Dynamic and structure of lowland Dipterocarps forest after fire in Bukit Suharto East Kalimantan, Indonesia

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Abstract.

Approximately 3.5 million ha of lowland forest in Indonesia was heavily burnt in 1982 due to forest fire associated ENSO. This catastrophe were reoccurred heavily in 1998 caus severe damaged of 1.5 million ha forest area. Meanwhile, 520,000 ha were destroyed included those in Bukit Suharto Education Forest covering no less than 4205 ha. It was about 21% of total area. This research reported the impact of forest fire on forest dynamic after 4 years. The research plots was conducted in lowland dipterocarps forest after fire of 9 ha experiment plots. Research plots categorized into 3 subplots of Light Felling (LF) plots (dbh > 50 cm), Heavy Felling (HF) with dbh > 30 cm and control. The result showed that average tree density/ha after prescribed fire were 13.9%, 20.9 %, and 29.1% in LF, HF and control respectively. Mean while the diameter distribution of the stand were changed. Considering this severe damage, forest recovery toward normal (climax) stand would take longer time, so that rehabilitation is compulsorily important.

Key words : Forest fire, stand dynamic, lowland dipterocarps.

Introduction.

Two of the world's largest forest fire burned the lowland dipterocarps forest in East Kalimantan, Indonesia within 15 years period. During the dry spell in 1982-1983, wildfires in the Indonesian province of East Kalimantan affected about 3.6 million ha of primary and secondary rain forest (Goldammer and Seibert, 1990). From 1997 to 1998 several droughts linked to another strong EL NINO- Southern Oscillation (ENSO) even occurred and resulted in a second immense forest fire in East Kalimantan (Toma et al. 2000). It was reported around 1.5 million ha burned included 520,000 ha in East Kalimantan , where 4205 ha occurred in BSEF. After the fire, the regenerated forest often had a different species composition from that of the original forest stands. Trees of pioneer species in the genus Macaranga, particularly M.triloba and M.gigantea were definitely promoted by 1982-1983 fire, especially in a severely burned forest with large openings in the canopy (Goldammer and Seibert 1990; Matius and Okimori 1991; Goldammer et al. 1996)

The objective of the study was to determine the stand dynamic and change of structure of lowland dipterocarps forest 4 years after fire. During the period, the recruitment and mortality of the stand were recorded.

Material and methods.

Location.

The experimental site were established in BSEF, East Kalimantan. It is located amidst Samarinda – Balikpapan highway approximately 50 km south from Samarinda the provincial capital. Geographically the research site is at 117°10'E longitude and 0°50'S latitude.
The vegetation is mainly lowland dipterocarp forest which was selectively logged in the early 1970s and experienced wildfire in 1982-1983. Prior 1983 fire most of the area was classified as tropical lowland dipterocarps forest. The dominant genus were Shorea, Dipterocarpus and Eusideroxylon. After fire about 60% of area became poor secondary forest dominated by fast growing species e.g. Macaranga, Trema, Homalanthus, Mallotus, Nauclea, Piper and many Solanaceae (Hadriyanto et. al 2002).

Methods.

In May 1997, a 9-ha permanent plot was established in order to investigate the effect of second felling in a log over dipterocarp forest and subsequent recovery from the felling. The 9- ha plot was composed of nine 1-ha subplot (each 100m x 100m), arranged in a regular square of 3 x 3 plots. Tree were felled in 6 of the 9 plot with two different felling intensities and 3 plots were left as controls. The felling criteria was as follow : (1)Light felling (LF) is the conventional method used in the forest consesion, in which trees with a diameter of at least 50 cm are harvested for merchantable timber, (2) Heavy felling (HF), trees with a diameter of at least 30 cm are harvested, (3) Controls plot without felling. However, soon after prescribed fellings were done, plots were experienced heavy fire in 1998.

In 2001 and 2002 all the plots were enumerated and measured. Trees greater than or equal to 10 cm in diameter at breast height (DBH) were tagged, identified and their dbh values were recorded. Trees were classified as Dipterocarps and Non-dipterocarps. In 2002, recruitment and mortality of the trees were again recorded and tagged.

Result and Discussion.

Stand dynamic.

In general, Dipterocarp species are selected for felling because of their high commercial value. The species in this family are the dominant trees, with heights of 40 to 50 m, and their crowns cover large areas above the species in the lower canopy. To outline the forest structure in this study site, the mean tree density and basal area are shown in Table 1 combined with data from the primary dipterocarp forest in a commercial logging area (INHUTANI I) in Berau region(Sist and Saridan 1997), which is about 300 km north of BSEF. There were fewer small trees (10-20 cm in DBH) in the primary dipterocarp forest in East Kalimantan (Sukarjo et al.1990, Sist and Saridan 1997), but similar numbers of larger trees. Dipterocarps made up about 12% of the total number of trees and 39% of the basal area. The basal area of dipterocarps in primary forest usually ranges between 43% and 55% . The decreased number of small trees and the lower percentage of basal area in the study site reflect the previous selective logging operation and the 1982-83 wildfire. Nevertheless, the number of harvestable trees (above 50 cm in diameter) was similar to that of the primary forest in Berau. These figures represent the typical forest structure in BSEF.

As shown in the following Table 2, in LF plots forest stand were dominated by non dipteocarps trees. In 2001 the average tree density were 46/ha with 5.79 m^2 in basal area. After one year

periode (2002), tree density were 39/ha and basal area 4.57 m^2. Both of tree density and basal area in LF plots were markedly decreased.

Table 1. Comparison of structure between primary dipterocarp forest in Berau and BSEF

Species	Stand Parameter	Diameter class					
		> 10 cm		>30 cm		>50 cm	
		BSEF	Berau	BSEF	Berau	BSEF	Berau
All	N/ha	429	530	81	99	30	34
	G/ha (m^2)	27.2	31.5	18.5	22.3	12.8	14.8
Dipt.	N/ha	52	135	29	46	19	24
	G/ha (m^2)	10.7	15.9	10.2	13.1	8.9	10.4

Table 2. Tree density (ha^{-1}) and basal area in LF plots categorized as Non Dipterocarps (ND) and Dipterocarps (D)

Plots Number	2001				2002			
	ND		D		ND		D	
	N	G (m^2)	N	G (m^2)	N	G (m^2)	N	G (m^2)
1	59	5.093	6	0.375	59	5.093	6	0.405
5	27	3.382	3	1.810	20	2.339	1	0.016
7	36	3.035	6	2.833	27	2.660	5	2.366
Average	40.6	4.120	5	1.670	35.3	3.640	4	0.930

In HF plots (Table 3) the average tree density recorded in 2001 were 61 trees and basal area was 4.980 m^2, but it changed to only 54 trees and 4.618 m^2 in basal area during 2002 enumeration. As in LF plots also HF plots, the average tree density per ha were decreased and hence no basal area increase.

Table 3. Tree density and basal area (ha^{-1}) in HF plots

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Plot number	2001				2002			
	ND		D		ND		D	
	N	G (m^2)	N	G (m^2)	N	G (m^2)	N	G (m^2)
4	18	1.819	1	0.435	18	1.819	1	0.435
6	39	5.007	2	0.063	39	5.069	2	0.063
9	113	7.285	10	0.330	105	6.138	10	0.330
Average	56.7	4.704	4.3	0.276	54	4.342	4.3	0.276

Compared with LF and HF the average tree density and basal area in control plots (Table 4) were higher of 132 trees and 15.042 m^2. This was in contrast to the situation in 2002 where the average were 125 trees and 13.965 m^2. To illustrate the stand dynamic from 1997 – 2002, before and after second felling data were presented in Table 5.

As demonstrated in Table 5, tree density and basal area after felling in 1997 was much less than that of after fire in 2002. This clearly indicated the severe and catastrophic intensity of the fire. For example, in LF the impact of felling was 28.4% of tree reducer while fire causing 86.1% of trees mortality. This situation in HF was lower of trees mortality (79.1%).

Table 4. Tree density and basal area per hectare in control plots.

Plot Number	2001				2002			
	ND		D		ND		D	
	N	G(m^2)	N	G(m^2)	N	G(m^2)	N	G(m^2)
2	77	6.683	32	9.453	73	6.675	30	8.876
3	107	8.078	14	3.802	103	7.793	13	3.132
8	143	9.705	22	7.406	133	8.168	22	7.252
Average	109	8.155	22.7	6.887	103	7.545	21.7	6.420

Table 5. Stand dynamic in tree density and basal area (ha^{-1}) of 9-ha plot from 1997 –2002.

Plot	1997				2002	
	N_1	G_1 (m^2)	N_2	G_2 (m^2)	N	G(m^2)
LF	391	25.7	280	16.8	39	4.57
HF	440	27.3	281	15.3	59	4.62
Control	429	27.2	429	27.2	125	13.96

N_1,G_1: before second felling N_2,G_2: after felling

Stand stucture.

To describe the stand structure, the diameter class was ranged into 10 cm interval. Result is presented in the following Figures in 3 ha data. The abundance of seedling or lower diameter class was typical reversed J-shape on all plots. This was particularly true in control plot of having wider span of diameter class. Despite of this, species composition in lower diameter class of LF and HF were dominated mostly by non dipterocarps species.

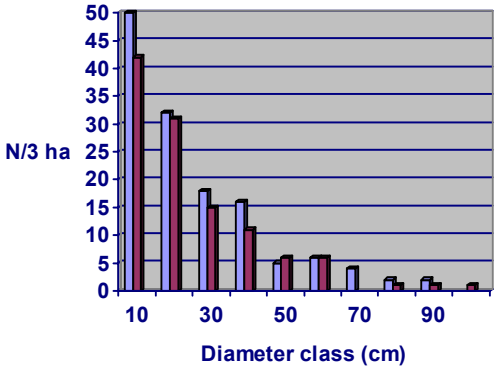

Figure 1. Diameter class distribution of LF

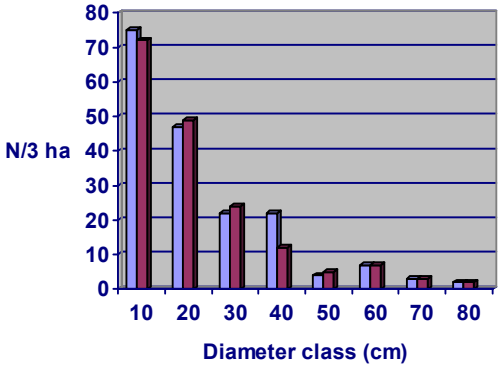

Figure 2. Diameter class distribution of Hf

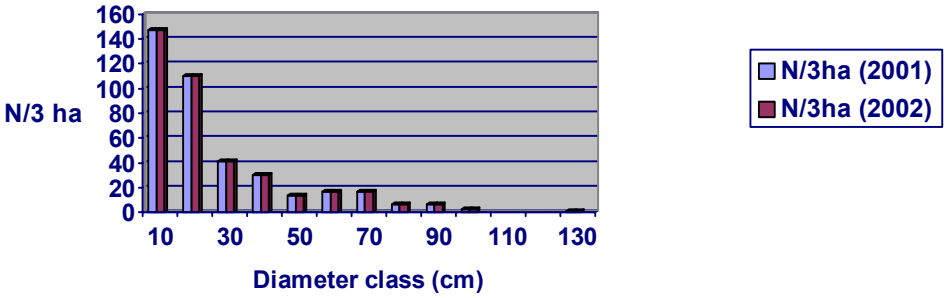

Figure 3. Diameter class distribution of control

Recruitment and Mortality.

During one year period or even four years after fire, it was no significant tree recruitment in all plot. As shown in Table 6, there were tree recruitment in LF plot (1,5,7) of 30 trees and 60 trees of ND and D respectively. The mortality in these plots however were 16 for ND and 3 for D. Mean while the species recruitment and mortality in HF (4,6,9) was much simpler and smaller in number. In control plots (2,3,8) where after fire have higher stand density compared to the treated plots. The recruitment of the trees were not significant. Trees recruitment were dominated by non dipterocarps species (50 trees) and none by dipterocarp species. The mortality in control plot were 18 trees for non dipterocarp species and 3 trees for dipterocarp species.

Table 6. Recruitment and mortality until 2002.

Plot number	ND		D		Recruitment		Mortality	
	2001	2002	2001	2002	ND	D	ND	D
1	59	59	6	6	30	-	-	-
5	27	20	3	1	-	23	7	2
7	36	27	6	5	-	37	9	1

4 6 9	18 39 113	18 39 105	1 2 10	1 2 10	- - 13	- 21 1	- - 8	- - -
2 3 8	77 107 143	73 103 133	32 14 22	30 13 22	14 3 33	- - -	4 4 10	2 1 -

Conclussion.

Most wild fires in East Kalimantan associated with human activities. The dynamic and structure of lowland dipterocarp forest four years after fire reflects a slow successive progress. This was partly due to the lack of dipterpcarp seed source in the surrounding area. Naturally most pioneer species were still predominant in this area. Rehabilitation need very carefull species selection in accordance to the current site condition.

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