with the spacing 0.5x0.5 m. Fortunately, this planting technique success to grow mangrove seedlings well with the survival rate of more than 80 % showing the good performance of seedling growth (at 3 years old, steam diameters reached 2.5-3 cm seedling height 2.8-3 meter, and biomass 506-702 g/ind for 2 years old) (Figure 4). Surprisingly, this technique can also facilitate natural sucession in guludan, such as Sonneratia spp, Avicennia spp, etc (Figure 5). For constructing a Guludan of 4.5 m (width) x 6 m (lenght) x 1 m (height) planted by 200 seedlings needs a budget amounted to Rp 10,938,000 (Table 12).

(a)

(b)

Figure 3. Performance of Guludan.

Figure 4. Well growth seedlings in Guludan.

Figure 5. Develope succsession of 10 years mangrove planted by Guludan.

From the experience of applying guludan technique, we got some lesson learns such as follows:

a. Mangrove can be planted in the mineral soils
b. The appropriate media for growing mangrove seedlings is the mixed soil between 60% mineral soil and 40 % mud
c. In order to avoid abundant weeds, planted mangrove seedlings in the guludan should be submerged about 10-20 cm by waters
d. R. mucronata seedlings show grow well at the water salinity less then 20 ppt
e. More denser the spacings, more higher the height growth of seedlings and vice versa for stem diameter growth
f. Spacings of 0.5 x 0.5 m resulted in the good growth of R. mucronata seedlings planted in guludan
g. Lateral Root Manipulation (LRM) with the fertilization of Rock Phospat combined with Humic Substance Complex and Terabuster can be applied to improve the neglected growth of seedlings
h. Planted seedlings in the guludan should be maintained until 3 years old from the weeds, snails and caterpillar.

b. Case (2): Mangrove planting in the over-logged forest area

This action research carried out at over-logged forest area of PT. Bina Lestari Riau by Division of Research and Development of the company for 2 years measurment period (1996-1998) sampled 60 trees of Rhizophora apiculata and Bruguira gymnorhiza with spacing of 1 x 1 m, 1.5 x 1.5 m, and 2 x 2 m, each starting at 6 years old tree and ending at 8 years old ones. Measurement of stem diameter and seedling height steam of sampled trees was done twice in a year (June and December) in two research plots comprising of three measurment plots of 50 x 30 m each for both Rhizophora apiculata and Bruguire gymnorrhiza.

Obtained action research results as lesson learn were:

a. Based on considering survival rate, volume increment and budget spending, the best spacing is 1.5x1.5 m which showing the increment of steam diameter 0.987-1.464 cm per year, height 0.478-0.689 m per year, and tree volume 10.33-10.78 m3/ha/year
b. For chipwoods production, the felled trees should be at least 10 cm at DBH, rotation (cutting cycle) 10 years with the forest management period 25 years and the minimal forest area to be managed about 20,140 hectars
c. For managing the forest area 20,140 ha for chipwoods production needs about 2,026 workers consisting of 47 person at Forest Management Unit (KPH), 76 persons at Sub-KPH Level (BKPH), 100 persons at Sub-BKPH level (RPH), 628 persons for silviculture activities (nursery, planting, maintenance), and 1,175 for forest harvesting.

c. Case 3: Mangrove Rehabilitation Using Agroforestry Techniques (Sylvofishery, Agrosilvofishery, Agrosilvofishery Pastoral System).

At 1970s Perum Perhutani (Forest State Company) introduced the system of Tambak Tumpangsari (Sylvofishery System) using design of empang parit (mangrove forest stand in the middle surrounded by pond channal for culturing fish/shrimp) with the ratio area in one unit fish pond about 80 % forest and 20 % pond channal. In accordance with the passage time, sylvofishery system developed to become various system such as agrosilvofishery and agrosilvofisherypastoral systems which have been applied by local coastal communities (Figure 6).

Those kinds of techniques better to be applied for mangrove rehabilitation on the mangrove degraded areas borderline or surrounded by landless poor community. The Farmer at least obtain the net profit amounted to Rp. 4,500,000 in cultivating fish of bandeng/milk fish (Chanos chanos) for one ha fish pond using sylvofishery system (Table 12).

The profit increases if the farmer applied agrosilvofisherypastoral system for (chicken, oil palm, milk fish, fuelwood) for once harvesting period (6 months), about Rp. 12,641,000 per ha (Bapak Ginting, personal communication).

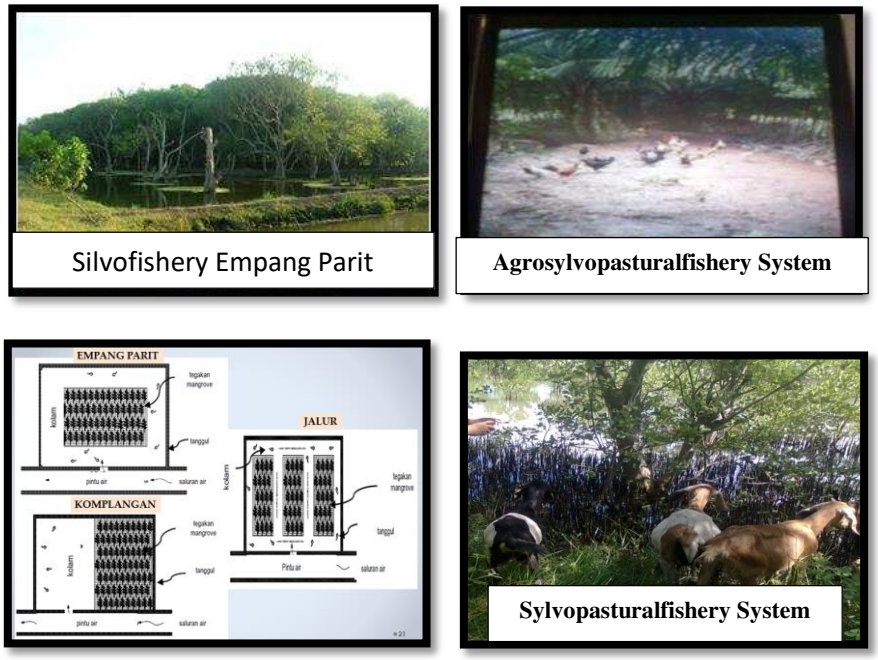

Figure 6. Various agroforestry system in mangrove ecosystem

Table 7. Expenditure, income, and profit in cultivating milk fish for one ha fish pond sylvofishery system for 4 to 5 months cultivating period of fish

No	Items	Volume	Unit price (Rp)	Total (Rp)
I	EXPENDITURE			
	Juvenil fish	5000 ind	110	550,000
	Fish feed (pellet)	400 Kg	7,000	2,800,000
	Saponin	100 Kg	5,000	500,000
	Pond maintenance	-	500,000	500,000
	Fish harvesting	-	750,000	750,000
	Total			5,100,000
II	INCOME			
	Fish (milk fish)	700 kg	13,000	9,100,000
	Natural fish, shrimp sand crabs	-	500,000	500,000
	Total		9,600,00	
	PROFIT		4,500,000	

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