

## SOME NOTES ON ARTIFICIAL REVEGETATION IN EAST KALIMANTAN

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### Introduction

As defined by FAO (5)\*\*, revegetation covers a broad scope of forestation activities that include afforestation and reafforestation. Some notes on artificial revegetation presented in this article are meant to review activities of revegetation in East Kalimantan excluding those processes occurring naturally in the field.

The notes are the result of compilation of various information and data available at the Forestry Service Office of East Kalimantan in Samarinda which have been collected from 10 forest districts in the whole province. The author did not carry out systematic or overall survey of the data except for several field investigations in some concessions and localities. By examining the available data it is hoped to point out some research problems as expected from this Tsukuba Symposium.

### The expected role of revegetation

As the author stated it previously (10) revegetation program in East Kalimantan is expected to fulfill the following objectives:

- (1) to overcome the uncertainty of the regeneration in the current natural process of the TPI system;
- (2) to reclaim the existing abandoned shifting cultivation fields;
- (3) to rationalize the ever-expanding shifting cultivation practices;
- (4) to promote the forest value by increasing the timber stock due to the growth of the new forest plantations and ensure future supply;
- (5) to provide forward linkage activities of future wood industries.

Referring to the author's view as above mentioned, more data have enabled to demonstrate that with the current TPI system, practically, the future of commercial trees will be less guaranteed. Although at the seedling stage there is a large number of commercial seedlings, the trees gradually disappear in the later stages. Abandoned shifting cultivation land seems to be the ever existing problem for the economic development, while newly abandoned land increases every year following the continuous increase of population, locally, in addition to the arrival of new settlers. Here again the revegetation program can play an important role in solving the new as well as the old problems of shifting cultivation.

The new forest plantations will positively contribute to the formation of the growing stock to a great extent. This is because of the increment of the wood mass which is much bigger in plantations than in natural forests. Besides the establishment of homogeneous and compact wood mass, the new plantation forests ensure the future wood supply in quantity and quality. Such provision for supply which was just mentioned, opens new possibilities of wide range for wood industries in the future. This means that revegetation programs guarantee a forward economic linkage to the utilization of the forest resources in East Kalimantan.

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\*\*The numbers in the brackets show the source of reference used as mentioned in the list at the end of this article.

### Current policy of revegetation program

The basic policy of revegetation in East Kalimantan, as has been outlined by the Provincial Forestry Service, is to promote the restoration of the so-called unproductive forest land. What is meant by the unproductive forest land is forest land that does not yield normally its expected actual potential, such as understocked natural production forest, secondary forest in forms of shrubs-brush-etc., and alang-alang

Revegetation activities in those forest lands are the obligation of the concession holders since those production forests are under their management. Meanwhile the Forestry Service manages the revegetation activities outside their production forests, such as reclamation of degraded land, creation of forest models, revegetation on the resettlement schemes, etc. Through various extension programs the Forest Service also encourages the local people to become active in revegetation activities in their own land. These programs are meant to promote forest-mindedness among people, to convince them to be self-sufficient in their needs for multiple forest products and make them aware of problems relating to the environment as well.

The policy should enable to achieve the following goals:

- (1) to sustain the current marketable forest products;
- (2) to sustain the conventional needs of the local people for various forest products;
- (3) to promote the forest value;
- (4) to reclaim degraded land;
- (5) to animate the society in promoting sustained forestry.

To implement the policy, the government has prepared various regulations which the Forestry Service has been assigned to supervise. According to the regulations the revegetation in the concessions has to be carried out by the concession holders, the people are persuaded to undertake revegetation in critical plots within their own land while the Forest Service implements the revegetation program in building model forest, helping supply the seedlings, providing technical advice and various extension activities.

### Data on artificial revegetation activities

Artificial revegetation activities in East Kalimantan consist of many aspects, such as enrichment planting, afforestation and reforestation and rehabilitation planting, as well.

The enrichment planting, as has been mentioned earlier, is the obligation of each concession holder engaged in logging activities based on the TPI system (the Indonesian selective cutting system). Whenever a logged-over area is judged understocked according to the criteria of the TPI system, the concession holders immediately have to improve the stands.

In the execution of their improvement planting, the concession holders generally follow two methods:

- (1) transplanting seedlings from natural stands;
- (2) transplanting seedlings from nurseries.

Table 1 summarizes the activities.

In addition to enrichment planting some concessions are also carrying out reforestation. ITCI, BFI, GPI, KRTP, etc. for example have clear cut their forests and replanted them with some new species such as *Pinus merkusii*, *Pinus caribaea*, *Eucalyptus deglupta*, *Gmelina arborea*, etc.

The Forestry Service has actually started afforestation and reforestation activities since 1969. Originally the activities were meant to establish model forests and species trials, while reclaiming degraded land. Today the activities are repeated annually to speed up reforestation programs. It has been thought of lately that such annual reforestation program should be rationalized and concentrated so as to back up future wood industries. Table 2 summarizes the revegetation activities of the Forestry Service.

When the resettlement schemes are initiated, the Forestry Service is also active in promoting reforestation activities to support sustained forestry in the settlements. Table 3 shows the revegetation activities of the Forestry Service in settlement areas.

Table 1 Nursery and plantation statistics of concessions, East Kalimantan

Forest District	Concessions			Average AAC		Nurseries			Plantations		
	Total	Nur	Plant	Ha	m <sup>3</sup>	Ha	N	Species	Ha	N	Species
1. Pasir	9	—	3	28153	879833,27	—	—	—	72	4	Ag, Pm, Dr, Al
2. Lower Mahakam	4	1	2	15150	759725,29	8	8	Pm, Al	30	2	Pm, Natseed
3. Middle Mahakam	18	—	1	63000	3940227,42	—	—	—	2,5	3	Pm, Al, Dp
4. Upper Mahakam	22	1	1	25204	1403038,36	1,5	3	Pm, Al	1	1	Sh
5. North Bulongan	5	1	1	17405	281406,18	16,25	3	Pm, Al	20	1	Sh
6. Middle Bulongan	4	1	—	28921	719002,29	4,5	3	Pm, Al	—	—	—
7. South Bulongan	5	1	1	18361	887727,82	9	—	—	2491,7	6	Al, Ec, Pc, Pe, Gma
8. Bontang/Sang-kulirang	15	1	—	77000	2857886,23	0,7	3	Pm, Al	—	—	—
9. Balikpapan	4	1	1	68700	1762016,46	8	2	Pm, Al	1284,5	5	Pe, Edeg, Al, Gma
10. Berau	14	—	—	47000	1324677,38	—	—	—	—	—	—

NOTE: Pm = *Pinus merkusii*; Ag = *Agathis* sp.; Dr = *Delonix regia*; Natseed = Natural seedlings; Al = *Albizia* sp.; Dp = *Dryobalanops* sp.; Sh = *Shorea* sp.; Ec = *Eucalyptus* sp.; Pc = *Pinus caribaea*; Pe = *Pangium edule*; Gma = *Gmelina arborea*; Edeg = *Eucalyptus deglupta*.

Table 2 Revegetation activities 1969–1978 by Forestry Service, East Kalimantan

Forest District	Original Plot	Plantation			
		Species	Spacing	Ha at planting	Ha today
1. Pasir	Bare land alang-alang	Sl, Pm, Dr, Al.	3x3	554	544
2. Lower Mahakam	belukar alang-alang	Sl, Pm, Ac, Al.	3x3, 10x10.	35	35
3. Middle Mahakam	belukar alang-alang	Sh, Ac, Pm, Su, Co, Rt, Dr.	4x4, 3x3, 5x5.	258,14	258,14
4. Upper Mahakam	—	—	—	—	—
5. North Mahakam	—	Al, Ac.	—	1,7	1,7
6. Middle Bulongan	belukar	Ag, Ac.	—	8	8
7. South Bulongan	—	—	—	—	—
8. Bontang/Sangkulirang	—	—	—	—	—
9. Balikpapan	erosion critical area belukar alang-alang	Pm, Dr, Ac, Su, Pr, Dp, Nyer, Sl, Ex, Dt, Ang, Sh, Ag, Al, Cal.	3x3, 4x4.	433,95	410,75
10. Berau	—	—	—	—	—

NOTE: Sl = *Shorea larfifolia*; Dr = *Delonix regia*; Al = *Albizia* sp.; Ac = *Acacia* sp.; Sh = *Shorea* sp.; Sw = *Swietenia* sp.; Co = coconut; Rt = rattan; Ag = *Agathis* sp.; Su = sungkai; Pr = *Pericopsis* sp.; Dp = *Dryobalanops* sp.; Nyer = nyerakat; Ex = *Eusideroxylon zwageri*; Dt = *Dipterocarpus* sp.; Ang = anggi; Al = *Albizia falcata*; Cal = caliandra.

Table 3 Establishment of rehabilitation plantations on abandoned shifting cultivation areas in resettlement projects

Forest District	Nursery		Plantation		Area according to species				
	Location	Area (Ha)	Location	Area (Ha)	Pm	Al	Ac	Su	Others/ fruit trees
1. Pasir	Lolo	1	Lolo	90	90	—	—	—	—
2. Upper Mahakam	Sekoleq Djolek	1	Sekolaq Djolek	35,5	1	—	—	—	35,5
3. Middle Mahakam	a. Long Segar/Long Noran	1	Long Segar/Long Noran	40	7	—	—	33	—
	b. Long Kejeak	1	Long Kejeak	31,8	—	—	—	31,8	—
	c. Ma Ritan/Pedohon	1	Ma Ritan/Pedohon	30	—	—	—	30	—
4. Middle Bulongan	a. Sekataq Buji	1	Sekatak Buji	26	4	—	—	—	22
	b. Sembuak	1	—	—	—	—	—	—	—
5. South Bulongan	Mara I & II	1	Mara I & II	21,8	8	13,8	—	—	—
6. Berau	Rantau Harapan	1	Rantau Harapan	52	3	45	4	—	—
Total		9		326,1	113	58,8	4	94,8	55,5

NOTE: Pm = *Pinus merkusii*; Al = *Albizia falcata*; Ac = *Acacia* sp.; Su = Sungkai

Generally the regeneration programs in East Kalimantan are carried out under contract worker system. A group of workers under a contractor receive the job either in forest clearing, forest planting, transportation or nurseries. The taungya system is uncommon in East Kalimantan although PT. ITCI in Kenangan for example, has made taungya plantation trials. Apparently such trials are always fully supported by the company which subsidizes fertilizers and other cultural devices. These attempts may raise the problem as to whether such system can be used widely throughout the whole province, from the economic point of view.

## Concluding remarks

### 1 The revegetation size

If we carefully observe the data listed on the above Tables which indicate that revegetation programs have involved only about 5,000 hectares within 8 years, we can say that the results are relatively unsatisfactory compared with the annual cut and drain of the forest potential in the whole province. This becomes even more evident when one realizes that an average of 9,000,000 m<sup>3</sup> of log (200,000/250,000 hectares) are being cut each year. This fact clearly requires a serious consideration to stimulate revegetation programs to balance the inflow and outflow of the forest potential. Additional data show that only 20–25% of the concession holders have implemented the revegetation programs.

### 2 Choice of species

An interesting fact is that, besides the TPI system, most of the revegetation programs today are generally concerned with planting exotic species in East Kalimantan. Scientifically, this matter requires a serious consideration. Exotic species always need an adaptation period in the process of acclimatization since various pests and diseases may threaten them in the future. Some data have already been recorded from various nurseries and plantations. Consequently, rational steps have to be taken to try out various local species, such as some pioneer species recently studied by Hadrijanto (6), as mentioned in the Tables. Research activities concerning those pioneer species may be started in the near future as in the Philippines (3).

### 3 Silvicultural data

The data and information compiled in the above Tables remain too incomplete to understand the silvicultural aspects of the forest plantations concerned. Nevertheless, there are some attempts at performing spacing experiments (1). There are also experiments in fertilization of the forest plantations, weeding, pruning etc., although the experiments should actually be more intensively conducted to get more comprehensive knowledge about several tree species (1) (7) (9). This will automatically create immediate needs for research activities in the near future.

### 4 Social and economic aspects

The real success of the revegetation programs should logically be backed up by the society. People who used to consider that their forest resources are abundant, should now change their attitude and consider them as sustained resources. Such a view can only be reached if the people themselves become directly aware of the benefit derived from the forest. To attain such target, we have to urge the society to participate in the various revegetation programs.

Finally, it is interesting to learn that although a lot of revegetation activities have been undertaken, the total number of areas involved, which is still small in size, is geographically spread out throughout the whole province. Individually, the revegetation plots do not give a meaningful economic value since they could not support any industrial activity. Future steps should logically be taken to establish plantations of compact economic size to back up reasonable future wood industrial activities.

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**Appendix 1** List of pioneer species in abandoned shifting cultivation areas at PT. Good Hope Indonesian Timber, East Kalimantan, 1977/1978

No.	Seedling	IV (%)
1.	<i>Trema orientalis</i>	10,31
2.	<i>Trema cannabina</i>	8,52
3.	<i>Macaranga hosei</i>	5,60
4.	<i>Macaranga</i> sp.	4,70
5.	<i>Nauclea</i> sp.	4,30
Sapling		
1.	<i>Trema orientalis</i>	62,64
2.	<i>Nauclea</i> sp.	29,87
3.	<i>Trema canabina</i>	24,57
4.	<i>Anthocephalus</i> sp.	14,93
5.	<i>Octomeles sumatrana</i>	12,03

IV = Importance Value

**Appendix 2** List of pioneer species in abandoned shifting cultivation areas at PT. Good Hope Indonesian Timber, East Kalimantan, 1975/1976

No.	Seedling	IV (%)
1.	<i>Octomeles sumatrana</i>	6,49
2.	<i>Vitex</i> sp.	6,49
3.	<i>Macaranga conifera</i>	5,19
4.	<i>Pterospermum</i> sp.	5,19
5.	<i>Mallotus</i> sp.	5,19
Sapling		
1.	<i>Vitex</i> sp.	26,03
2.	<i>Cordia</i> sp.	21,69
3.	<i>Alangium</i> sp.	19,09
4.	<i>Trema orientalis</i>	18,19
5.	<i>Macaranga</i> sp.	14,49
Poles		
1.	<i>Vitex</i> sp.	58,17
2.	<i>Cordia</i> sp.	41,23
3.	<i>Alangium</i> sp.	35,53
4.	<i>Macaranga indica</i>	35,10
5.	<i>Artocarpus</i> sp.	22,12

Trees		
1.	<i>Koompassia mallacensis</i>	122,24
2.	<i>Octomeles sumatrana</i>	59,93
3.	<i>Baccaurea</i> sp.	59,93
4.	<i>Milettia</i> sp.	57,89

**Appendix 3** List of pioneer species in abandoned shifting cultivation areas at PT. Good Hope Indonesian Timber, East Kalimantan, 1973/1974

No.	Seedling	IV (%)
1.	<i>Melanorrhoea</i> sp.	10,48
2.	<i>Macaranga hypoleuca</i>	10,48
3.	<i>Debregeasia</i> sp.	6,45
4.	Kaloboto (Ind.)	5,64
5.	Ketumbu (Ind.)	4,83
Sapling		
1.	<i>Trema orientalis</i>	28,66
2.	<i>Macaranga</i> sp.	27,16
3.	<i>Vitex</i> sp.	15,59
4.	<i>Macaranga conifera</i>	11,79
5.	<i>Alstonia scholaris</i>	16,72
Poles		
1.	<i>Macaranga indica</i> cf	101,78
2.	<i>Trema orientalis</i>	45,57
3.	<i>Cordia</i> sp.	101,78
4.	<i>Mymecylon</i> sp.	29,51
5.	<i>Milettia</i> sp.	10,79
Trees		
1.	<i>Trema orientalis</i>	100,40
2.	<i>Macaranga indica</i> cf	92,21
3.	<i>Eugenia</i> sp.	23,60
4.	<i>Milettia</i> sp.	23,17
5.	<i>Duabanga molluccana</i>	20,43

Appendix 4 List of pioneer species in logged-over area at PT. Lestari Jaya Utama, East Kalimantan, 1977/1978

No.	Seedling	IV (%)
1.	<i>Macaranga gigantes</i>	5,95
2.	<i>Dillenia</i> sp.	4,68
3.	<i>Macaranga hypoleuca</i>	2,05
4.	<i>Trema orientalis</i>	1,43
5.	<i>Anthocephalus</i> sp.	1,02
6.	<i>Milettia</i> sp.	1,02
7.	<i>Macaranga conifera</i>	1,02
8.	<i>Pterospermum</i> sp.	0,82
9.	<i>Cratoxylon</i> sp.	0,82
10.	<i>Nauclea</i> sp.	0,61
11.	<i>Vitex</i> sp.	0,41
12.	<i>Macaranga</i> sp.	0,41
13.	<i>Mallotus</i> sp.	0,41
14.	<i>Artocarpus</i> sp.	0,20
Sapling		
1.	<i>Macaranga hypoleuca</i>	13,74
2.	<i>Macaranga gigantea</i>	13,61
3.	<i>Dillenia</i> sp.	9,05
4.	<i>Trema orientalis</i>	5,89
5.	<i>Pterospermum</i> sp.	4,46
6.	<i>Anthocephalus</i> sp.	3,29
7.	<i>Nauclea</i> sp.	2,82
8.	<i>Cratoxylon</i> sp.	0,84
9.	<i>Macaranga</i> sp.	0,54
Poles		
1.	<i>Pterospermum</i> sp.	13,52
2.	<i>Dillenia</i> sp.	4,55
3.	<i>Octomeles sumatrana</i>	4,40
4.	<i>Anthocephalus</i> sp.	3,52
5.	<i>Schima walichii</i>	1,53
6.	<i>Artocarpus</i> sp.	
7.	<i>Macaranga hypoleuca</i>	
8.	<i>Dyera</i> sp.	2,16
Trees		
1.	<i>Dillenia</i> sp.	20,25
2.	<i>Pterospermum</i> sp.	5,59
3.	<i>Dyera</i> sp.	5,26
4.	<i>Parkia</i> sp.	2,09



Appendix 5 List of pioneer species in logged-over area at PT. Lestari Jaya Utama, East Kalimantan, 1975/1976

No.	Seedling	IV (%)
1.	<i>Macaranga gigantea</i>	4,98
2.	<i>Dillenia</i> sp.	3,73
3.	<i>Milettia</i> sp.	3,73
4.	<i>Dyera</i> sp.	2,80
5.	<i>Nauclea</i> sp.	1,24
6.	<i>Parkia</i> sp.	1,24
7.	<i>Macaranga conifera</i>	1,24
8.	<i>Mallotus</i> sp.	0,93
9.	<i>Pterospermum</i> sp.	0,93
10.	<i>Macaranga hypoleuca</i>	0,93
11.	<i>Anthocephalus</i> sp.	0,62
12.	<i>Vitex</i> sp.	0,31
13.	<i>Artocarpus</i> sp.	0,31
Sapling		
1.	<i>Macaranga gigantea</i>	11,65
2.	<i>Dillenia</i> sp.	8,01
3.	<i>Pterospermum</i> sp.	6,90
4.	<i>Macaranga hypoleuca</i>	5,62
5.	<i>Nauclea</i> sp.	4,33
6.	<i>Anthocephalus</i> sp.	4,18
7.	<i>Milettia</i> sp.	4,15
8.	<i>Dyera</i> sp.	3,12
9.	<i>Mallotus</i> sp.	2,42
10.	<i>Parkia</i> sp.	2,42
Poles		
1.	<i>Macaranga gigantea</i>	10,00
2.	<i>Anthocephalus</i> sp.	7,78
3.	<i>Macaranga hypoleuca</i>	4,10
4.	<i>Trema orientalis</i>	2,88
5.	<i>Dillenia</i> sp.	2,47
6.	<i>Octomeles sumatrana</i>	2,44
7.	<i>Artocarpus</i> sp.	1,87
8.	<i>Parkia</i> sp.	1,24
9.	<i>Pterospermum</i> sp.	1,15
10.	<i>Nauclea</i> sp.	0,61
11.	<i>Duabanga molluccana</i>	0,61
12.	<i>Dyera</i> sp.	0,61

Trees		
1.	<i>Dillenia</i> sp.	10,47
2.	<i>Dyera</i> sp.	8,06
3.	<i>Nauclea</i> sp.	3,81
4.	<i>Octomeles sumatrana</i>	1,93
5.	<i>Pterospermum</i> sp.	1,75

**Appendix 6** List of pioneer species in logged-over area at PT. Lestari Jaya Utama, East Kalimantan, 1973/1974

No.	Seedling	IV (%)
1.	<i>Macaranga hypoleuca</i>	3,66
2.	<i>Dillenia</i> sp.	3,42
3.	<i>Duabanga molluccana</i>	2,74
4.	<i>Macaranga gigantea</i>	1,60
5.	<i>Parkia</i> sp.	1,60
6.	<i>Pterospermum</i> sp.	0,68
7.	<i>Anthocephalus</i> sp.	0,45
8.	<i>Cratoxylon</i> sp.	0,22
Sapling		
1.	<i>Macaranga hypoleuca</i>	15,79
2.	<i>Macaranga gigantea</i>	7,39
3.	<i>Dillenia</i> sp.	4,79
4.	<i>Cratoxylon</i> sp.	4,73
5.	<i>Pterospermum</i> sp.	3,61
6.	<i>Anthocephalus</i> sp.	3,27
7.	<i>Trema orientalis</i>	2,98
8.	<i>Duabanga molluccana</i>	2,81
9.	<i>Parkia</i> sp.	1,06
Poles		
1.	<i>Macaranga gigantea</i>	17,72
2.	<i>Macaranga hypoleuca</i>	9,09
3.	<i>Anthocephalus</i> sp.	7,75
4.	<i>Trema orientalis</i>	3,62
5.	<i>Dillenia</i> sp.	3,22
6.	<i>Pterospermum</i> sp.	2,59
7.	<i>Parkia</i> sp.	1,94
8.	<i>Artocarpus</i> sp. (Jomo, Ind.)	1,01
9.	<i>Duabanga molluccana</i>	0,65
10.	<i>Artocarpus</i> sp. (Terap, Ind.)	0,65
11.	<i>Dyera</i> sp.	0,44

Trees		
1.	<i>Dillenia</i> sp.	6,78
2.	<i>Octomeles sumatrana</i>	3,63
3.	<i>Parkia</i> sp.	1,81
4.	<i>Dyera</i> sp.	1,76

### Discussion

**Choob K.** (Thailand): Do you have any problem with mycorrhiza? What is the method of inoculation of mycorrhiza in your *Pinus caribaea* planting? I just attended a mycorrhiza workshop in Africa where it was emphasized that inoculation of the right mycorrhiza fungus enhances tree growth.

**Answer:** Mycorrhiza inoculation is only carried out in nurseries. Then “bare-root” stocks can be conveniently transplanted in the field.

**Sasaki, S.** (Japan): Have you tried to transplant Dipterocarps in clear cut areas?

**Answer:** We have no experience with Dipterocarps.

**Liew T. C.** (Malaysia): You mentioned in your paper that no indigenous species have been tried out in plantations. Could you comment on this?

**Answer:** Sorry, I did not say that no indigenous species have been tried out but that little effort is being made in this direction.