(1-4) A rehabilitation study on degraded peat swamp forests in riau biosphere reserve

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Abstract: The first step of rehabilitation study was carried out in Bukit Batu Forest Block of Riau Biosphere Reserve started in June 2010 until now. There are three main reasons that we need to do rehabilitation in this location arc: (1) large degraded forest area, particularly in about 3 km of both side along river basin of Bukit Batu River, (2) low the capability of natural regeneration, particularly typical upper storey species of peat swamp forest, and (3) need to restore tree species utilized by local people as Non Timber Forest Product (NTFP). The aim of the study are (1) to rehabilitate logged over peat swamp forests, and possible to improve the socio-economic values, (2) to improve the methods of producing seedlings stock and rehabilitation techniques on tropical degraded peat swamp forest area, (3) to enrich the number of main typical upper storey species, and (4) to restore tree species which has function as NTFP. We used three methods to produce seedling stock are (1) cuttings, (2) wildings, and (3) seed germination. Line and gap planting method were used to rehabilitate logged over forest area. We have applied two different planting methods such as normal and hill planting. Survival rate, height and diameter of planting trees are recorded. We carried out an open ended interview using questionnaires for 36 household of local community of Temiang's Village. The achievement indicators of rehabilitation study after one year are (1) the better method for production of seedlings stock is wildings and seeds germination method compared with cutting method, (2) all of tree species planted is high survival rate >57%, and even *Palaquium burckii, Palaquium sumatranum, Callophylum lowii,* and *Cratoxylon arborescens* are the highest survival rate of 100% with distinct rehabilitation techniques, (3) indicated that the highest growth performance is *Cratoxylon arborescens* with mean of height increment by normal planting 44.7+ 28.8, hill planting 34.4+ 14.0, and diameter increment by normal planting 0.8 + 0.16, hill planting 0.7 + 0.21. Followed by *Tetramerista glabra* with mean of height increment by normal planting 13.1+ 7.94, hill planting 15.1+ 4.68, and diameter increment by normal planting 0.6 + 0.2, hill planting 0.7 + 0.2 after five month planted and, (4) most of respondents (94.4%) agree in any rehabilitation degraded forest areas. Forest is important for maintaining environment and their life, but two respondents revealed that the priority to be done is a clear decision about boundary between protected forest and village area. Successful forest rehabilitation can be used to minimize conflict between forestry department and local villager in core area of Riau Biosphere Reserve in the future.

Key words: Logged over forest, peat swamp forest, protected forest, rehabilitation, Riau Biosphere Reserve Reserve.

The rehabilitation of tropical degraded forest and local community living widi forest (The Mitsui & Co., LTD. Environment Fund 7-078)

INTRODUCTION

The current rate of deforestation in tropical regions constitutes a major global biodiversity crisis. On average 12.5 Million ha of tropical forest disappears every year. In addition about 5 Million hectares of natural forest from annually degraded to logged over forest. Rehabilitation of these degraded forest along with sound concept of sustainable management are needed urgently (Thang 1987). Many healthy forest functions such as mitigation of global warming and biodiversity maintenance are important for sustainable forest management (Kobayashi *et al.,* 2003; 2004; 2005). Degraded forest have lost much of their productivity and biodiversity as well as many of the ecological goods and services they once provided (Lamb and Gilmour2003).

Indonesia's forested areas arc being destroyed at an alarming rale. Between 1990 and 2005, Indonesia lost over 25% of its forest and woodland habitats, with an annual destruction rate of 1.9% (Butler 2006). Furthermore deforestation rate at various type of forest ecosystem in Riau is more than 70,000 ha/year (Holmes 2000). After 2000s, forest conversion started largely on the peatland. In period 1990s to 2007 peat swamp forest loss about 1 Mha in Riau, currently remaining is approximately 2,581,752 Ha (Holmes 2000, WWF 2008). Degradation of peatland occurs due to legal and illegal logging for limber, conversion of the land into plantations (oil-palm, rubber, timber), and massive yearly fires-exacerbated by LI Nino events and through the drainage of the swamp forests by canals (Holmes 2000, WWF 2008).

In Sumatra the largest area of peat land was located in Riau with extent was 4.04 Mha as being classified as Sumatran peat swamp forest eco-rcgion, includes the Giam Siak Kecil-Bukit Batu, which officially declared as Biosphere Reserve in 2009 (Jarvie *et al.* 2003, MAB Indonesia 2008, WWF 2008) with a total area of more than 700,000 ha. The integrity of this biosphere is under threat, due to land conversion, forest-land Orii, and logging activities. Analysis of LANDSAT satellite images indicates that forest cover decreased from about 600,000 ha in 1985 to 350,000 ha in 2002 (Jarvie, et al., 2003).). The ongoing development of large areas of peatland as timber estates, illegal logging activities and palm oil plantations on a landscape scale constitutes a serious threat to the peat swamp forest ecosystem. A large area of the Buffer zone had been developed as an industrial timber estate (195,259 ha or 88%) and

production forest (27,167 ha or 12%), while the development of the peatland area in the transition zone focused on palm oil plantations, agriculture, and housing (304,123 ha) and industrial timber estate (5,665 ha) (MAB Indonesia 2008).

Peatlands are one ecosystem that are fragile and perhaps been subject to most abuse in the region and as a consequence are receiving more attention recently (Prentice and Parrish, 1992; Parkyn *et* al., 1998). The utilization of these lands results in a decline or loss in productivity with a significant impact on the entire ecosystem.

From 1999 to 2009, the peat swamp forest of the Bukit Batu Wildlife Reserve was subject to illegal selective logging of trees species with high-quality timber, such as *Shorea* spp, *Tetramerista glabra, GonystylliS bancanus, Palaquium sumatranum, Palaquium burckii, Durio acutifolius,* and *Koompasia malaccensis.* From 2005 to 2009, the logging activities decreased, and they stopped completely by the beginning of 2010. The degradation of forest area continued where in along of river basin side has been converted by local people as rubber jungle garden. Some of old local people used to cultivate rubber trees as marking their land. Currently the younger follow to plant rubber trees. Hence the problem between local people and forestry department will increase after that due to claim of land owner status. In the other hand our hypothesis that the successfully rehabilitation program will be useful to minimize conflict between forestry department and local people in the future.

Degraded forest ecosystems are characterized by low productivity, low diversity, or both (Hobbs & Norton, 1996). In completely degraded areas, human intervention is essential for rehabilitation of tree species. Hence, successful restoration of a forest ecosystem results in rehabilitation o/ nfts structural (forest structure and plant density), functional (food-web rehabilitation), and biodiversity components (species richness).

A study conducted by Gunawan *et al* (2009, 2010, and 2011), Riau Biosphere Reserve is divided into three forest conditions, namely (1) natural peat swamp forest; bintangur forest type, and mixed forest type with different main dominance species, located at the core area and buffer zone, (2) logged-over forest and degraded shrub forest located at the core area, and (3) secondary forest; wind and burnt disturbed forest located at the buffer zone and transition area. Level of degradation has been classified to be three condition are (1) severely degraded, (2) heavily degraded, and (3) moderately/medium degraded. The main characteristic of severely degraded is dead or none tree remains, open area, and colonized by fern or grass. While heavily degraded is Loss much of its original biodiversity and most of its structure (Bintangur stands), land colonized by grass, fern, and *melastoma* sp on a site after an earlier succession. Moderately/medium degraded is forest regenerates naturally, some residual trees remain is still present (e.g. *Palaquium sumatranuni/Bintangur).* According to Toma *et al* (1997) moderately degraded forest has large gaps which are generally occupied by pioneer tree species of

Euphorbiaccae *(Macaranga mallotus, Homalanthus* sp, and *Glochidion* sp). Effendi *et al* (2011) revealed that degraded forest can broadly be grouped into three main categories. The first category is lightly degraded forest still containing the main characteristics of the original forest. Natural regeneration restores the original forest within a reasonable time. Medium to heavily disturbed forest created by logging and forest fire or combinations of the two is the second category. The vegetation consists of trees and shrubs of the original forest or of pioneer species. This secondary forest can be rehabilitated by enrichment plantings in lines or in other spatial arrangements. The third main category includes *Imperata cylindrica* (alang-alang) grasslands.

Study results have indicated that natural regeneration of some tree species of peat swamp forest in Riau Biosphere Reserve is vigorous, but some of the typical canopy species (e.g. *Shorea spp, Gonystylus bancanus, Tetramcrista glabra, Durio carinatus, Dyera lowii,* and *Calophyllum lowii)* show limited or no regeneration (Gunawan *et al.,* 2010). Rehabilitation methods will improve the natural regeneration capabilities of these typical canopy species.

In the past local people utilized trees of peat swamp forest to produce non timber forest product such as seeds of *Palaquium sumatranum* can produce cooking oil, *Dyera lowii* and *Payena lerii* produce latex, and bark of *Alscodaphne ceratoxylon* produce anti mosquito. The other trees were used to medicine and fruits. The other important of trees which has good timber quality such as *Gonystylus bancanus, Shorea spp, Tetramcrista glabra, Callophylum lowii* (Interviewed results, Gunawan *et al,* 2010). From those activities local people can combine varying income for their sustainable life.

The main rehabilitation question is how to create the appropriate growing conditions, particularly light conditions for each species from juvenile to mature stages (Wcidelt and Banaag 1982)."Forest patch improvement" may be a promising method to accelerate natural regeneration (Kobayashi, 1988). More effort is put into the patch than into the surroundings. Treatment is limited to ensuring adequate light intensity and regulating inter-specific competition in the patch. It can be employed where seedlings are present or seed is available *o\'* target tree species, otherwise "enrichment planting" must be undertaken. "Line planting" and "gap planting" are typical methods of enrichment planting. However, enrichment planting is a promising means of sustainable management of tropical forests as it provides potentially suitable growth conditions for the tree species to be regenerated (Whitmore, 1975). In both methods it is necessary to determine how to provide and maintain appropriate light intensities which may differ with the growth stages of each target species.

Furthermore ecological, social, and economic constraints must be considered when management options are determined. Complementary research on socio-economic problems is highly desirable to ensure technical solutions to the problems can be effectively adopted

(Kobayashi *et al.,* 2007). The aim of the study are (1) to rehabilitate logged over peat swamp forests, and possible to improve the socio-economic values, (2) to improve the methods of preparing seedlings stock and rehabilitation techniques on tropical degraded peat swamp forest area, (3) to enrich the number of main typical upper storey species, and (4) to restore tree species which has function as Non Timber Forest Product (NTFP).

MATERIALS AND METHODS

Site **Description**

The study will be conducted in Riau Biosphere Reserve, Riau Province, Sumatra Indonesia. The Riau Biosphere Reserve is located in two districts, Bengkalis and Siak, and one city Dumai, in Riau, Sumatra Island, Indonesia. The total area is 698,663 ha, of which 75% is covered by peatland. The reserve is located between 0°44-l°irN and **0°H·-102º10·E.** The uniqueness of this biosphere is that it is a vast landscape consisting of a unique hydrological network of small lakes and streams and remaining natural peat swamp forest. The dominant natural ecosystems are peat swamp forests surrounded by different types of land use, such as production forests, degraded/abandoned lands, industrial plantations (timber and palm oil), agricultural lands, and settlements. Topographically, most of the terrain is at altitudes of 0-50 m asl. The climate is tropical and is influenced by the ocean, and the temperature averages between 26°C and 32°C. The rainy season is from September to January, with rainfall of 804-4,078 mm/year. The dry season is from February to August (MAB Indonesia 2008).

To implement the rehabilitation methods we will select two types of degraded peat swamp forest: (1) moderately degraded of logged-over peat swamp forest located at a river basin of Bukit Batu River, in a core area of Riau Biosphere Reserve, and (2) severely degraded areas in Tanjung Leban Village in transition zone of Riau Biosphere Reserve. The exact geographical location of logged over forest is 0r23'24.4"N, 101°5r59.1"E and degraded areas is 01º38'9.81"N, 10r46'13.8"E . For this paper will be focus on the progress report of rehabilitation study carried out in logged over forest in Bukit Batu forest block of Riau Biosphere Reserve.

Study Method

1. Production of Seedlings

Several techniques are employed for the production of seedlings stock. They include seedling from wildings, cuttings raised in the nursery and seeds germination methods. Production of seedlings to assure a continuous supply of seedlings for forest rehabilitation. For getting homogenize and difference of environmental condition we constructed three distinct simple nursery from plastics and plastics net (Fig 1) related by necessity of seedling growth level. The other treatment we also put wildings of some tree species on the forest floor directly after taking them (e.g. seedlings of *Palaquium sumatranuin-B-d\din* and *Tetramcrista glabra*-Punak).

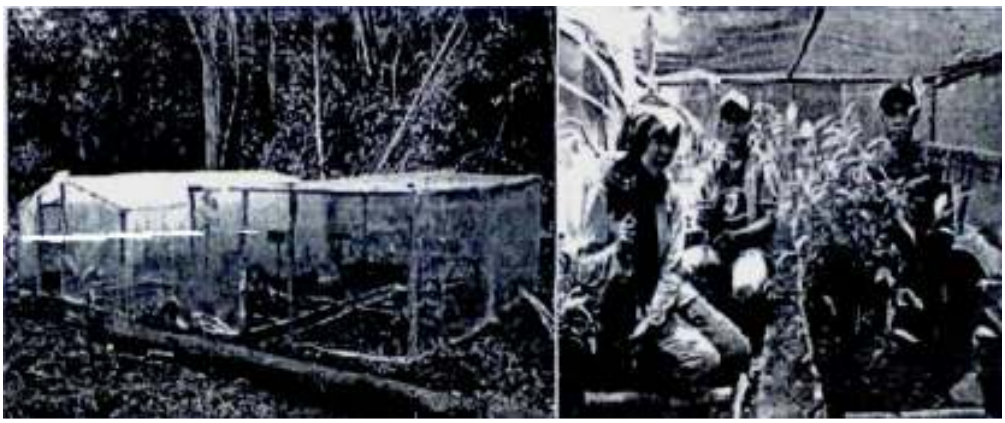

Fig 1. Simple nursery for production seedlings stock

2. Rehabilitation Techniques:

Enrichment planting methods will be developed on areas where seeds or seedlings of target tree species are lacking. Seeds or seedlings to be planted will come from either neighbouring areas or nurseries. Line and gap planting method is commonly used in logged over forest.

2.1. Treatments for line planting:

a. Lines will be set on the west-cast direction with width determined in relation to the height of substorey (e.g. 5, and 10 m); (Fig. 2).
b. Distance between lines will be 5-10 m; and
c. Tree species in the area has been selected for transplanting.

d. To get the seedling we use some of techniques as following: cuttings methods, wildings,

and seed germination.

e. Totally experimental area is 7 line planting covered 3500 m .

f. Totally 2 typical canopy tree species of peat swamp forest planted (e.g. *Shorea spp, Gonytylus bancanus, Callophylum lowii, Palaquium sumatranum, Tetramcrista glabra, Cratoxylon arborescens).*

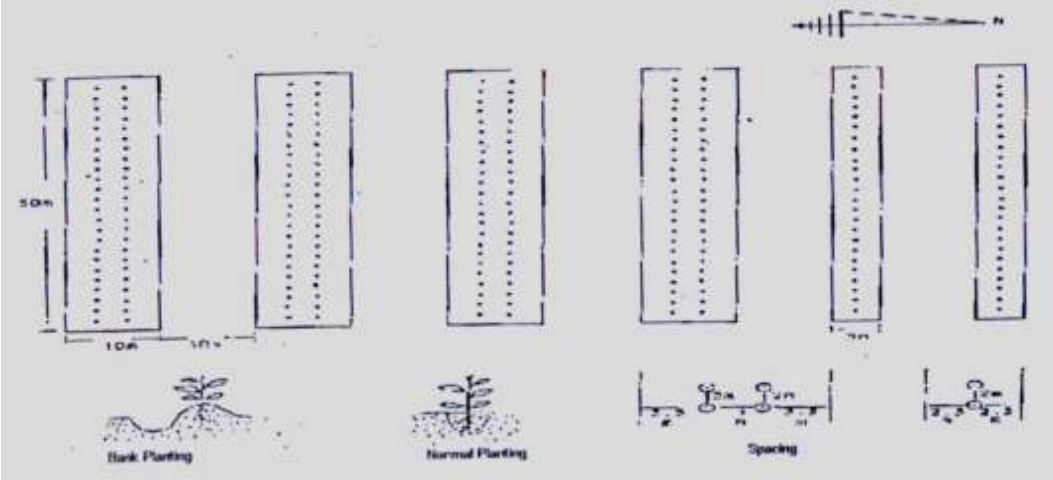

Fig 2. Experimental hill and normal planting in each of line planting method (Kobayashi, 2010).

2.2. Treatments to be taken for gap planting:

a. Gap size will be 10 m x 10 m.

b. Totally 25 economical gap planting *of Dyera lowii* has been *tried,*

c. Totally 6 mixed gap planting of mixing tree species has been tried (e.g. *Dyera lowii, Palaquium sumatranum, Palaquium burckii, Callophyllum lowii, Cratoxvlton anborescens, Tetrameristra glabra* and *Madhuca motleyana, Xylophia ferruqinea, Vatica rassak, Paratocarrrpus lianda)*

d. Tree species suitable ffor tin site codition will be selected. Wildings has beein be appplied (Fig. 3).

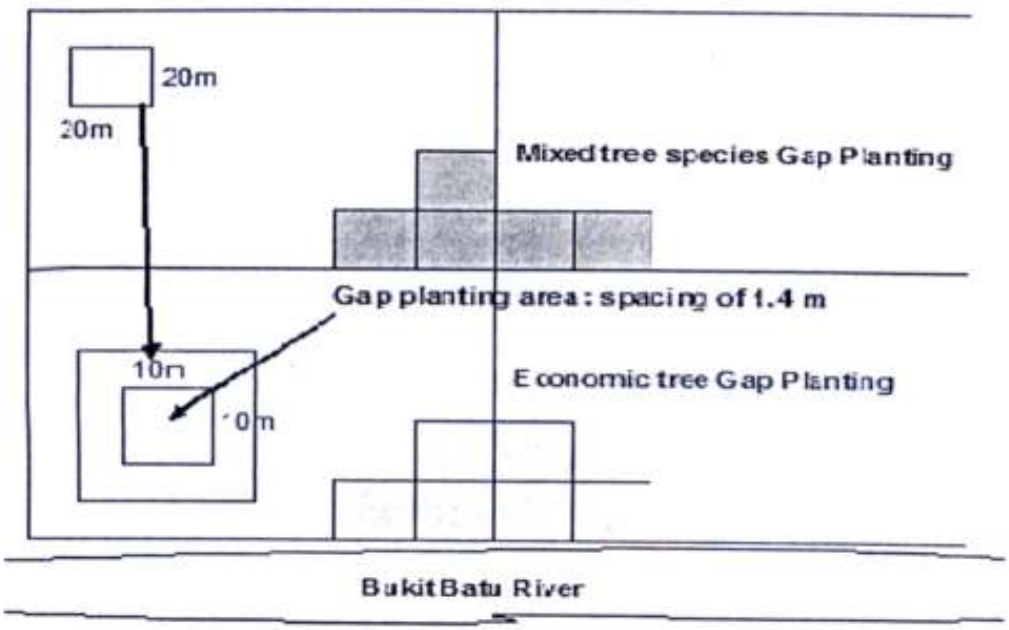

Fig 3. Experimental Gap Planting (Kobayashi, 2010). The following lands of planting methods were applied at these location arc normal and hill planting methods (Fig.4).

1. Normal planting method; a hole in the peat is dug and seedlings are planted in this hole. Hill planting method; the peat soil is accumulated as a Hill and the seedlings are planted on this hill.

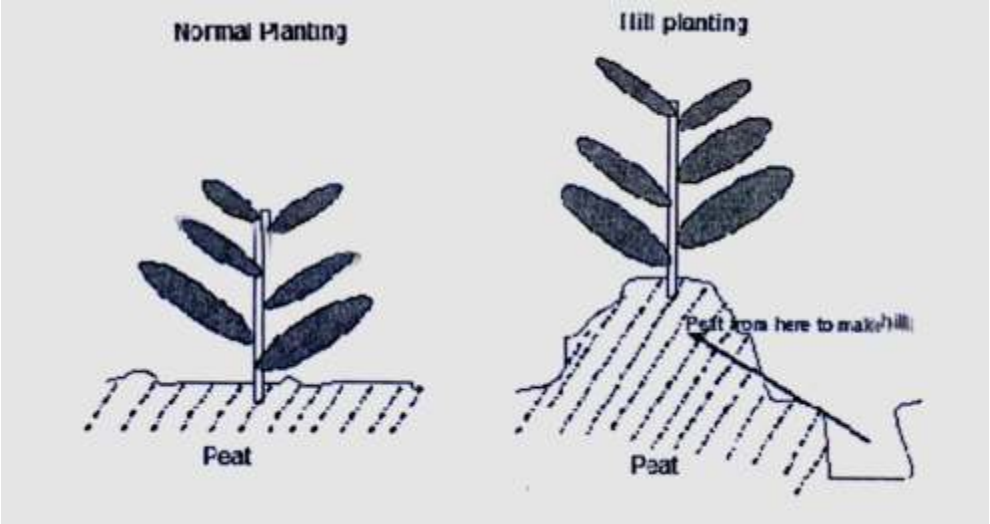

Fig 4. Experimental normal and hill planting methods (Kobayashi, 2010).

All of planted seedlings are monitored to determine the survival rate, height and their growth. The Survival rate are determined by formula:

$$\frac{\text{Number of alive species}}{} \times 100\%$$

Total number of species

Local Community Perception and Participation on Rehabilitating Degraded Forest

We carried out an interview using questionnaires for 36 households of local community crfTemiang's village. Open indeed interview method used. We classified respondents to become 4 group as following: (1) 10 households who work inside forest area as fisherman, (2) 9 households who works on inside and border of conservation area as rubber farmer, (3) 9 households who work as village officer, (4) 3 households who are informal leader, (5) 3 households who are common villagers, and (6) 4 households who are representative of KMPH (Conservation Group of Temiang's Forest Communities).

Percentage participation will be measured by formula Daniel (2002):

P(%) = ni_x 100% N Where: P = Percentage participation

ni= Number of respondents on category i meaning that high participation >66%, moderate 33-66%, and low participation < 33%. N

= Total number of respondents

RESULTS AND DISCUSSIONS

Survival rate of seedlings stock

Table 1 show that 11 months after producing the seedlings using various method. The percentage of survival rate range 41% to 100% by using wilding method.Indicated that wilding method is the best way to produce seedling stock for some species which has problem in seed sources production. Tree species of *Cratoxylon arborescens, Vatica rassak, Madhuca motleyana,* and *Xylophia ferruginea* was highest of their survival rate (100%), followed by *Palaquium sumatranum* and *Tetramcrista glabra* are survival rate of 92% and 88%. The lowest of survival rate was seedlings *of Palaquium burckii* (41%). From this results show that wildings method can be used to produce seedlings stock of some typical canopy species of peat swamp forest in rehabilitating degraded areas. Even though to increase the survival rate *of Tetramcrista glabra* and *Palaquium burckii* need to put their seedlings in forest floor firstly, before transport to nursery.

Table 1. Survival rate of seedlings stock comparison between cuttings, wildlings and seeds

germination methods of nine typical canopy species started in June 2010.

Family	Species	Number of Seedlings surveyed	Survival rate of seedlings stock method			Survival Level
			Wildings (%)	Cuttings (%)	Seeds (%)	
Thecaccae	*Tetrameristra glabra*	51	88	34	-	High and Low
Dipterocarpaceae	*Shorea spp*	115	-	11	-	Low
Dipterocarpaccae	*Vatica rassak*	7	100	-	-	High
Clusiaeeae	*Callophyllum lowii*	547	-	-	96	High
	Cratoxvlum arborescens	34	100	-	-	High
Sapotaccae	*Palaquium sumatranum*	493	92	-	-	High
	Palaquium burckii	109	41	-	-	Moderate
	Madhuca motlevana	11	100	-	-	High
Tymeliaccae	*Gonystylus bancanus*	314	-	7.5	-	Low
Moraceae	*Paratocarpus trianda*	33	-	-	100	High
Annonaccae	*Xylopia fcrruginea*	9	100	-	-	High

The other method to produce seedlings stock tried is cutting method. Survival rate of seedling from this method is still low range 7.5% to 34%. The highest survival rate is *Tetramcrista glabra* (34%), followed by *Shorea spp* (11%), and the lowest is *Gonystylus bancanus* (7.5%). The causes of low survival rate using cutting method identified as following: (1) size of branch used, (2) need to be transported seedling which has indication growth to plastic net nursery, (3) need to be frequently monitored during three month after cuttings. From this experiences the appropriate nursery for first stage seedling growth and frequently monitoring is important to increase the survival rate of seedling by using cutting method. In addition using such as kind a growth hormone will be useful as well.

The production of seedlings stock for efforts rehabilitation can use seed germination method. The high percentage of survival rate from seed germination method ranging 96%-100%, especially for tree species which has many seeds production such as trees of *Callophylum lowii* and *Paratocarpus trianda.*

The combination seedling stock method used to rehabilitate degraded forest areas is important to get more success in supply of seedlings. Furthermore rehabilitation of degraded forest area need to consider the suitable species which can grow well in their habitat. Peat swamp forest is an unique ecosystem and need specific requirement for tree growth and survive. The extreme acid, poor nutrient and waterlogged condition, main characteristics of peat swamp forest ecosystem, should be considered for selecting trees species tried in degraded forest sites.

Survival rate and growth comparison between gap planting and line planting method of

six typical canopy species planted in October 2010.

The survival rates of the seedlings at the rehabilitated sites and varying rehabilitation techniques are shown in Tabic 3. In general, survival is high ranging 57.14% to 100% after five months *of* planting in all tried rehabilitation techniques. The highest tree species survival of normal-gap planting was *Palaquium burckii* and *Cratoxylon arborescens* with about 100% survival, then followed by *Tetramcrista glabra* with 96.2% survival. The lowest of survival was *Dyera lowii* with 69.1% survival from a total of 450 tree species.

fable 3 Survival rate (%) of cuttings and wildlings and mean height and diameter increment (cm) of 7 main typical canopy species of peat swamp forest, 5 months after planting.

Species	Num of Tress	Survival Rate (%)				Height Increment (cm)		Diameter Increment (cm)	
		Gap Planting		Line Planting		Normal	Hill	Normal	Hill
		Normal	Hill	iNormal	Hill				
Dyera lowii	900	69.1	75.3	-	-	4.4+ 3.2	4.9+ 3.2	0.3+ 0.2	0.3+ 0.2
T. Glabra	52	96.2	96.3	-	-	13.1+7.9	15.1+4.7	0.6+ 0.2	0.7+ 0.2
P. Burckii	32	100	88.2	-	-	10.8+ 13.7	9.6 + 9.8	0.5+ 0.2	0.5 + 0.2
P. Sumatranum	118	90.1	100	74.19	100	11.6±13.3 4.1+4.7	6.9+11.3 4.6+6.1	0.4+ 0.2 0.07+ 0.08	0.3+0.1 0.04+ 1.2
C. arborescens	12	100	100	-	-	44.7+ 28.8	34.4+ 19.0	0.8+0.16	0.7+ 0.2
C. lowii	75	-	-	57.14	100	3.9+ 3.3	10.8+7.8	0.06+ 0.05	0.09+ 0.09

Five months after trying a gap-hill planting method showed high survival rate in all of tried tree species range 75.3% to 100%. The species with the highest survival rates are *Palaquium sumatranum (*100%) and *Cratoxylon arborescens* (100%), followed by *Tetramcrista glabra* (96.3%) and *Palaquium burckii* (88.2%) respectively. The lowest survival rate was *Dyera lowii* (75.3%). Whilst the line-hill planting method the highest survival rate was *Palaquium sumatranum* and *Callophyllum lowii* with 100% survival, then decreasing survival rate in line-normal planting method with about 74.19% then 57.14% survival respectively.

In general hill planting method is better method than normal planting method are shown high survival rate of planted tress. A number of factors have been identified as causes of mortality of tress. In the early establishment, some of seedling died due to wetter of peatland. The seedling for the first stage can't be adaptive in wet situation. The other factors the seedlings is still small to transplanted on the field, such as seedlings of *Callophylum lowii.* The insect also was caused seedling *of Dyera lowii* died.

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Total height and diameter increment

The average height and diameter increment from October 2010 till April 2011 arc-shown in Table 3. The highest growth performance is *Cratoxylon arborescens* with mean of height increment by normal planting 44.7+ 28.8, hill planting 34.4+ 14.0, and diameter increment by normal planting 0.8 + 0.16, hill planting 0.7 + 0.21. Followed by *Tetramcrista glabra* with mean of height increment by normal planting 13.1+ 7.94, hill planting 15.1+ 4.68, and diameter increment by normal planting 0.6 + 0.2, hill planting 0.7 + 0.2 Seedlings from this species showed a higher survival rate (97%) than its wildlings (61%) (Fig 5).

Fig.5. High performance *of Cratoxylon arborescens* and *Tetramcrista glabra)* **Local Community Perception and Participation on Rehabilitation Logged Over Forest**

We classified two respondents group related by their perception about rehabilitation study. The first group are 34 respondents or 94% of totally respondents having well perception on forest rehabilitation shown on the high scoring and category level (Table 3). Most of them know the important of forest and rehabilitation. They have reasons that forest rehabilitation will re-establishing tree species which has been lost. The rehabilitated forest will keep in natural condition and improve the ecological function of the forest. The respondents realized that forest should be managed in better way, such as rehabilitation or restoration program. The high number of respondents who agree to rehabilitation degraded forest will help the similarity program will be done by Forestry Department in the future. The social aspect is very important within managing the program rehabilitation sustainably. The awareness of villagers are one of some important factors to increase or extend the rehabilitation of degraded forest areas in the future. However the other factors should be considered to establish restoration program largely in this areas, example determining mechanism of their participation and economy incentive for villagers. The rehabilitation processes need to be monitored longer-term for ecological and economic success (Chokkalingam 2001, Kobayashi 2007).

Table 3. Perception and participation respondents on rehabilitation logged over forest.

No	Scoring (%)	Category	Number of respondents	Percentage of participation	Main reasons
1.	0-33	Low	0	0	-
2.	33.3-66.6	Moderate	2	5.6	1. Villager can't use the protected forest area to convert agricultural land, and to cut the tress. 2. Boundary between protected forest areas and village areas is unclear. 3. Forest rehabilitation can be started, but the priority is determining the boundary of protected forest. 4. The forest company has been determined boundary of protected forest areas without discussing or negotiating with local people.
3.	66.6-100	High	34	94.4	1. Forest rehabilitation will re establishing tree species which has been lost due to illegal logging activities. 2. Forest will keep in natural condition. 3. The ecological function of forest will be recovered, such as clean river water, increasing fish stock, mitigate flood, preventing forest fire, and wildlife conservation purpose.

The second group are two persons who are fisherman, one of them are also village officer. They didn't understand what the meaning of forest rehabilitation. Basically they think that forest is important, but after the area was declared in 1999 by Central Government, the access entering the area was limited. They can't cut trees for their building house and also restricted to open the forest to become agriculture land. The Temiang's village has long history in utilizing the area for their activities. In the field we still found the old of rubber jungle as marking for their land. The change political situation of central government where the area was not well managed in 2000 s, giving well opportunities for the people cut illegally trees, and then open the are to plant rubber jungle. For this history they claim that they should participate in determining the management of protected forest in the future.

The success of rehabilitation program are one of some options to promote biodiversity conservation and find out the solution in an old problem between government and villagers. Basically respondents want to assure that they will be secure in their livelihood, especially they still get access for tapping rubber trees. From at this point we introduce and enhance number of tree species which has well potency for supporting their live without converting forest area

through enrichment some of economically species without cutting. Some species planted which has potency for improving their income in the future, such as *Dyera lowii, Callophylum lowii,* and *Palaquium sumatranum* will produce goods as non timber forest product.

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