4. Characterization of land use systems in the benchmark areas

4.1 Community and household surveys

Five institutions in the ASB-consortium collaborated with ICRAF staff to adapt the ASB global characterization guidelines for research in Sumatra. This process yielded two instruments that have been used for fieldwork on land use and socioeconomic characterization. One instrument is a structured questionnaire for use in a stratified random-sample survey of households. The three strata are: local farmers, spontaneous migrants, and government-sponsored transmigrants. The other instrument is an informal checklist for open-ended discussions as part of community-level appraisal.

Community-level characterization activities are developing a holistic picture of prevailing land use patterns at the forest margins, including forest concessions, industrial forest plantations, tree-crop estates, and large-scale absentee owners as well as smallholders. Similarly, the household-level characterization covers the range of smallholder farming systems, not just shifting cultivation. (Ms. Beckey Elmhirst started her PhD research at the Lampung benchmark site on gender-specific aspects of livelihood strategies and environmental knowledge among local farmers and transmigrants.)

The household-level questionnaire for Indonesia is built around sets of systematic questions for each of eight different land use categories:

* wet rice fields (*sawah*)
* fish ponds (*kolam ikan*)
* home gardens (*pekarangan*)
* upland fields (*ladang*)
* perennial plots, including agroforests (*kebun*)
* bush fallow (*belukar*)
* grasslands (*padang pengembalaan*)
* forests (*hutan*)

Developing a valid sample frame for spontaneous migrants proved especially challenging since these households typically are unreported or under-reported. Table 12 indicates the communities selected.

After some preliminary fieldwork, ASB-Indonesia researchers participated in a three-day methodology workshop (discussed above in section 2), including a practicum on participatory appraisal methods. Workshop participants included researchers working in biophysical, land use, socioeconomic, and policy aspects of characterization.

Household-level characterization was completed for all benchmark areas in May 1995. Data processing and analysis for the household questionnaire, combining data from the various groups and sites, however, is not yet completed and will be reported at a later stage.

Table 12. Administrative units and communities selected within the benchmark areas for household characterization

Benchmark area	Kabupaten /District (province)	Kecamatan/ Sub-District	Desa/ Village	Strata
Rantau Pandan	Bungo Tebo (Jambi)	Rantau Pandan	• Laman Panjang • Lubuk Beringin • Karak • Timbolasi	Local People
Bungo Tebo	Bungo Tebo (Jambi)	Tebo Tengah	• Mangun Joyo (Silva Gama concession)	Local People Spont.Migrants
		Muara Bungo	• Bangun Harjo	Transmigrants
		Pelepat	• Senamat	Local People Spont.Migrants
			• Muara Kuamang	Local People
			• Lubuk	Spont.Migrants
North Lampung	North Lampung (Lampung)	Pakuan Ratu	• Tiuh Baru/Kaliawi	Local People
			• Kaliawi Indah	Spont.Migrants
			• Negara Jaya	Spont.Migrants
			• Tegal Mukti	Local Trans.
		Tulang Bawang	• Panaragan Indah	Spont.Migrants
Sitiung	Sitiung (West Sumatra)	Kotobaru	• Koto Padang • Koto Besar • Ampang Kuranji	Local People
			• Aur Jaya/Sitiung V	Transmigrants

The following description of the benchmark areas is based on the community-level characterization (Hadi *et al.*, 1995), secondary data, and to a certain extent data from the household characterization (Gintings *et al.*, 1995a,b,c.; Sabarnuddin *et al.*, 1995; Saleh, 1995; Zaini and Basa, 1995). It should be noted here that the secondary data available are based on administrative units (kecamatan or above), which are composed of heterogenous ecological zones, while the benchmark is based on agro-ecosystems.

4.2 Sitjung benchmark area (West Sumatra)

The Sitiung area, which was the first site selected for ASB studies, represents the transition area between the peneplain and piedmont agro-ecological zones. Government- sponsored transmigration dominates the area, although there are spontaneous migrants and local people as well. Forest is being logged by PT Ragusa Ltd. At some distance to the area there is a (state owned) rubber plantation.

Kotobaru sub-district is located on the Trans-Sumatra highway, 200 km away from the provincial capital. The sub-district represents lowland tropical rainforest that is rapidly being transformed into agriculture through settlement and population increase. It consists of both transmigration villages (Sitiung I-V) and villages of local farmers (Minangkabau). This upland ecosystem is characterized by strongly acidic soils and steeply hilly landscapes, with low available phosphorus and high aluminum saturation. Villages that were selected for survey are Koto Padang, Koto Besar, Ampang Kuranji, and Sitiung V (Aur Jaya). Aur Jaya (Sitiung V), is a transmigration village that was established more than 10 years ago. It is close to the forest concession of PT. Ragusa Ltd, with its logging operation, where natural forest is converted into plantation forest (Industrial Timber Plantation, HTI) based on species like rubber, sungkai (*Peronema canescens*) and Mahogany (*Swietenia macrophylla*). Forest-related activities like a sawmill and nursery give transmigrants some access to off-farm employment. Local villages that were established at least one hundred years ago are located around Sitiung. Livelihoods of the farmers in these villages depends mostly on rubber.

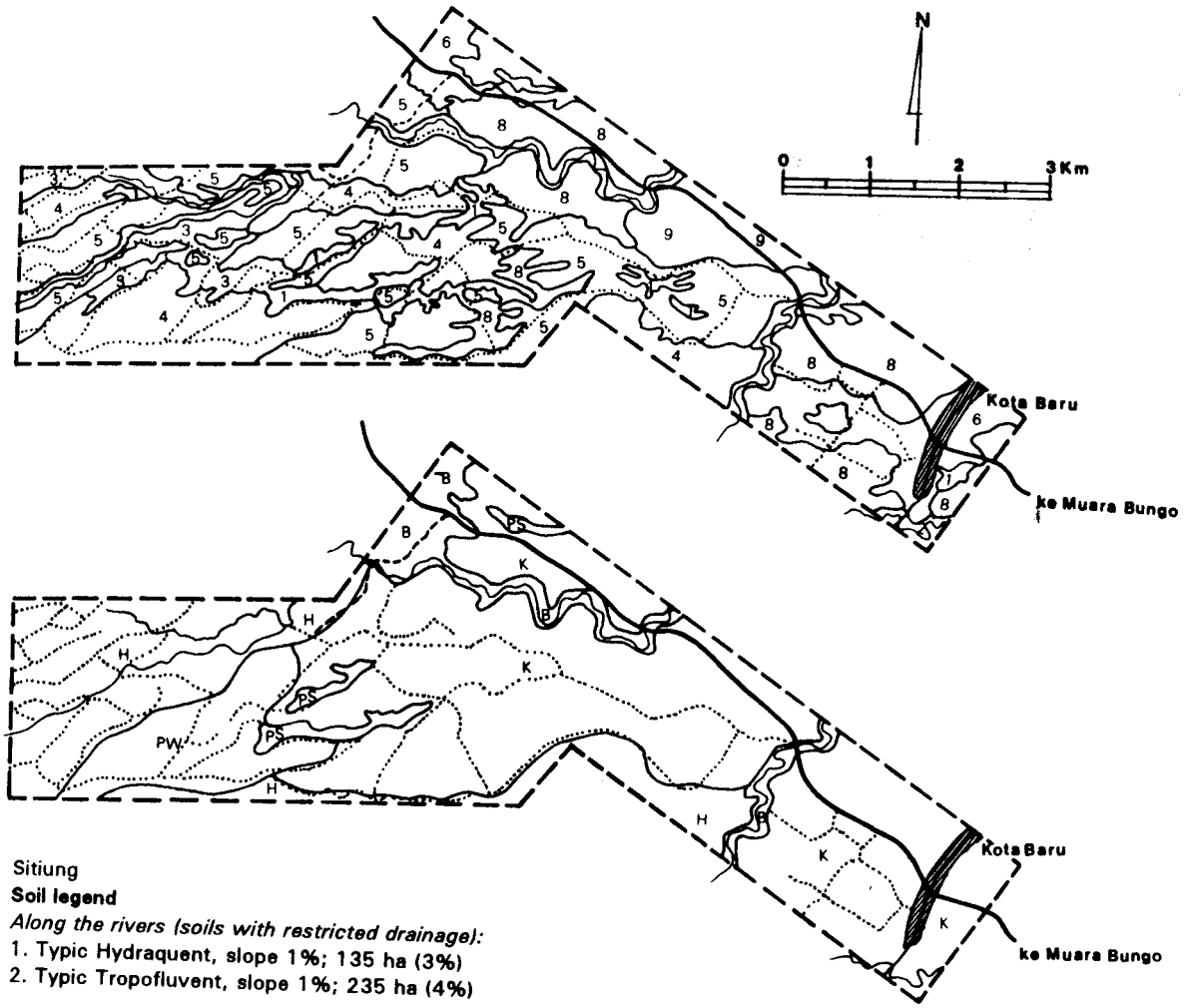
Climate

Average annual rainfall is around 3000 mm $year^{-1}$, with November/December the wettest and June-August the driest months. Humidity is about 85 percent on average and temperature ranges between a minimum of 22°C to a maximum of 32°C. Potential evapotranspiration averages 1484 mm $year^{-1}$, with the lowest monthly value in January (111 mm) and the highest in May (134 mm). Radiation averages 13.4 MJ m^{-2} day^{-1}, with the lowest value in January (11.1) and the highest in April (14.4).

Geology

According to the geological map (sheet: Painan; Rosidi *et al.*, 1976), the Sitiung benchmark area consists of recent Alluvium along the Batanghari river and the upper Palembang bed (Qtpu) formation. The upper Palembang formation consists of acid tuff from the Plio-Pleistocene period, and is less than 700 m thick.

Figure 19. Sitiung (Aur Jaya) Soil and land use map (Rachman *et al.*, 1995)



Sitiung

Soil legend

Along the rivers (soils with restricted drainage):

1. Typic Hydraquent, slope 1%; 135 ha (3%)
2. Typic Tropofluvent, slope 1%; 235 ha (4%)

Acid soils in the peneplain/piedmont (soils formed on acid tuff):

3. Typic Paleudult, slope 3-8%; 280 ha (8%)
4. Typic Paleudult, slope 15-25%; 1145 ha (2%)
5. Typic Paleudult, slope 25-45%; 1920 ha (8%)
6. Typic Hapludox, slope 1-3%; 385 ha (66%)
7. Typic Hapludox, slope 3-8%; 30 ha (1%)
8. Typic Hapludox, slope 8-15%; 1010 ha (19%)
9. Typic Hapludox, slope 15-25%; 260 ha (5%)

: Streams and rivers
: Houses
: Trans Sumatra Highway
: Main road
: Dirt road
: Boundary of area surveyed

Land use legend

H = Secondary forest; 1310 ha (24%)
B = Shrub/fallow (belukar); 305 ha (6%)
PS = Wetland rice (sawah); 110 ha (2%)
PW = Upland crops; 445 ha (8%)
K = Rubber; 3180 ha (8%)
X = Homegarden; 50 ha (1%)

Table 13. Climate data for the Sitiung benchmark area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Sungai Dareh	289	290	312	327	234	143	137	161	191	224	329	364	3001
Sungai Langsat	358	300	487	452	320	151	152	200	228	350	476	471	3945
Sitiung	287	223	275	279	239	131	147	121	199	260	339	357	2859
Temperature (°C)													
Average	25.1	25.6	25.9	26.4	26.5	26.3	25.8	25.8	25.9	25.9	25.9	25.4	25.9
Stand. dev.	0.26	0.42	0.53	0.29	0.26	0.31	0.33	0.34	0.51	0.34	0.29	0.43	0.21
Maximum	29.6	30.4	31.2	31.7	31.4	31.6	31.1	31.3	31.2	31.3	31.1	30.2	31.0
Minimum	22.4	22.6	22.7	22.8	23.0	22.4	21.9	21.8	21.9	22.2	22.3	22.5	22.4
ETP* (mm)	111	119	124	133	134	131	122	122	124	124	124	116	1484
Radiation (MJ m^{-2} day^{-1})													
Average	11.1	12.7	14.3	14.4	13.6	14.0	13.2	13.3	13.8	13.9	13.8	12.2	13.4

ETP = Potential Evapo-Transpiration (Thornthwaite and Mather, 1957)

Soil

A detailed soil map (1 : 50 000) was made for the Aur Jaya area (5 400 ha; slope 0 - 25 %; elevation 50 - 170 m a.s.l.) (Fig. 19).

Land use and farming system in Aur Jaya

Each transmigrant was allotted 2 ha of dry lands consisting of a 0.25 ha houselot, 1 ha designated for food crops (called Lahan Usaha I or LU-I), and 0.75 ha for perennials (called LU-II). Land tenure is guaranteed by certificates from the government. In the home garden farmers plant vegetables and fruit trees e.g rambutan, jack fruit and durian. The LU-I land is planted with annual cash crop, and perennials e.g. rubber and coffee. Most of the LU-II area is not yet opened; that which already is opened is planted with rubber and jengkol ("stink bean"; *Archidendron pauciflorum* (syn. *Pithecellobium jiringa*). Slash and burn is by far the most common method used to prepare the land for cultivation.

Problems faced by farmers in this area when they try to grow food crops are:
- low soil fertility, such that farmers cannot grow food crops continuously without substantial inputs of lime and fertilizer; on slopes erosion is an additional problem,
- *Imperata* (alang-alang) which quickly invades the land opened for food crops,
- wild pigs which make the harvest uncertain even if the crops grow.

The major solution is that transmigrant farmers learn from the surrounding Minangkabau system and move towards smallholder rubber. Study of the transmigration group revealed a 100 % increase of the rubber area in Aur Jaya in the 1987-1994 period.

Land use by Minangkabau farmers

Land use patterns of the local people are dominated by agroforestry practices, with rubber

as the dominant crop, followed by coffee (on the better soils). Food crops (mainly rice) are planted in the sawah land along streams and rivers or grown prior to rubber in the drylands in the first two years after opening a new site. Average size of land holdings for rubber is about 4-5 ha, while for sawah it is 0.5 ha. Most of the rubber gardens are more than 20 years old. Expansion of rubber takes place in the secondary forest and/or old rubber plots (jungle rubber). Land tenure is determined by customary law. At present, most of the land is under clan- or lineage authority. Such land can only be sold after consensus is reached in the clan or lineage, which is very difficult to achieve. The right to use is inherited from generation to generations (via the female line). Some transmigrants were able to get permission from the adat (customary law) leaders to use the land. They use this land to plant food crops because their own fields are planted with rubber, and can not yet be tapped. Rotational-fallow is practiced by farmers in planting food crops. Slash and burn methods are used to clear the land.

Population dynamics

In the transmigration site, considerable population movement occurred in the first ten years. The original village consisted only of Javanese and Sundanese transmigrants, and a small proportion of Minangkabau farmers (under the 'local transmigration' scheme). Lately several families from Flores and Tapanuli bought land and replaced transmigrants who moved out from the area due to harvest failures (Saleh et al 1995). The total size of the population increased slightly.

4.3 Bungo Tebo and Rantau Pandan benchmark area (Jambi)

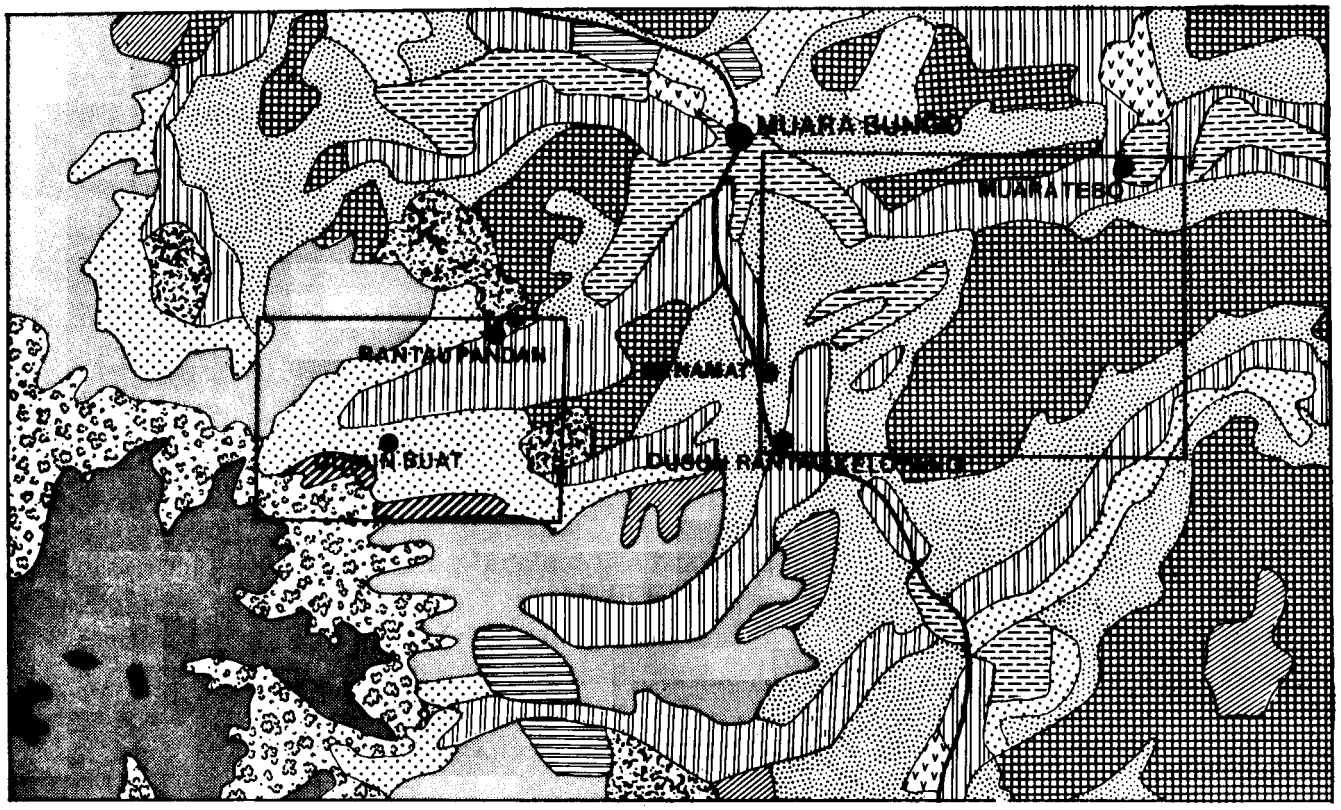
4.3.1 General

Jambi province has a clear zonation of vegetation type from coastal swamp up to mountains. Nearly 20 % of the province (in the east) is covered by mangroves (very little), swamp and peat swamp forest; 40 % is covered by the "Riau-Jambi" type of lowland tropical rain forest and the remaining 40 % is covered by piedmont and mountainous dense moist evergreen forest of the Bukit Barisan range.

Figure 20 shows details of the 1986 vegetation map for the Bungo Tebo and Rantau Pandan benchmark areas. An elevation gradient from the peneplain (< 150 m a.s.l) in the upper right corner to around 1000 m a.s.l in the lower left corner is reflected in the vegetation pattern. Along the various streams and rivers, jungle rubber agroforest are found. The influence of the Trans-Sumatra highway on settlement patterns is evident. The vegetation around Dusun Buat is classified as 'slash-and-burn' mosaic, consisting of crop land, shrub, and probably young jungle rubber. No *Imperata* grasslands appeared on this map. The Kuamang Kuning transmigration area is also not yet evident. The land cover and land use of Jambi province is divided into nine distinct classes i.e swamp and peat swamp forest, lowland tropical rain forest, hill forest, piedmont forest, mountain forest, estate plantations, agriculture, home gardens, and settlements.

Available data on Landsat TM dated 1992 and the vegetation map of 1986 gave information on vegetation change in Jambi province (Wasrin and Murdiyarso, 1994;

Figure 20. Rantau Pandan and Bungo Tebo benchmark areas on the 1986 Biotrop vegetation map



Legend:

- Jambi lowland forest
- *idem,* exploited
- Shrubland
- Jungle rubber
- Coconut + rice
- Rice paddy
- Limestone formation
- Transition forest (150-450 m)
- *idem*, exploited
- S&B mosaic
- Mid-elevation forest (450 - 1000 m)
- *idem*, exploited
- Submontane forest (1000 - 1800 m)
- Montane forest (1800 -2700 m a.s.l.)

Murdiyarso and Wasrin 1995; fig. 15). The most drastic change was from primary limestone forest into secondary forest (92 % of the area on the 1986 map). A considerable part of the primary swamp forest was changed into cultivated areas (11.3 %). During the period of 1986-1992 forest conversion in Jambi province was mostly from logged-over forest and it is likely that this was mostly through slash-and-burn practices.

4.3.2 Rantau Pandan

This benchmark area (101° 45' - 102° 00' E, 1° 37' - 1 44' S) represents the piedmont zone ranging from 100 to 500 m a.s.l. Soils of the area are composed of latosol-litosol complex with fine texture. Annual rainfall varied from 1,656 to 2,868 mm during 1987-1993. The site has been studied by ORSTOM and BIOTROP regarding socio-economic and vegetation aspects. The upper part of this benchmark area is part of the Kerinci Seblat National Park (KSNP).

Total area of Rantau Pandan sub-district is about 82,000 ha (BPS, 1993; curiously, in some of their tables the total area is given as 120 000 ha); the benchmark area is approximately 50 000 ha (20 x 25 km). The largest part of the area is situated on 100-500 m a.s.l, and only small portions are located below 100 m a.s.l or above 500 m a.s.l. Landscape of this area is dominated by logged-over forest. Large scale logging activities have taken place at the cost of primary forest; at present virtually all remaining primary forest is above 500 m, within theNational Park. Based on the statistical record of the state-owned forest located in this sub district, nearly 42,000 ha is categorized as production forest and 35,700 ha protection forest (KSNP). Thus 97% of the land in the sub-district is categorized as state forest land. According to the statistics (BPS, 1993) only 37,650 ha is forest/ shrub land ('hutan/belukar') and 38,970 ha agroforest ('perkebunan'). In practice, a large part of the forest land outside the national park is used for (rubber) agroforests and other forms of agriculture. The implementation of "Forest Status" by the state was declared after the local community had already settled here. Forest categorization is based on the slope. As a large part of the farmer's land is rubber agroforest, the watershed protection functions may be adequately covered.

Typical transects of the benchmark start in the river valley (+road + villages) and pass through the agroforest zone into the secondary forest remnants.

Climate
Climate data for the nearest three stations are summarized in table 14. The nearest climate data available are for relatively low elevation stations, so they may underestimate rainfall and overestimate temperature for the higher parts of the benchmark area.

Annual rainfall is around 3000 mm $year^{-1}$, with December the wettest and July the driest months. Potential evapotranspiration averages 1450 mm $year^{-1}$, with the lowest monthly value in November (97 mm) and the highest in March (131 mm). Radiation averages 15.0 MJ m^{-2} day^{-1}, with the lowest value in June (13.6) and the highest in March (16.0).

Geology
According to the geological map (sheet: Painan; Rosidi *et al.*, 1976), the Rantau Pandan

benchmark area belongs to the Pelepat and the Batuan granite formations. The Pelepat formation consists of andesitic lava. The Batuan granite consists of pegmatite and dates back to the Carbon period.

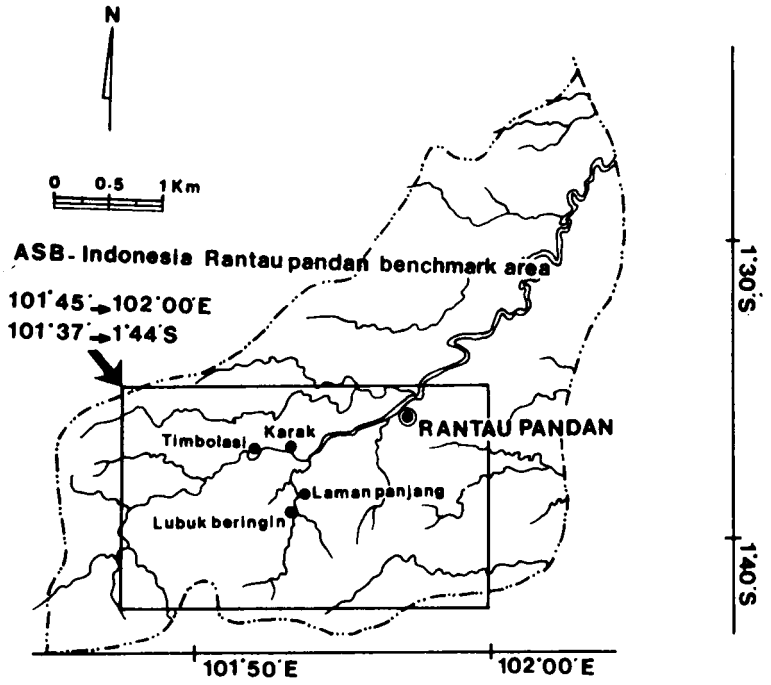


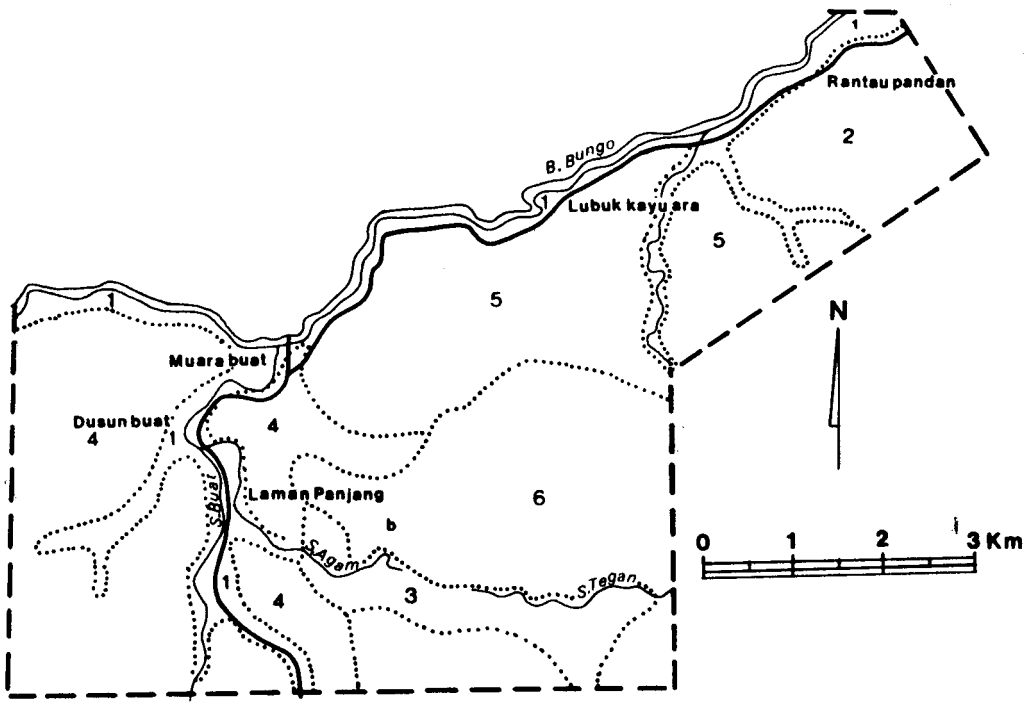
Figure 21. Administrative boundary and ASB benchmark area in Rantau Pandan

Table 14. Climate data for the Rantau Pandan benchmark area (Rachman *et al.*, 1995)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Tanah Tumbuh	339	273	230	353	171	109	115	181	191	217	336	411	2926
Rantau Panjang	302	234	275	317	236	147	121	209	165	269	280	343	2898
Bangko	313	268	325	299	245	142	147	206	170	297	345	389	3146
Temperature (°C)													
Average	29.1	28.6	28.6	29.1	28.7	29.4	27.1	29.4	30.4	28.9	28.8	29.0	28.9
Stand. dev.	0.30	0.30	0.30	0.15	0.60	0.40	0.20	0.10	0.05	0.10	0.05	0.25	0.23
Maximum	33.5	32.5	32.1	32.9	32.5	32.8	28.1	32.7	34.8	33.9	33.2	32.9	32.6
Minimum	24.6	24.8	25.0	25.3	24.9	25.9	26.0	26.0	25.9	23.8	24.3	25.1	25.1
ETP (mm)	112	123	138	134	120	117	114	127	127	117	97	124	1450
Radiation (MJ m^{-2} day^{1})													
Average	15.2	15.6	16.0	15.3	14.3	13.6	13.9	14.7	15.5	15.8	15.2	15.1	15.0

Soil

An area of 5 300 ha was mapped in detail. Its slope ranged from 0 to >45 % (fig. 22).



Rantau Pandan
Soil legend:
Along the Bungo river:
1. Tropofluvent, slope < 1%; 650 ha (12%)
In the hills, well-drained soils formed on granite and colluvial material:
2. Oxic Dystropept, slope 15-30%; 500 ha (9%)
3. Typic Dystropept, slope 15-30%; 250 ha (5%)
4. Typic Dystropept, slope 25-45%; 1 400 ha (26%)
5. Complex of Oxic Dystropept and Lithic Dystropept, slope 25-45%; 1 300 ha (25%)
6. Complex of Oxic Dystropept and Lithic Dystropept, slope > 45%; 1 200 ha (23%)

Figure 22. Rantau Pandan soil and land use map (Rachman *et al.*, 1995)

Land Use and Farming Systems

Land use and farming system in this area can be summarized as follows:

1. Wetland rice fields (Sawah) belong to the clan and are categorized as ,'harta berat'; they can not be sold. The sawah is only inherited by women (matrilineal system). Since the total area is small, families within the same lineage have to take turns in using it. The size of sawah holdings per season per family is between 0.5 and 1.5 ha. This sawah is only used for one crop per year; yields are not enough for family subsistence.

2. Shrub land (belukar, locally called sesap) is fallow land covered by small trees and bush/shrub. There are two kinds of tenure and utilization of this land, communal and

private. Communal belukar land is only used for annual crops, especially upland rice, for food security. This land is relatively fertile and located near the village/residential area. Usually there are many plots of communal belukar. Members within the community are free to use it, but those who do not have inherited land get priority. Outsiders have to get permission from the customary leader to use it. Generally, one household is able to open 1 ha of this land per year by slash and burn. Farmers follow a fallow rotation within this land. Average fallow period is between 3-5 years.

Private belukar, the second category, belongs to clans or families. Land use is limited to family members. Outsiders have to request permission of the owner to use it. Outsiders are not allowed to plant perennial crops. The owners usually plant upland rice for 1-2 seasons, and then move to another plot within the belukar. If the land is suitable for planting rubber or cinnamon (cassiavera), these tree crops are interplanted in the first year of cropping; subsequently, when there are no annual crops, this land is known as a garden ('kebun').

3. Kebun. The kebun is usually privately-owned and tradeable. The land originates from belukar or forest, and is planted with rubber and cinnamon (cassiavera). The latter tree seems to be increasing in popularity. Two years ago the state marked the boundary of the national park (KNSP) and farmers were prohibited to open new land for cultivation. However, there are many kebuns inside the park from before the regulation was made. In these cases, farmers are only allowed to tap the rubber but not to (re-)plant. A large part of the forest outside the park has been allocated to transmigration projects, logging companies for industrial timber plantations, and estate crop plantations. Therefore, opening new forest for cultivation is becoming difficult.

Land use change

The BIOTROP study showed that rubber (jungle rubber) is the predominant farming system in the area. In the 1986 vegetation map large areas were indicated as 'mosaics of rubber and shrub' or 'mosaics of rubber and forest'. On the 1992 and 1994 satellite maps, however, the major part of the 'rubber complex' is indicated as 'old secondary forest' (Fig. 23). Whether this change is a true maturation of the jungle rubber system, or a result of the coarser scale of the 1986 map is not clear. Farmers said that jungle rubber is inherited from generation to generation and seldom rejuvenated due to 1) limited access to better planting material, 2) loss of potential income while waiting for the new plantation to become productive, 3) wild pigs disturbing young rubber plants (Hadi, et al. 1995). The farmers will replace jungle rubber only after production has become very low and when they need land for their food crops. Land size of rubber and/or cinnamon (cassiavera) per household ranges between 0.5 to 4 ha.

Presently there is a pilot project from the Department of Forestry called "Hutan Rakyat" (community forest) in the community's belukar. About 50 ha of belukar were distributed to families to be cultivated with durian, cinnamon (cassiavera), surian (*Toona sinensis*) and sengon (*Paraserianthes falcataria*). Planting material came from the project. The project recommended a slash-and-mulch system, without burning. This project is a first step in the government's recognition of the role of local people in managing the forest. If this project succeeds, it may be a good basis for future programmes.

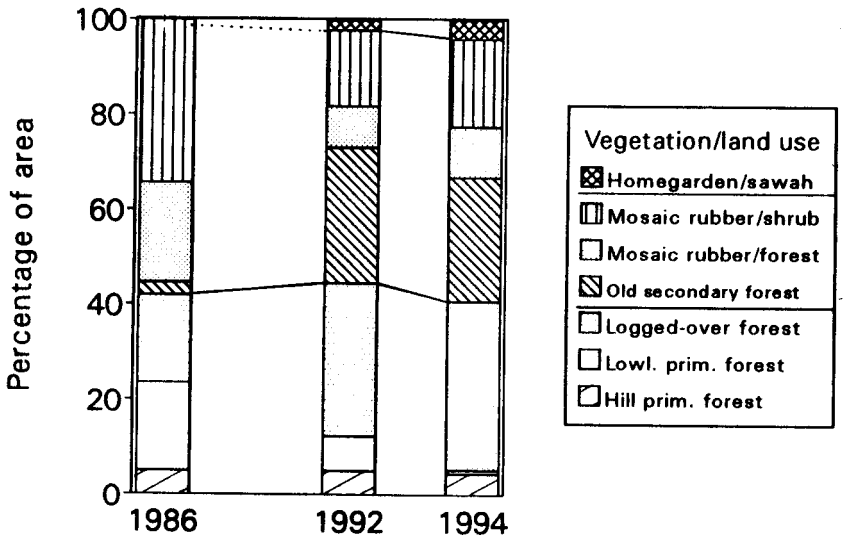


Figure 23. Land use change between the 1985 vegetation map and 1992 and 1994 satellite images

Population dynamics
The population of the benchmark area is increasing primarily by natural growth and is currently around 18 persons km^{-2}. In comparison to other benchmark areas, migration in and out of this area is less. This may reflect both a reasonable ecological balance and a community land tenure system that still functions effectively.

4.3.3 Pelepat and Muara Tebo

This benchmark area (102° 08' - 102° 30' E and 1° 26'- 1° 40' S) represents the peneplain zone. It contains part of a forest concession, original Jambi villages along the Pelepat and Tebo river, and transmigration villages (Kuamang Kuning). The forest concession (HPH) has been selectively logged by PT Sylva Gama (30,000 ha). Part of the concession will be clear-felled to establish an Industrial Forest Plantation (HTI). Parts of the forest (known as Wanagama-2) were allocated for research on forest regeneration and management, and for education purposes for Gadjah Mada University staff members and students. The Kuamang Kuning transmigration area neighbours the forest.

Most of the original Jambi villages are located along the Pelapat and Tebo River as river transport used to be dominant. Soils along the river tend to be better. Spontaneous settlers (forest squatters) have opened ladang along the logging roads; some of them are freshly burnt. A small number of Kubu people (who are still in the stage of hunting and gathering)

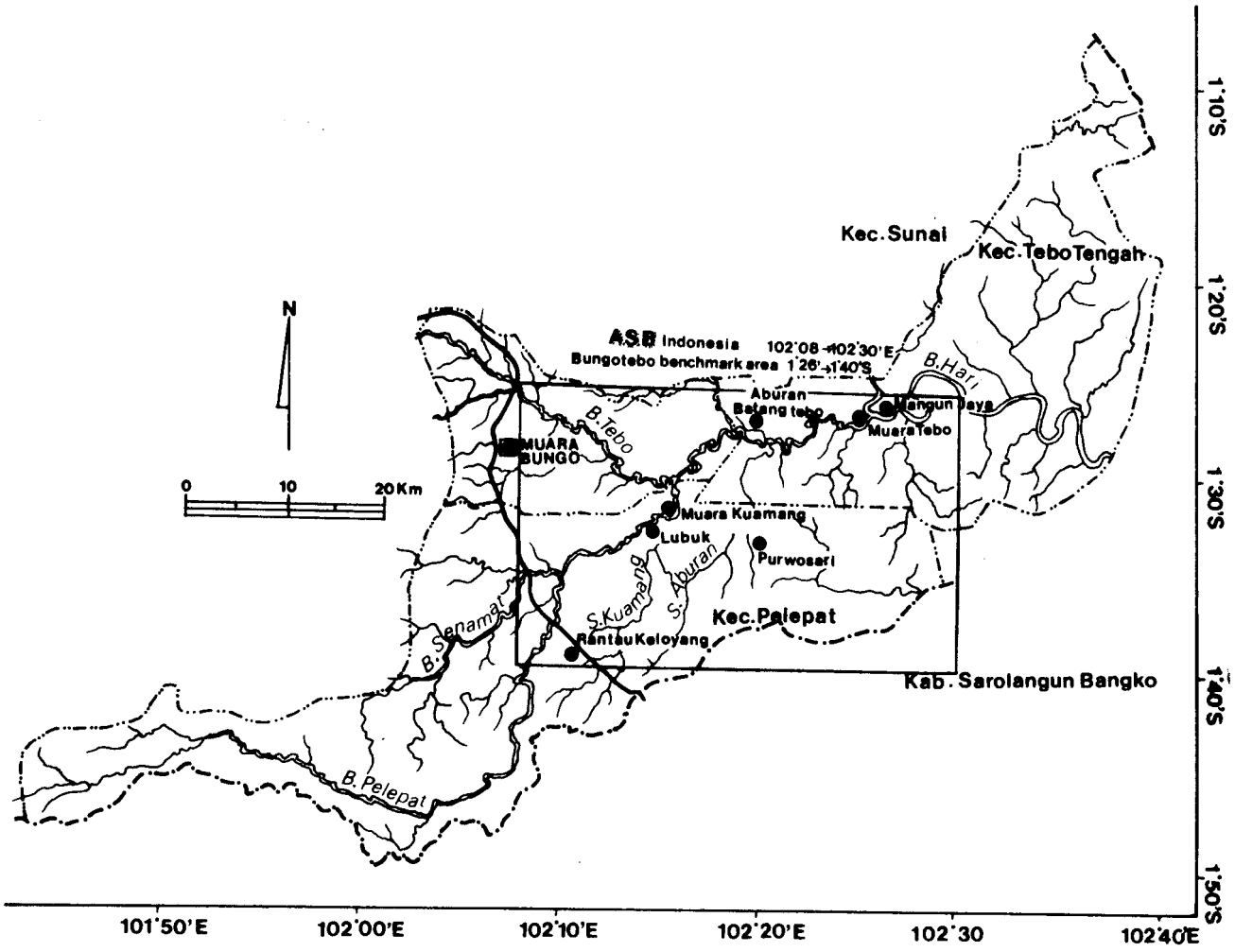


Figure 24. Pelepat and Bungo-Tebo administrative boundaries and ASB benchmark area

also live within this area. Their contact with newcomers is limited. The families interviewed derive some cash income from collecting forest turtles (labi-labi) for sale to merchants in Muara Tebo.

Senamat and Muara Kuamang villages in Pelepat sub district were selected to represent the local farmers (Jambi ethnic group). Mangun Joyo village in Muara Tebo sub district and Lubuk in Pelepat sub district have a high proportion of spontaneous migrants (ethnic Javanese, many of whom resettled here from Lampung). These villages were selected to represent forest encroachment by spontaneous migrants. Presence of the spontaneous migrants in Mangun Joyo is closely linked with logging activities. These migrants gained access to the forest via logging roads and their plots are quite isolated. Elsewhere, spontaneous migrants can also be found along the Trans Sumatra Highway with better road and market access. Purwosari, Bangun Hardjo and Abuaran Bungo Tebo in Muara Tebo sub-district were selected to represent transmigration villages; the transmigrants included local people from surrounding villages, although the 'rules of the game' differ for them (see below).

Climate

Climate data for the nearest three stations are summarized in table 15

Table 15. Climate data for the Bungo Tebo benchmark area (Rachman *et al.*, 1995)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Muara Bungo	399	251	350	355	179	119	138	139	217	239	299	297	2982
Kuamang Kuning	329	221	373	326	281	70	56	202	210	238	286	420	3012
Muara Tebo	249	184	251	220	141	65	88	113	165	179	211	283	2149
Temperature (°C)													
Average	25.6	25.7	25.9	26.2	26.3	26.3	26.1	26.2	26.0	26.3	25.9	25.7	26.0
Stand. dev.	0.55	0.31	0.32	0.40	0.61	0.37	0.35	0.45	0.36	0.39	0.30	0.42	0.29
Maximum	30.9	31.3	31.9	32.1	32.3	31.9	31.9	32.1	32.0	32.3	31.6	31.1	31.8
Minimum	22.3	22.3	22.6	22.7	22.7	22.6	22.1	22.1	22.1	22.4	22.4	22.5	22.4
ETP (mm)	119	120	124	129	131	131	127	129	125	131	124	120	1508
Radiation (MJ m^{-2} day^{-1})													
Average	13.7	15.2	16.0	17.3	14.3	16.1	15.8	15.0	16.3	15.2	16.9	15.8	15.6

The data for the Eastern-most station (Muara-tebo) show a much lower rainfall (2150 mm $year^{-1}$) than the two other stations (around 3000 mm $year^{-1}$). For all stations January-December are the wettest and June-July the driest months. Potential evapotranspiration is on average 1508 mm $year^{-1}$, with the lowest monthly value in January (119 mm) and the highest in May (131 mm). Radiation is on average 15.6 MJ m^{-2} day^{-1}, with the lowest value in January (13.7) and the highest in April (17.3).

Geology

On the geological map (sheet: Muarabungo; Simandjuntak *et al.*, 1991), the Bungo Tebo benchmark area is indicated as part of the Kasai (QTk) and Muaraenim (Tmpm) formation. The Kasai formation dates back to the Plio-Pleistocene, and consists of tuff and sandy tuff, with clay lenses; it a about 400 m thick. The formation was formed in the Miocene (Tertiary) and consists of sandstone and shale; it is at least 800 meters thick.

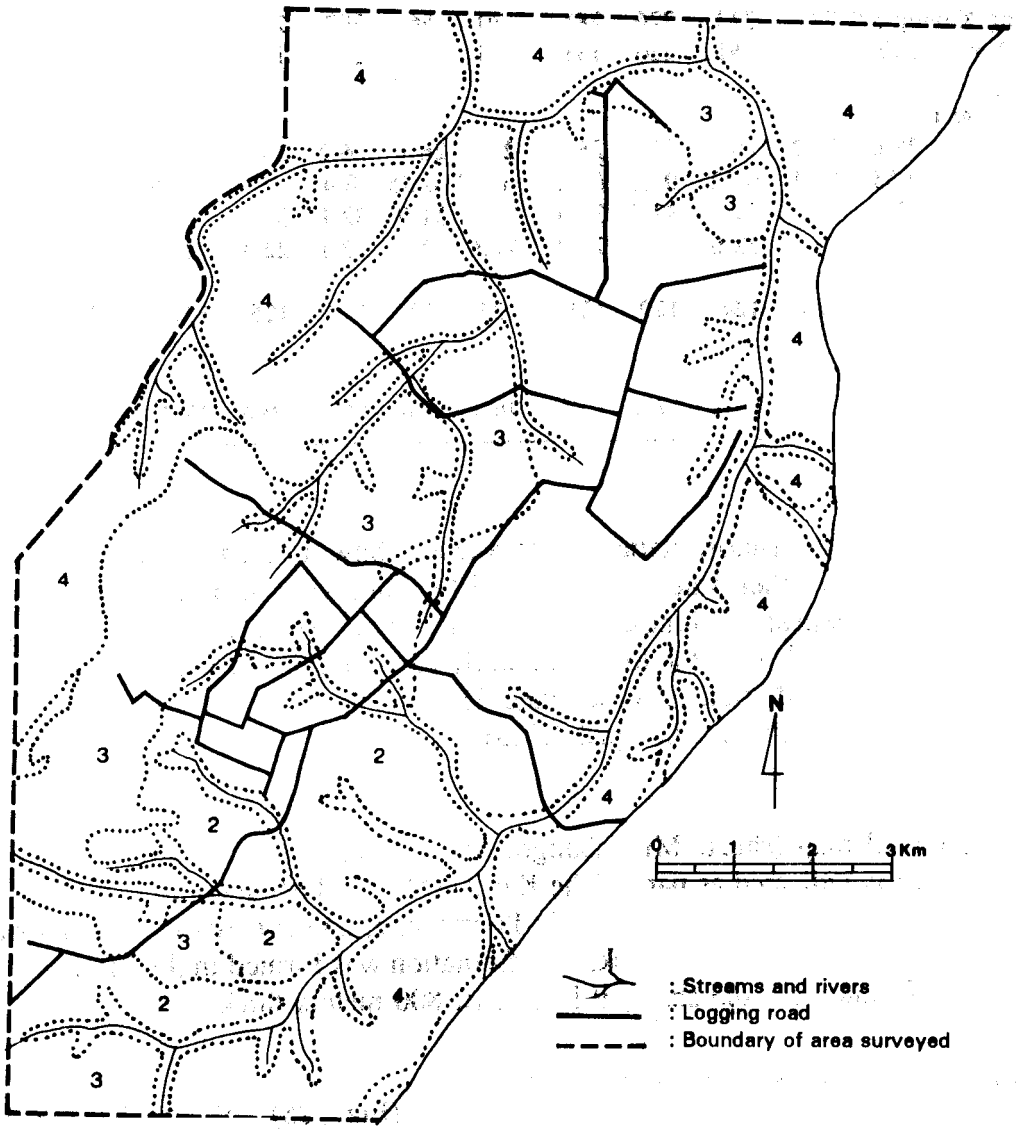
Soil

Two areas were chosen for detailed soil maps (Fig. 25): a) the Kuamang Kuning transmigration area (4 600 ha; Slope 0 - 15 %.; elevation 25 - 50 m a.s.l.), and b) the Wanagama-II forest (1 050 ha; Slope 5 - 15 %.; elevation 25 - 50 m a.s.l.)

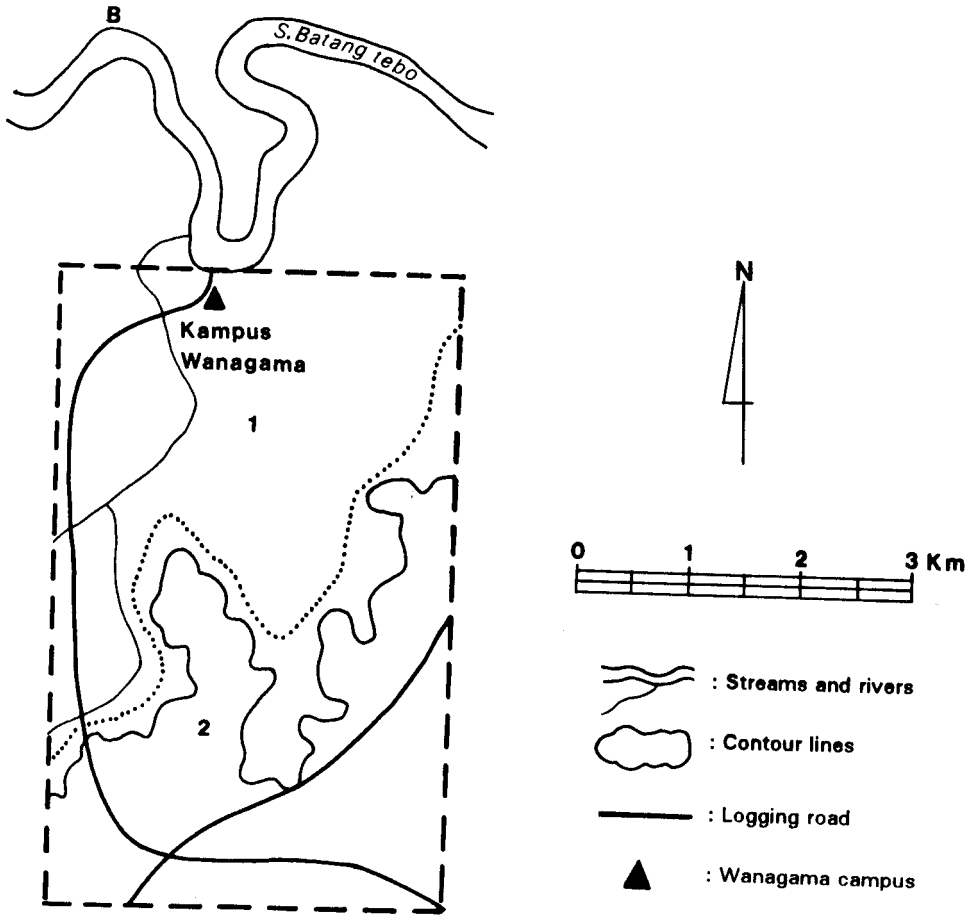
Land Use and Farming System

There is no primary forest left in this area, as all forest has been logged. The dominant land use in this area is secondary forest/bush and agroforestry in which rubber is the dominant crop. Farming systems and thus land utilization within the village can be differentiated into three different group:

Figure 25. Bungo Tebo soil maps **A.** Kuamang kuning transmigration area, **B.** Wanagama-2 forest area (Rachman *et al.*, 1995)



Kuamang Kuning
Soil legend:
Along the streams and rivers
1. Tropofluvent, slope < 1%; 1 000 ha (22%)
Upland soils:
2. Typic Kandiudox, slope 3-5%; 1 350 ha (29%)
3. Typic Kandiudox, slope 5-8%; 850 ha (19%)
4. Typic Kandiudox, slope 8-15%; 1 400 (30%)



Wanagama
Soil legend:
1. Typic Kandiudox, slope 5-8%; 500 ha (48%)
2. Typic Kandiudox, slope 8-15%; 550 ha (52%)

A. For local people

1. There is no sawah within the Senamat and Muara Kuamang villages, but there is wetland rice cultivation in Mangun Jayo. The yield from this cultivation is relatively high as the soil is fertile (flood plain of the Batanghari river).

2. Ladang/belukar . The belukar that belongs to the community is called 'Tanah Batin' or 'Tanah Datar'. Only a few farmers own dryland fields (called ladang) privately. Planting trees in the communal belukar is not allowed, as this land is specifically designated for annual crops. Everybody within the village is free to use the land as long as nobody else occupies the land. As a standard procedure the new cultivator will ask the previous cultivator of the land before opening it. Usually there are three periods of flooding in this village during February to April. Farmers generally prepare the land by slashing the existing vegetation after the third flood and then burn the litter one month later. Seeds are planted at the onset of the next rains.

The average size of land holdings is about 2 ha per household (this figure may need correction after the data processing is completed). Slash and burn is the standard practice for cultivation. The fallow period ranges from 3-5 years. There is increased awareness of problems caused by the decreasing land/person ratio in recent years. More remote areas are now used for cultivation and the decreasing fallow periods close to the village result in lower soil fertility.

3. Belukar lebat/secondary forest (called 'Tanah Kasang'). Most of the tanah kasang is old smallholder rubber (jungle rubber). There are small portions of young rubber. Tenure over the land is determined by customary law, though most of the kasang are claimed as private land and thus tradeable. The customary law stated that whoever fells the forest for the first time is the owner. However, many said that hardly any forest is available to expand their land; much land already is designated for state projects. Land holdings for rubber in Senamat village range from 0.5 ha to 3 ha per household.

B. Spontaneous migrants

1. Sawah (wet rice) land is used by spontaneous migrants in some villages close to the river, although the area is limited. Two kinds of sawah exist, one irrigated, the other rain-fed. This sawah is created by converting dry land along streams and rivers. Both local rice varieties and HYV are used by the farmers. External inputs such as fertilizer and pesticide are already used. Prominent pests are 'walang sangit' and wild pigs. This land is considered to be private, as it was bought from the local people. Land size per household is approximately 0.5 ha to 1 ha.

2. Kebun's (perennial plots) rubber plantations and originated either from old jungle rubber or from logged-over forest. Spontaneous migrants usually start in the area as rubber tappers. Accumulation of capital may enable them to buy rubber plantations from the local people (Rp 1,000 m^2 on the road side, less in more remote places). Other spontaneous migrants opened kebuns in secondary or logged-over forest. Normal land holdings for these rubber plantations range from 0.5 ha to 3 ha, but one farmer owned 30 and another more than 50 ha. The latter are 'absentee' or 'white collar' farmers, employing labourers to clear forest and as rubber tappers.

C. Transmigrants

The plot granted by the government in this area is about 3.5 ha (1 ha more than in Sitiung or North Lampung transmigration sites) consisting of a 0.25 ha homelot, 1 ha LU-I designated for food crops and 2.25 ha of LU-II for perennials. Land tenure is secured by certificates from the government.

1. Homelot. The home garden is usually planted with various kinds of fruit trees (especially rambutan) and vegetables.

2. Ladang (LU-I). The land is cultivated for upland rice with one crop per year, but the yield is decreasing. In the first year the yield was about 6 ton ha^{-1} of unhusked rice and presently it is only about 1.5 ton ha^{-1}. Therefore many farmers abandon upland rice and

plant cassava instead. To continue planting rice they would have to add large amounts of fertilizer. A number of farmers have planted rubber in LU-I to improve their future income.

3. Kebun (LU-II). Most of this land is planted with oil palm through a business partnership with a private company operating a processing plant and a large plantation nearby. All costs are prefinanced by the company and the farmers will repay their credit after harvesting begins.

For the local transmigrants, land allotment differs from that for general transmigrants (mostly from Java). Local transmigrants received 625 m^2 of homeyard, 0.3 ha of LU-I, and 1.65 ha of LU-II; both plots are cultivated with rubber, some with 'improved' varieties as part of a rubber extension project (P2WKSS).

Land use change

Land use change (Fig. 26) in the Bungo-Tebo benchmark area was dominated by the opening of 'old secondary forest' (including jungle rubber) and the establishment of large scale plantations of oil palm and rubber. The land around the transmigration sites is described as a 'mosaic of food crops, fruit trees and *Imperata'*.

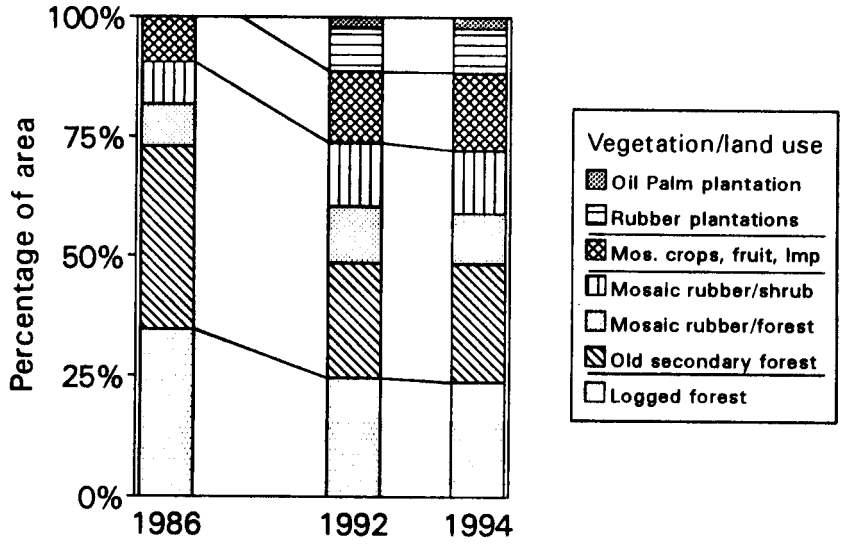


Figure 26. Land use change between the 1985 vegetation map and 1992 and 1994 satellite images

Population dynamics. There has been considerable population movement in the last decade both from spontaneous migrants and government sponsored transmigrants. The first group came around 1970, while the second in the 1980s. Total population density is about 12 persons km^{-2}. The annual population growth is around one percent. The number of people *tends to* increase as migrants invite other persons (usually relatives) to join them. Land ownership is changing. Many local people have sold their lands. Oil palm and intensive rubber monoculture are new activities.

4.4 North Lampung

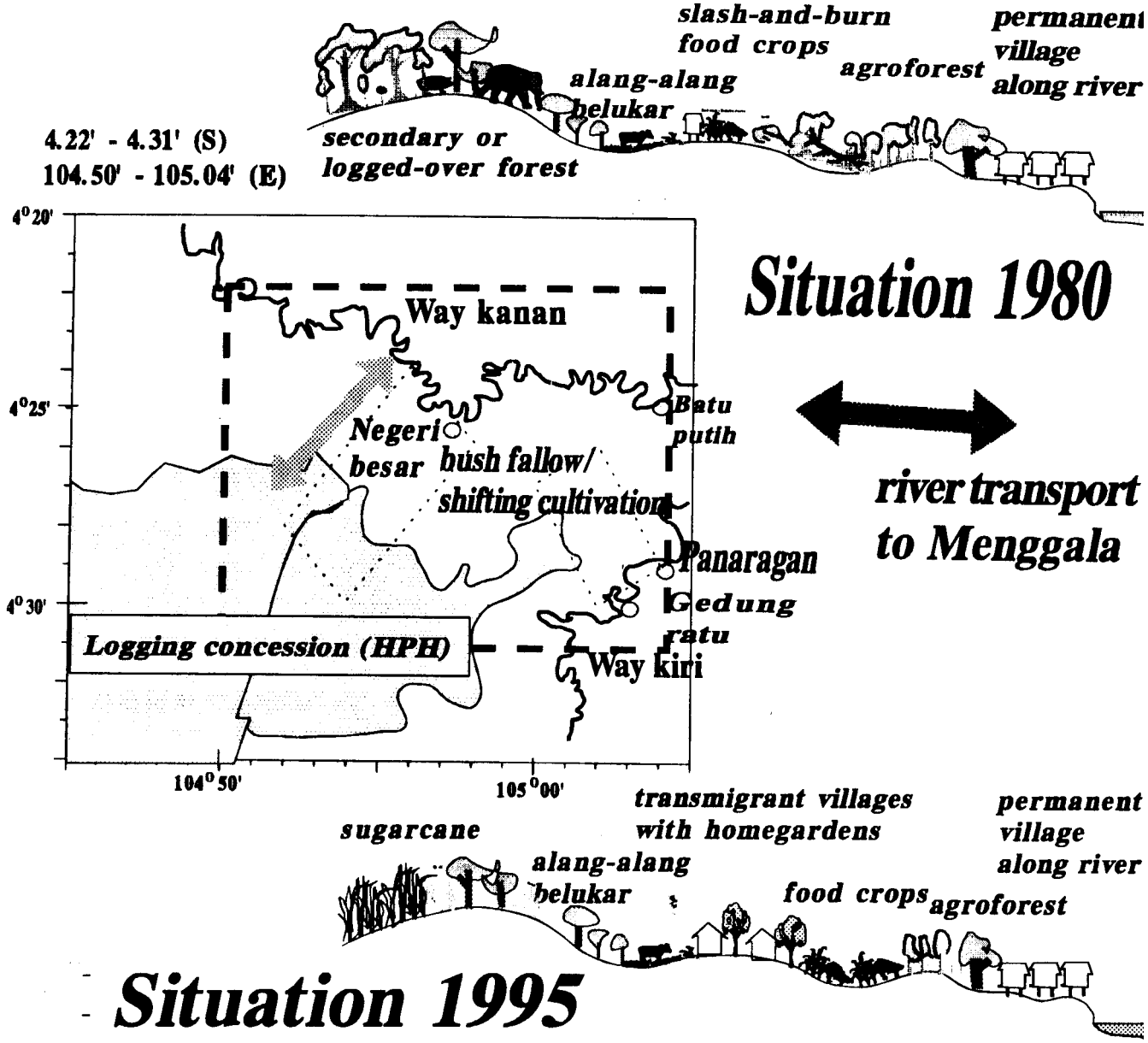
The North Lampung benchmark area (4°22' - 4°31' S and 104°50' - 105°04' E, covering an area of approximately 17 x 25 km^2) represents the peneplain zone of Sumatra with a high population density so that agriculture and forestry activities are intensified. *Imperata* grasslands are partly reclaimed. The benchmark site is a potential source of migrants to new forest margins. Negara Jaya and Tegal Mukti were chosen to represent transmigration villages, while Tiuh Baru (one of the four sub-villages of Negeri Besar) was chosen as representative of local communities. Spontaneous migrants were interviewed in one of the sub-villages of Negara Jaya, in Kaliawi Indah and in Panaragan Indah. The latter two were established under the jurisdiction of local village leaders, on land sold to newcomers.

Negara Jaya and Tegal Mukti, both are home to local transmigrants, who were re-settled in the early '80's from 'protection forest' land in Central and South Lampung, where many of them had coffee gardens. Negara Jaya has good infrastructure and access to off-farm employment from the Bunga Mayang sugarcane factory and plantation, and from a sawmill and industrial forest plantation (HTI) with fast growing species (*Paraserianthes falcataria* and *Acacia mangium*). Much of the *Imperata* grassland has recently been converted into sugarcane under a nucleus-estate small holder scheme. Tegal Mukti was established in 1983/84 and has poorer infrastructure compared to that of Negara Jaya. The distance to the sugarcane factory is about 30 km over a road which was in bad condition until recently. A new road connection towards Menggala in the East will open by mid 1995 and is likely to dramatically improve the accessibility of the area.

Tiuh Baru is part of Negeri Besar, a large original Lampung village, on the right bank of the Way Kanan river. The area is part of the much-disputed boundary of the previous Sriwijaya kingdom of S. Sumatra and the Lampung area which had close connections to W. Java (Banten). The Tulang Bawang river was of considerable economic interest in the past as it gave access to pepper gardens of the Piedmont zone and Menggala had strong fortifications. Negeri Besar consists of fertile land banking the river, surrounded by infertile higher ground. A traveller around 1920 noticed the logs and rubber transport on the Tulang Bawang river and the depleted forest on the river bank around Negeri besar. Until 1980 these uplands were used for extensive 'shifting cultivation' or 'long rotation fallow' systems. Free roaming buffaloes grazed the area. Land close to the river was described as 'mosaic of shrub, secondary forest and *Imperata'*. Further from the river some primary forest remained, until this was logged. Access to the area was mostly by river and an old road from Menggala to Pakuan Ratu following the river (Fig. 27).

Transmigration brought large changes to the area. Large tracts of land were sold by the adat leaders and used for transmigration settlements. Improved road access via Kotabumi opened new economic opportunities and exposure to the neighbouring transmigrant communities induced gradual social change in the village. Maybe the most remarkable phenomenon is that now many girls/young women work in textile factories in Tangerang (near Jakarta).

Figure 27. North Lampung benchmark area



Climate

Climate data for the nearest three stations are summarized in table 16.

Table 16. Climate data for the North Lampung benchmark area (Rachman *et al.*, 1995)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Menggala	393	316	342	254	160	118	97	84	116	138	250	345	2613
Negeri Besar	311	303	291	240	189	176	105	122	116	163	219	399	2634
Tela	330	258	368	214	193	110	122	92	114	128	205	337	2471
Temperature (°C)													
Average	26.7	26.7	27.1	27.1	27.1	26.8	26.2	26.2	26.5	27.1	27.2	26.8	26.8
Stand. dev.	0.34	0.75	0.63	0.63	0.53	0.60	0.50	0.83	0.66	0.51	0.57	0.43	0.32
Maximum	31.3	31.4	32.4	32.5	32.7	32.8	32.5	32.6	32.9	33.1	33.0	32.0	32.5
Minimum	22.4	22.3	22.1	22.1	21.7	21.4	20.8	20.6	20.9	20.9	21.4	22.0	21.5
ETP (mm)	136	136	144	144	144	138	127	127	133	144	146	138	1660
Radiation (MJ m^{-2} day^{1})													
Average	12.9	13.3	12.9	13.0	12.2	10.8	10.6	14.2	13.7	12.9	14.0	13.2	12.8

Annual rainfall is around 2500 mm $year^{-1}$, with December the wettest month and August the driest. Potential evapotranspiration averages 1660 mm $year^{-1}$, with the lowest monthly value in July and August (127 mm) and the highest in November (146 mm). Radiation averages 12.8 MJ m^{-2} day^{-1}, with the lowest value in July (10.6) and the highest in August (14.2).

Geology

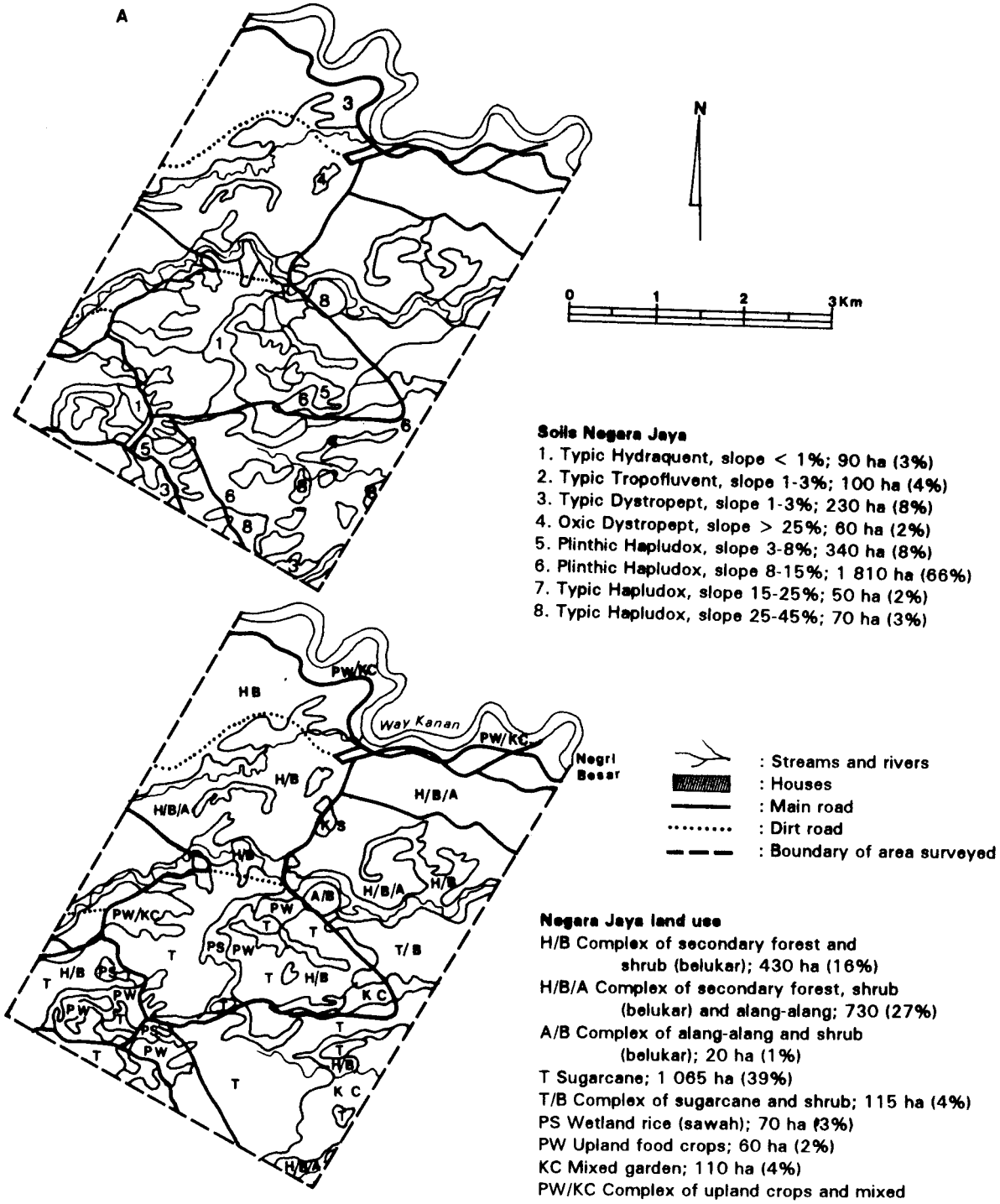
According to the geological map (sheets: Baturaja and Menggala; Gafoer *et al.*, 1993; Burhan *et al.*, 1993), the North Lampung benchmark area belongs to recent Alluvium along the two branches of the Tulang Bawang river (loam and sand) and to the Kasai formation (same as Bungo Tebo; here about 200 m thick).

Soil

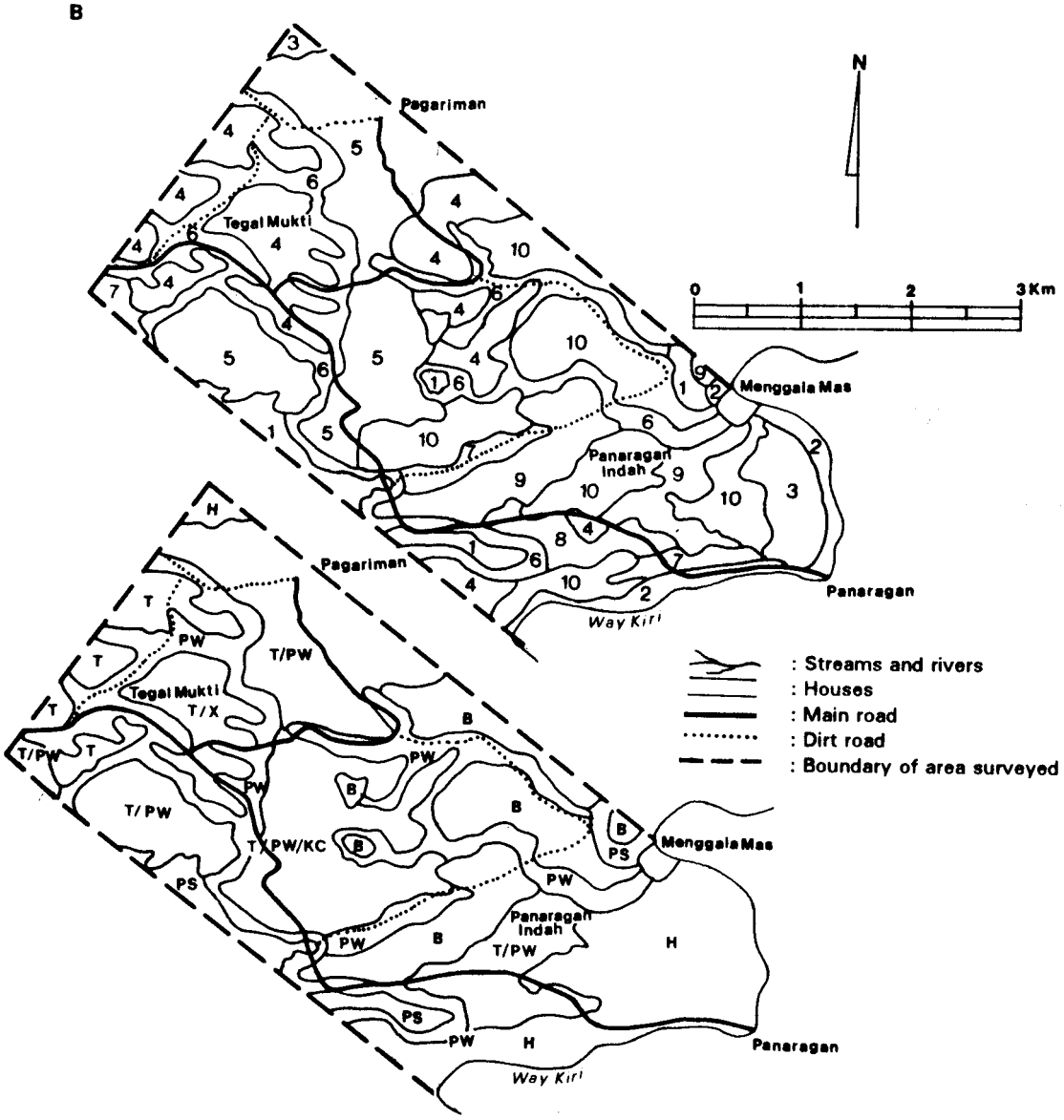
(a). Negara Jaya (2 750 ha; slope 0 - 45 %; elevation 20 - 100 m a.s.l.). Dominant land use: Complex of secondary forest, shrub (belukar) and alang-alang (45 %) and sugarcane (41 %)

(b). Tegal Mukti (2 750 ha; slope 0 - 45 %; elevation 20 - 100 m a.s.l. Dominant land use: complex of upland food crops and sugarcane.

Figure 28. North Lampung soil and land use map **A.** Negara Jaya, **B.** Tegal Mukti (Rachman *et al.*, 1995)



B



Soils Tegal Mukti

Along the river:

1. Typic Hydraquent, slope < 1%; 110 ha (4%)
2. Typic Propofluvent, slope 1-3%; 100 ha (4%)
3. Typic Plintaquept, slope 1-3%; 100 ha (4%); backswamps

Uplands:

4. Oxic Dystropept, slope 3-5%; 450 ha (16%)
5. Complex of oxic Dystropept and Plinthic Hapludox, slope 1-3, 15-25%; 565 ha (20%)
6. Oxic Dystropept, slope > 25%; 510 ha (18%)
7. Plinthic Hapludox, slope 3-8%; 85 ha (3%)
8. Plinthic Hapludox, slope 8-15%; 60 ha (2%)
9. Typic Hapludox, slope 15-25%; 280 ha (10%)
10. Typic Hapludox, slope 25-45%; 500 ha (18%)

Tegal Mukti land use

H Secondary forest; 435 ha (16%)
T Sugarcane; 110 ha (4%)
B Shrub (belukar); 360 ha (13%)
T/PW Complex of sugarcane and upland crops; 605 ha (22%)
PS Wetland rice (sawah); 95 ha (3%)
PW Upland food crops; 735 ha (27%)
T/KC/PW Complex of sugarcane, mixed garden and upland crops; 280 ha (10%)
T/X Complex of sugarcane and homegarden; 125 ha (5%)
X Homegarden; 15 ha (1%)

Vegetation and land use change

No clear systematic formation is shown for the vegetation cover and land use pattern in North Lampung. The few remnants of intact/primary forest are mostly found in the Bukit Barisan range, inside the South Sumatra Reserve. They consist of patches of sub-mountain formation (1,000-1,800 m) and piedmont formation (300 m - 1,000 m) of dense moist evergreen forest. In the coastal swamp zone, very little mangrove forest and swamp forest remains. In the peneplain, the record for 1983 showed a dominance of alang-alang (*Imperata*) with the local fire tolerant tree *Peltophorum dasyrrachis* as the first step in secondary succession. This tree is appreciated for producing charcoal. In recent images a considerable part of this had been changed into plantation, cropland or settlement. Other vegetation types prominent in 1983 were a mosaic of degraded vegetation and coffee plots, and a mosaic of food crops and secondary vegetation.

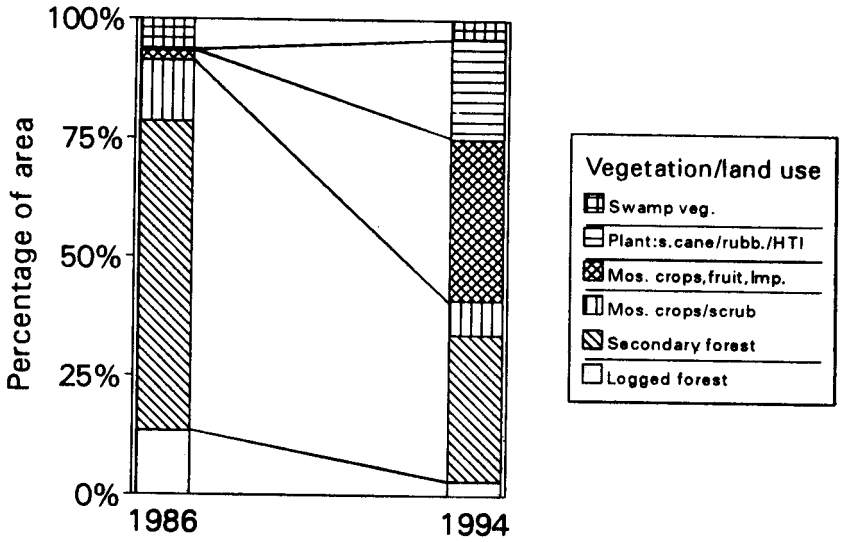


Figure 29. Land use change in North Lampung benchmark area

The vegetation cover of the benchmark area (and its immediate surroundings) was mapped as logged-over forest (originally 'Lampung' dense moist evergreen forest of the peneplains, with a semi-evergreen tendency), secondary and derived-types mosaics (mainly shrubby), savanna and shrub savanna, mosaics of food crop cultivation (cassava, upland rice, corn) and secondary vegetation, coconut and fruit trees, and mosaics of rubber, coffee and food crop cultivation.

Land use and farming systems

The farming systems within the selected villages can be differentiated as follows:

A. Local people

There was a great change in the farming system among the villagers. Losing large parts of the adat (customary) land to the transmigration programme marked the end of shifting cultivation. Now farmers tend to intensify production on their remaining land. Planting cash crops, both annuals and perennials, indicated a movement towards commercial cultivation. Hybrid corn is the most popular annual cash crop, while coffee is the perennial choice on the

small patches of suitable soil. Similarly, land tenure has been changing from communally-owned to privately-owned land. Much of the adat/customary land has been sold, but disputes over the land are common.

B. Transmigrants
Each farmer in the two transmigration villages was allotted 2 ha of land divided into homelot (0.25 ha), LU-I (0.75 ha), and LU-II (1 ha). Most of these plots are dry land. The farming system in Negara Jaya and Tegal Mukti is slightly different. The first village was reached earlier by the sugarcane smallholder scheme, but by 1994/1995 many farmers were disappointed with this scheme. Poor soils and logistical problems of fertilizer delivery and the pronounced dry season of 1994 caused poor crop growth (some sugarcane resembled *Imperata*) and problems with transport of the cane harvest to the factory led to financial disappointment. Many farmers could not repay their credit to the sugarcane plantation and said that when the contract to the company expired, they will not renew it. Currently, there is increased interest in growing other perennial crops: rubber (encouraged by the village head, who is of Lampung origin), oil palm (the recently improved roads allow traders from the provincial capital to operate in the area to collect the bunches) and fast growing timber (mainly *Paraserianthes)* as used by the HTI.

In Tegal Mukti cassava used to be the most important crop (heavily infested by *Imperata*). Recently sugarcane was extended to this area. A previous rubber extension project failed, but a cattle project has been (moderately) successful in this village.

Soils in both villages are poor, but Tegal Mukti is worse than Negara Jaya. The acid soils accompanied with frequent drought have made the land very susceptible to weed invasion. Farmers have to use high doses of fertilizer for planting annuals. Interruption of weeds (i.e. *Imperata*) and pests such as rats and wild pigs are a significant factor in causing poor harvests. Many farmers stated that uncertainty about planting food crops in the dry land meant that it was more worthwhile to leave it as bush or sell it, and work at off-farm opportunities. Many farmers sold their dry land to buy sawah; 1 ha of dry land is equal to 0.25 ha of sawah (Elmhirst, R. 1995).

From Elmhirst (1995) it appears that no one can libe by agriculture alone in the transmigration settlement; those who come close are the ones who one sawah. As much as possible, farmers have tried to convert available land into sawah; share-cropping of other people's sawah is common as well. Only farmers with access to sawah can live from on-farm income. Accumulation of capital from these ventures is used for buying more land from the local people. Other livelihood strategies chosen by transmigrants include moving away to urban areas or to more fertile land in the nearby forest margins (in surrounding provinces).

Population dynamics
The North Lampung benchmark area is the most dynamic of the four benchmark areas. Inflow of migration has been taking place since colonial times, which changed land use significantly. Presently population density in this district is 98 persons km^2. As pressure on the land increased, the land was degraded. Those who cannot survive have moved to other areas, so that the area has changed its function from a receiver to a sender of migrants. Recently, however, there is cause for some optimism that conditions in the benchmark area

can improve. Improved road access and transformation of the degraded lands to productive tree crops is improving the options for local farmers.

4.5. From characterization to diagnosis

4.5.1 General

From the characterization results available so far, it is possible to begin 'diagnosis' of the constraints and opportunities faced by the various groups of households in the various benchmark areas. It must be emphasized here that this diagnosis is a very tentative one, which needs cross-checking with the communities involved as part of a 'participatory priority setting' exercise for phase-2 activities (see also section 6.2). 'Diagnosis' of both the opportunities and constraints must be evaluated in terms of the biophysical environment, socio-economic conditions, and available technology and current policies. In this way, priority issues can be identified where current constraints can be alleviated.

4.5.2 Summary of characterization results relevant to diagnosis

* No households were encountered that practiced 'shifting cultivation' in the classical sense.

* All households, whether local farmers, government-sponsored transmigrants, or spontaneous migrants, use slash and burn methods for land clearing.

* The most common land use system in the Jambi/West Sumatra benchmark areas is to clear logged-over or secondary forest or old 'jungle rubber' to plant upland rice mixed with rubber trees; in the second year upland rice or other food crops may be grown, but the emphasis is on the tree crop,

* Spontaneous migrants have been quick in adopting rubber-based land use patterns, similar to systems used by the local population, but they may be more inclined to intensify production; for the government-sponsored transmigrants adoption of tree-based production systems is a slower process.

* Most of the existing rubber gardens in Jambi are old and have low productivity. To get sufficient income, a large area is needed. Currently, land for rubber expansion is very limited; most of the forested land that is seen as area for rubber expansion by local people is already distributed by the government to 'projects'.

* The most common land use system in the North-Lampung benchmark area is to clear secondary (or logged-over) forest or shrub fallow vegetation to plant food crops or perennial cash crops (sugar cane); recently, however, interest is growing in converting the land to better-adapted (and hopefully) more profitable tree crops in the form of rubber, oil palm or fast growing timber species. Such tree-based systems can accommodate short term needs for food production.

Table 17. Summary of environmental characteristics, farming systems and constraints in four benchmark areas

Communities	Environmental Characteristics	Farming system and constraints	Land Tenure and Holding size
Transmigrants			
* Sitiung	Moderately poor soils, relatively high rainfall, land is prone to soil erosion and weed invasion	In the early years, food crops dominate, but there is a clear change towards perennial crops as the land cannot sustain food crop production without high doses of inputs. Rubber based farming and oil palm are the farmers' choices.	Land tenure is secure. Land allotment of only 2 ha has forced farmers to use the land intensively; poor soils and limited capital have forced farmers to move to other places or work on off-farm jobs to earn a living.
* North Lampung	Very poor soils and frequent drought. Soil is susceptible to erosion and weed infestation.	Dynamic development of the farming system as a result of adjustment to the environment. Sugarcane cultivation has not met expectations. Recent developments tend toward perennial cultivation; but it should be accompanied by food crop production and fire control.	Land tenure is secure, but land is limited and of low soil fertility. Many farmers sold some land to buy better land (sawah) or to move to another place to seek better land in the forest margins, or work on off-farm jobs; some conflicts with local communities still unresolved.
* Muara Tebo	Forest soils, better fertility	Farming system is dominated by large plantations; transmigrants engage in oil palm or rubber plantations with credit from estates.	Land tenure is secure.
Spontaneous migrants			
* North Lampung	Very poor soils and frequent drought. Soil is susceptible to erosion and weeds	see transmigrants	Land is bought from local owners or from transmigrants.
* Muara Tebo	Forest soils, relatively better fertility	Rubber is the dominant crop; cultivated in an extensive manner. Constraints are wild pigs and limited access to better rubber planting material.	Tenure is based on customary law. Arable land is difficult to obtain due to increasing population.
Local people			
* Sitiung	Forest soil, better fertility	Extensive, rubber-based farming system.	Tenure is secure.
* North Lampung	Alluvial soil, better fertility	Annual cash crop based farming system; some interest in rubber, oil palm or fast growing timber.	Land tenure is based on customary law, but there is a tendency toward privatization of customary lands. Disputes over land are common.
* Muara Tebo	Forest soil, better fertility	Land for rubber expansion is limited and farmers may be forced to intensify. But wild pigs have deterred rejuvenation; this was accompanied by limited access to better planting materials.	Land tenure is based on customary law. There is conflict between the state and farmers regarding forest land.

* Vertebrate pests (wild pigs and monkeys in the 'forest margin', rats on the 'degraded lands') are perceived as major constraints for cultivating food crops. Wild pigs also are a threat to young rubber plants and deter farmers from investing in more expensive, higher-yielding rubber planting material.

* Soil fertility constraints are most obvious on the peneplain sites where transmigrant farmers have attempted continuous food crop production; Al toxicity, P deficiency and rapid depletion of soil organic matter mean continuous food crop production is not possible without substantial inputs of fertilizer; many of the current higher-yielding crop varieties also require lime.

* North Lampung has more frequent, more pronounced dry seasons than the rest of Sumatra. These are a constraint for several tree crops, including hybrid coconut and various fruit trees. These dry periods also entail a fire risk and tend to maintain *Imperata* grasslands.

* Logging concessions in Jambi have affected large areas of primary forest in the piedmont as well as the peneplain zone; logging roads encourage an inflow of spontaneous migrants who usually plant rubber. Thus rubber expansion may prevent the regeneration of logged-over forests and speed up (permanent) forest conversion.* The transmigration programme can lead to two scenarios: where villages are successful, they attract a spontaneous influx of people from Java; where they do not succeed, they become a source for spontaneous migrants, who either search for more fertile land in the forest margins or go (back) to urban areas.

* Land tenure in the transmigration areas is recognized officially, while that in the local villages is mainly based on customary law (adat); land disputes are common where the two tenure systems overlap.

* Conflict over of forest land use occurs when current regulations and policies were declared after settlers had occupied the forest and/or when new settlers occupy forest land where such regulations are not effectively implemented