

ARTICLE

Village Level Land Use Changes and the State of the Forestlands: An Analysis of the Result of Transmigration Project in Lower Kapuas River Basin, West Kalimantan

NAKAGAMI Ken'ichi, CHAKRABORTY Shamik

CONTENTS

- I . Introduction and background of the study
- II . Review of previous works
- III . Methods/Rationale
- IV . Present village level land use and its implication on the environment
- V . Discussion and conclusion

Keywords: Land use changes, tropical rainforests, transmigration, West Kalimantan

I . Introduction and background of the study

The island of Borneo was a legend. The largest among the Great Sunda islands with an overall area of 737,000 sq. km, Borneo is the third largest island in the world after Greenland and New Guinea (Donner, 1987). This land was a legend for its wilderness, the jungle covered terrain with inhospitable climate and morphology, given by poor soil and swampy lands with mangroves starting from the coast and thus hindering a smooth entry into the land except through the big rivers which poured into the Sunda Shelf. Furthermore, infectious diseases, particularly Malaria also hindered the development by the outside settlers to a great extent (Donner, 1987). The retreat of lowland peat swamp forests in West Kalimantan is affected by many factors. The plantation agricultures since the colonial times were a major stimulus for opening up these forests since the colonial times. In the later stages the retreat of the lowland swamp forests have been affected by a greater population pressure from the various internal migrants as well as transmigration projects by the Indonesian Government. This paper analyses the effect of transmigration in a village level land use and the state of its forests and is divided into three sections. The first section describes the works presented by other scholars about the same context, the second section analyses the data gathered in a fieldwork by the researcher in the concerned region, the third section discusses the implication of present land use practices to the state of the forestlands.

Location and Morpho-climatic features

The study area constitutes two villages, Radak I and Radak II in the District of Terentang in the Pontianak regency of West Kalimantan. The two villages are situated to the left bank of the Kapuas river main flow as well as to Terentang River or Sungai Terentang, a left bank distributary of the Kapuas. The villages span from latitude extent of 0 22' 18" South to 0 27' 33" South and have a longitudinal extent of 109 41' 00" East to 109 35' 46" East. (Figure 1)

The two villages fall under tropical rainy climatic type or Af, climate with abundant moisture and rainfall all the year around with no dry season. The average temperature of the region is 28° C or 82° F and the average rainfall is 189.4 mm (Badan Pusat Statistik, 2001). (Figure 2)

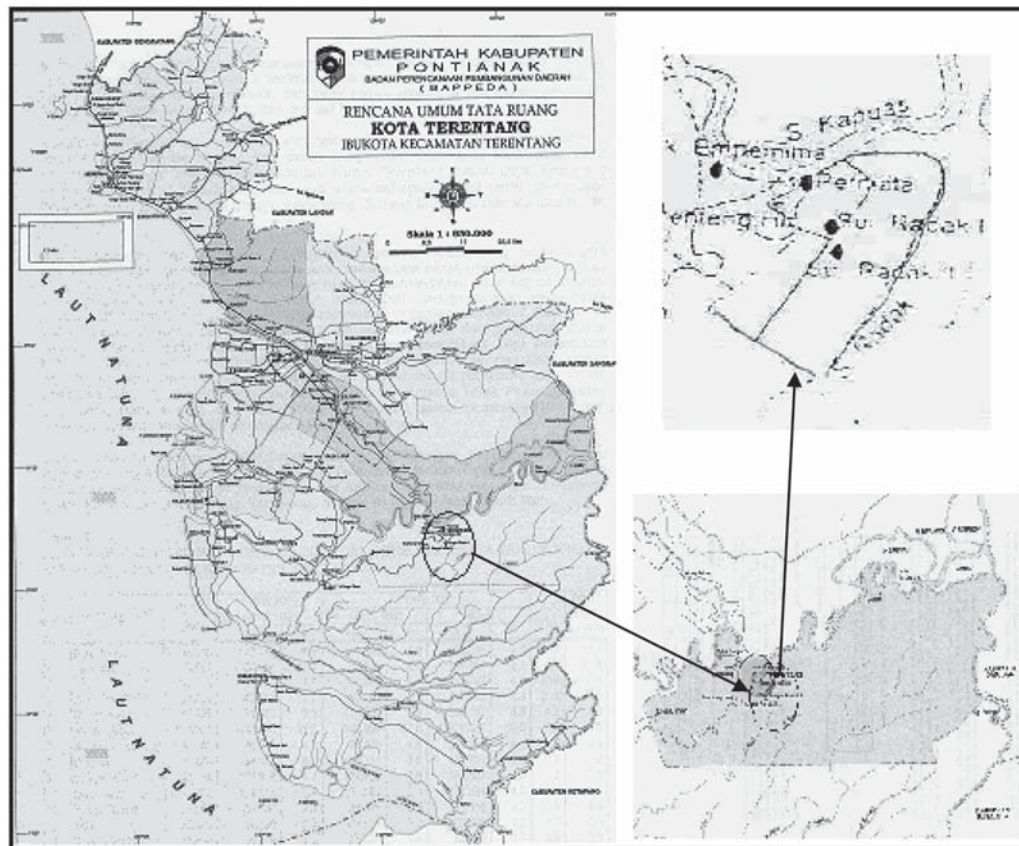


Figure 1. Location of the Study Area within Pontianak Regency (top) and Terentang District (bottom)

Source: Badan Planalogi Kehutanan dan Perkebunan, 1999

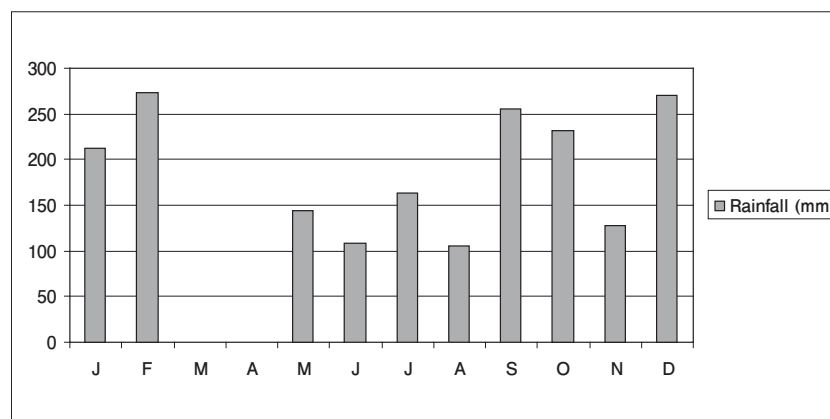


Figure 2. Yearly Rainfall in Terentang (2001)

Source: Badan Pusat Statistik, 2004

The study area, falls under the deltaic peat formed by the tidal actions and brackish water conditions made by the sea and the river systems. The whole process is supported by the deposition action of the big rivers as their flows are retarded along reaching the 'base level of erosion' formed by the Sunda Shelf. The deltaic environment of the study area has been formed by the action of Kapuas river with its distributaries such as river Terentang and Kapuas Kecile. Gradually with time and after the formation of peat, the area is elevated and the diminution of swampy condition allows thick tropical

evergreen broadleaves to colonize the land area. As the study area constitute the deltaic flatlands, it is characterized by level to gentle slopes, with the elevation never exceeding 25 meters, with average elevation being 8 – 10 meters above mean sea level.

The soil is characterized by the strongly acidic peat with fertile alluvial soils which predominate in a narrow belt to the both sides of Kapuas River. The soils of the swamplands are characterized by three types, namely Organosol or Histosol, Alluvial or Entisol and Latosol or Inceptisol or Oxisol. Alluvial soils or Entisols in the swamplands, although fertile, have high sodium content and thus are unsuitable for agriculture. Inceptisols have higher agricultural potential due to lower sodium content and high organic matter, whereas Histosols have lowest sodium content of the above three types and thus have good agricultural potentials (Donner, 1987). The average pH value of the swampland soils is 4.50 to 4.99 (Lindert, 2000), making them quite strongly acidic for cultivation. The major part of the Radak I and Radak II, except in their extreme northern part, is actually situated in the acidic peat soil zone, which is quite unsuitable for agricultural practices (Soil Research Institute, Bogor, 1973).

Vegetation

The natural vegetation of the region is characterized by broadleaved tropical lowland forests which can constitute as many as 240 different species of vegetation growing within 1 hectare of forestland (Whitmore, 1984). About 80 percent of the climax vegetation in the peat swamp forests is dipterocarps with an average height of 24 to 36 meters with occasionally trees reaching 65 meter in height (Whitmore, 1984). One of the most important features of the structure of the vegetation is different layers in the canopy structure. Below the emergent trees reaching 65 meters and the general canopy structure of 24 to 36 meters, a third layer situates which is more shade tolerant. This layer is mainly composed of lianas, epiphytes and ferns (Primack & Corlett, 2005). The present vegetation structure however, is a much changed one with human interference for hundreds of years. The much of the land is covered by vegetation mosaics mainly consisting different varieties of rice, cassava, vegetables and various types of beans along with plantations of rubber coconut and mango trees.

II. Review of previous works

The peat swamp forests of the coastal and inland Southeast Asia is on the brink with the trend of increasing intensity of human landscapes surrounding and 'eating away' natural ones. The land has a particular trend of exploitation for the purpose of land preparation for agriculture, comprising wet rice cultivation or plantation systems. The first step of forest opening and the expansion of human landscape are done by opening of the virgin forests by cutting and burning mainly with cutting of small canals or ditches. These small canals were dug from the principal drainage lines of a land parcel towards inland, penetrating into the forests (Abe, 2003; Furukawa, 2004). With the passage of time, these canal systems grew like a mesh in length with time and penetrate gradually inland opening the lowland forests (Abe, 2003). The building of the canals was important for draining additional water from the peat soils for plantation crop cultivation. However peat starts decomposing as soon as the water is drained. This leads to peat compaction and subsidence of the surface. Moreover, peat lacks the major mineral nutrients, particularly potassium and phosphorous, they are not good for cultivation. After a certain period of time, the natural fertility of the peat soils decrease suddenly and the conditions for cultivation diminishes further (Abe 2003). The land needed limited labor once the plantations have been done (Seavoy, 1980). However, once the initial site became unproductive the settlers had to move to a newer site and carry out the same procedure for opening the swamp forests. It was a destructive process as far as the peat swamp forests are concerned; however, these manual processes of opening up the lowland swamp forests were relatively slow process than the planned developments. This is because the planned developments used heavy machineries to open up the virgin forests and also to

dig the canals.

Seavoy (1980), identifies two major factors for the change of the land use in the lowlands of Northwest Kalimantan where tree crops or plantations are being converted to wet rice or 'sawah' cultivation. One, the lack of replanting program by the Indonesian government, both for the coconut as well as rubber plantations; and two, the greater rate of population increase in the littoral lands. The population increase from 1930 to 1971 in the littoral lowlands was 3.1% as compared to the uplands, where population grew at a rate of 0.9% from 1930 to 1971 (Seavoy, 1980). The conversion of tree crops or plantation cultivation to 'sawah' is the first step of intensive food production in order to feed a larger size of population a trend quite similar to North Java plain during the second half of 19 century (Seavoy, 1980).

Not only that the lowland areas, the upland areas of Southeast Asia is been under pressure from the increasing population pressure as well. Boserup (1965) identifies that the fallow period in the farming system gets shorter with the annual cropping (2 – 6 months) to multiple cropping systems (less than 2 months). The greater population pressures in the uplands need an intensive cultivation technique with more labor input per unit area of land. Thus the forest fallow changes into bush fallow and then from bush fallow to short fallow, annual cropping and multiple cropping (Cramb, 2005).

In case of humid tropics, with the increase of population, farming spreads from the upland areas where traditional shifting cultivation is practiced, to the lowland swamp areas which provide a higher return of the investment and labor expend (Pingali & Binswanger, 1987). Gradually with population increase as even the low lying areas cannot carry the population pressure, the intensive rice cultivations are extended to the upland areas.

Kartawinata, et al (1984) has described the differential outcomes of the same land use in different localities. Their case study covers two areas in East Kalimantan, one the Apo Kayan area and the other being the Telen River lowland area. It is observed that the shifting cultivators of the Apo Kayan, have more environmentally friendly land use practices in contrast to the Telen River lowland area settlers where the inhabitants have same land use practices but more extensive and practiced in primary forests with irrigation. The sustainability of swidden agricultural system is also evident in the studies done in Vietnam. Jacobsen et. al (2006) work founds out that as swidden agricultural area is restricted, there is an increase in the area of bush and grass fallow which replaces the previous forest fallow land. This has a negative implication on the yield from the swidden agriculture, labor productivity and food self sufficiency of the farmers. Shifting cultivation in the tropical rainforests takes place in an array of different ways depending on the diversity of different environmental characteristics and circumstances of the area. Any development plan should take into such diversity into account for the well being of the people and their environment. Works in the outer islands of Indonesia suggest that at the subsistence level, good forest cover; meaning considerable forest resources, lead to better livelihood and well being for the people (Dewi, Belcher & Puntodewo, 2004). Studies trying to relate the land suitability for agriculture, economic opportunities and forest cover suggest a big impact on the people's well being in the frontier areas of East Kalimantan. It has been observed that under more centralized governance the village people have little to extract from the rich natural resources which they have in their vicinity and their well being is also hampered as the forest resources is depleted by the large scale commercial logging activities, a common factor in Indonesian Borneo for the loss of natural forestlands. The oil palm plantations and transmigration projects on the other hand, did create some markets but it remained within the agricultural sector only. Dewi, Belcher & Puntodewo's work, (2004) suggests that the more the economic diversity in the village, more the well being of the people in terms of health education and assets. Higher levels of forest resources and suitable land for agro-forestry practices are equally important for the well being of the people at the village level and a good forest endowment allows the people to live well to the subsistence level. It is suggested that forest agricultural livelihoods can lead to a high level of welfare.

The lowland forests of not only Indonesian Borneo but in the other countries of Southeast Asia had undergone major changes since the later half of 19th century (Tomich, Thomas & Noordwijk, 2004). The major waves of land use changes

took place through the plantation agriculture encouraged first by the colonists and then by the governments (at least in Indonesia). The government not only took the previously cultivated land by the colonial rulers but also opened up new lands, mainly through opening up the land through canals followed by plantations. This was an ongoing process, as previous plantations became decadent or came up with lower yields; new lands were opened for cultivation. This trend of an increase of human landscape at the expense of natural one lead to some major environmental problems the most critical of which are the trans-boundary smoke, pollution, degradation of biodiversity and degradation of watershed functions (Tomich, Thomas & Noordwijk, 2004). Moreover, it is argued that these environmental problems affect mostly at the local or intermediate scales, thus the actions in intermediate to local scale are expected to play an important role to address these environmental issues (Tomich, Thomas & Noordwijk, 2004).

III. Methods/Rationale

Current village level land use and chronological land use change studies are relatively few, in West Kalimantan. The effect of the small family farms with individual land use combined with transmigrated population on the land use changes have been studied by few, but it is supposed to have a big influence on the land use and land cover changes in the coming future as Indonesian government hold plans for developing the West Kalimantan province through transmigrations (Suprpto, 2001).

The research methods are devised according to the context of the study which in this regard is the state of the present land use practice in a transmigrated village in West Kalimantan and its effects on the forestlands. The central questions of the research are, 'What are the present land use practices? What are the central issues of such land use practices? What are the effects of such land use practices to the forestlands?' The research takes an exploratory design to answer the first two questions, concentrating on 'what' question mainly, as little is known about the situation of the case. For the first two questions a structured close ended interview approach has been taken with household as the unit of reference, analyzing the result of a fieldwork survey carried out from 2nd March to 12th March 2007, based on account of 135 and 117 household respondents. The third question has been approached through an analysis of three multi temporal satellite images and topographic maps. The micro level of the study conducted with participation of 29% of the village household, combined with chronological qualitative interpretation of satellite imageries, makes this research quite special in finding out the inquiries concerned with land use practices by the villagers and how this have influenced the land use changes in the study area for the past 41 years. (Figure 3)

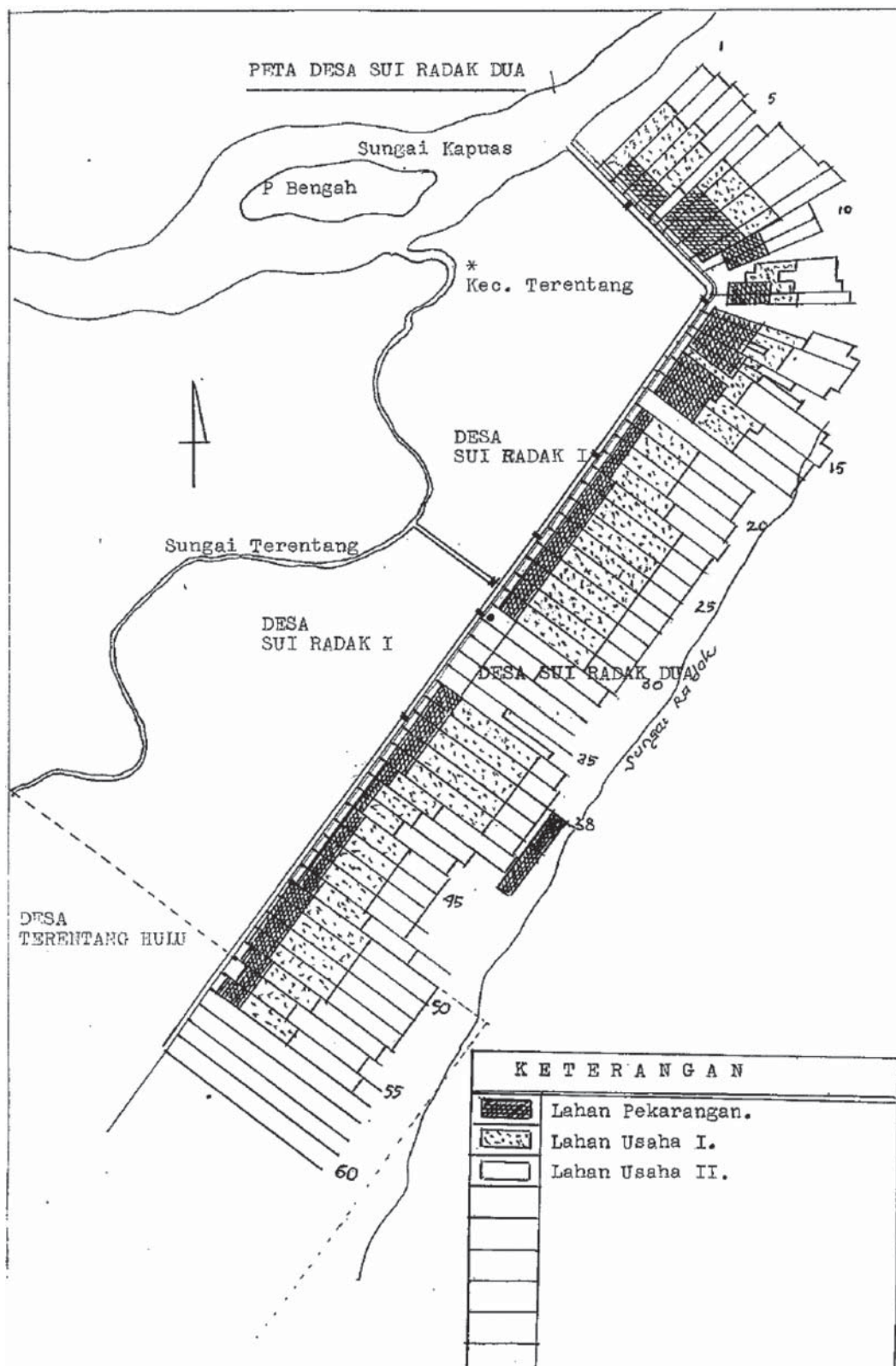


Figure 3. RADAK Village in lower Kapuas river basin, West Kalimantan

IV. Present village level land use and its implication on the environment

Population and transmigration

The island of Indonesian Borneo or Kalimantan had very little population density and distribution. In 1800, the total population in Borneo as well as in the Malay Peninsula was 1,500,000 (Brookfield, Potter & Byron, 1995). Given the cumulative area of the two geographical areas 743,330 sq. km plus 270,176 sq. km, the average population density of Borneo and Malay Peninsula by this time was about 3.75 per sq. km. It is worthwhile to mention that Malay Peninsula was characterized by a much larger population, mostly inland riverine and coastal people than what it was in Borneo. Therefore, it is expected that the population density in Borneo was much lower than 3.75 per sq. km. This scenario of an extremely low population density changed in the later periods with resettling certain groups of people through state planning and decision-making. The first application of the practice came with the Dutch's after they conquered Lombok island in 1894, such migrations to the outer islands came about 10 years later (Donner, 1987). Primarily the aim of these first transmigration schemes were to supply steady numbers of labors to keep the colonial plantation economies as well as the mining and oil drilling activities going. The government of independent Indonesia however, carried out transmigration projects mainly for two reasons, one, to resettle a highly dense population from islands such as Java, Bali, Lombok, Madura to relieve the excessive population pressure there, and two, to tap the natural recourse potential of the outer islands for development both at the national as well as local level (Donner, 1987).

Another important part of the transmigration is migrates who traveled to the outer island without government policies. These were the so called spontaneous migrates who were attracted by the facilities and amenities in the outer islands provided to the government sponsored transmigrants. However, resettling a large number of people to the outer islands was not an easy task, mainly due to the financial matters involved. Initially the target was to resettle 48 million people in 35 year period starting from 1953 (Donner, 1987). After realizing that the task is virtually impossible to achieve mainly due to the above mentioned reason, the Indonesian Government planed to resettle 100,000 people in 1953 of which only 40,000 were resettled (Donner, 1987). However, this rate of low achievement reversed during the third and fourth five year planning period (Tirtosudarmo, 2004). It was estimated that during the third five year plan (1979 – 1984), with a target population of 500,000; 535,874 families were resettled to the outer islands of Indonesia (World Bank, 1988) with the overall achievement being 107% (Tirtosudarmo, 2004).

However, it is argued that the transmigration projects as practiced by the Indonesian government's policy did not have any positive impact on the increasing population density and the resultant land scarcity in Java, Bali, Lombok and Madura islands. This is not only from the point of view of a considerable annual population surplus, which far exceeded the average annual transmigrant numbers, but also the project had social impacts among both the transmigrant as well as the local populations in the outer islands. Identity problems and problems in the practice of advanced agricultural techniques due to poor environmental conditions in the outer islands were just two of such impacts. Furthermore, many of the state promises such as providing better irrigation facilities was not actually carried out and the settlers were left to suffer under contrastingly different cultural and environmental traits (Donner, 1987).

The total population of Terentang in the year 2000 was 8,581 (Badan Pusat Statistik Kabupaten Pontianak, 2001). This population grew at a rate of 5.17%/y during the 1980 to 1990 growth period. This growth rate was second only to Sungai Raya, which had a growth rate of 6.49%/y during 1980 to 1990. In Terentang the population growth rate dipped contrastingly during the period 1990 to 2000 with a figure of 0.77, falling to 9th place. (Figure 4)

The population of Radak I and Radak II in the year 2000 was 1,324 and 1,749 respectively (Badan Pusat Statistik Kabupaten Pontianak, 2001), with a population density of 75 and 95 per sq. km, both of which was highest in the District of

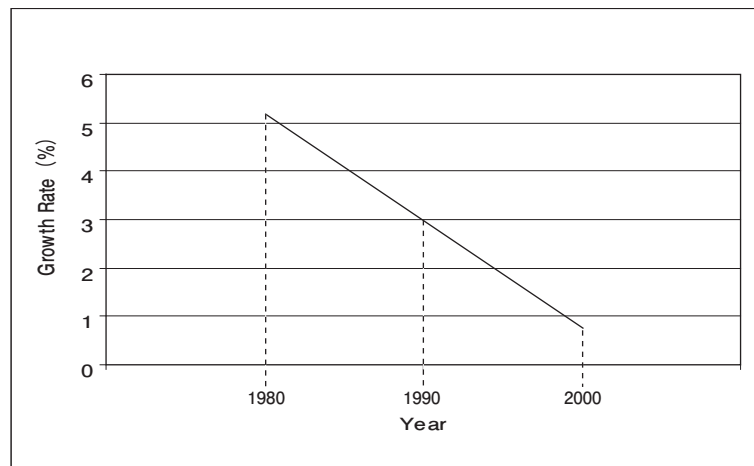


Figure 4. Population growth Rate in Terentang

Source: Badan Pusat Statistik, 2004

Terentang for that year. (Figure 5) The share of population size of Radak I and Radak II alone constituted about 36% of the total population of the district. The average district level population density for Terentang was much lower than Radak I and Radak II with just 11 persons per square kilometer of area. The average household size in Radak I and Radak II was 4.4 persons per household with highest being 9 persons per household and the lowest with 2 persons per household. The average household size, however, was not much different that the district level average which was 4 persons per household (Badan Pusat Statistik, 2001). The sizes of the households suggest small family sizes in the two villages.

The high population growth rate for the period of 1980 to 1990 was the result of transmigration projects. With an initial target group for 500 and 460 families for Radak I and Radak II respectively, the government of Indonesia actually replaced 450 and 393 families during the year 1984/85 to 1985/86. The figure below shows the share of this transmigrated population in relation to total population in Radak I and Radak II at present. A comparison between the two graphs in the figure below suggest that all statistically all the population in Radak I is constituted by transmigrated population. For Radak II however, the present population increased by 374 persons. Given that the average family size in the study area is 4 persons per family, this means about 94 families increased in Radak II since the transmigration project. In Radak I, 135 persons or 34 families decreased from the village. The two most possible explanations may be, first a migration of certain number of families either from Radak I to Radak II or from Radak I to other villages. Second, as the village boundary was changed from that of 2000 (Sensus Penduduk, 2000) to 2001 (Badan Pusat Statistik, 2001) a certain number of families must have been included in other village populations.

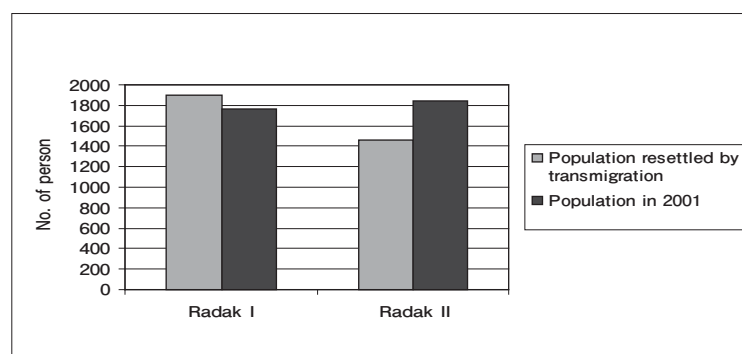


Figure 5. Comparison between the Present Population and the Transmigrated Population in Radak I and Radak II

Source: Badan Pusat Statistik, 2004

This situation of a higher share of transmigrated population is quite unique in West Kalimantan in general as the transmigration projects under former President Suharto's rule did not take West Kalimantan as a principal land area for the realization of transmigration projects. West Kalimantan remained so until now with insignificant share of transmigrated population (Suprpto, 2001). However, the share is found greater for Radak I and Radak II as nearly all of its population constitute transmigrated population.

Farm Size, Family Size and Size of Land Holdings

In the two villages, 44.9 % of the farmer population own 2 hectares of land or lesser, whereas 24.9 % own less than 1 hectare of land. The majority of the farmers, about 70 % in the two villages thus have a small parcel of land, about 2 hectares on the average, as was found during the fieldwork survey. The upper limit of these land holdings is 4 hectares and the lower limit being $\frac{1}{2}$ hectare. (Table 1) On the average however, Radak I inhabitants have a slightly bigger area of land, 2.15 hectare on the average. Radak II villagers, on the other hand have an average land holding of 1.88 hectares (see Figure 6). The owner of the land takes care of his own field as with his family, which has about 4 members on the average. The knowledge and the expertise of the older family member about crop cultivation directly go to the younger male member who is second oldest in the family.

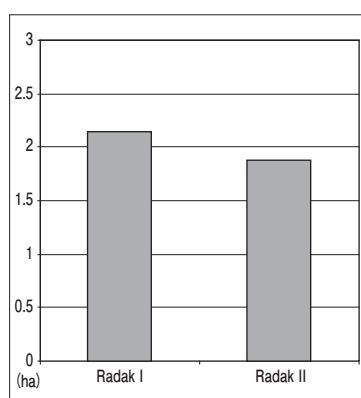


Figure 6. Average areal extension of land holdings in Radak I and Radak II (in ha)

Source: Badan Pusat Statistik, 2004

Table 1. Percentage distribution of land holding in Radak I and Radak II (in ha)

< 1	1.1-2.0	2.1-3.0	3.1-4.0	> 4
24.9%	44.9%	10.2%	20.0%	0%

Source: Survey data by the researcher 2007

Cultivation characteristics

The area under wet rice cultivation is greatest in Radak I and Radak II in the district of Terentang with Radak I having 1000 hectares and Radak II having 660 hectares of land under wet rice cultivation. Thus both Radak I and Radak II comprise the villages with small family farmers practicing wet rice cultivation. The two villages, Radak I and Radak II are unique in the sense that they are swasembada or self sufficient villages (Badan Pusat Statistik, 2001). This means that the majority of the villagers do not sell the production; rather it is consumed by the village population. However this scenario is only with the wet rice cultivations as well as other food crops. The cash crops such as rubber and coffee are sold to the outside markets situated in the Pontianak city. (Figure 7)

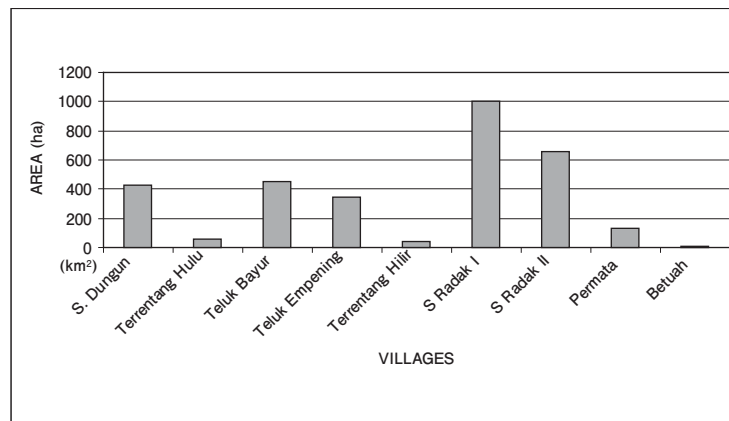


Figure 7. Area under wet rice cultivation in the district of Terentang

Source: Badan Pusat Statistiks, 2004

Although the cultivation mosaic in the two villages is dominated by wet rice, a significant number of farmers prefer to cultivate dry rice or shifting rice cultivation (padi ladang). More often than not there is a mixed farming system mainly consisting wet or dry rice cultivation with other types of crops such as onions, corn, cassava, chilly etc. Few farmers also prefer cultivating wet rice and plantations such as rubber. In Radak I, the farmers generally practice sawah or wet rice cultivation; however they tend to prefer mixing local varieties of paddy in their rice fields. These varieties include, siam, sambas, merah, hitam, putih etc. Rice is obviously preferred as almost 95% of the farmers tend to cultivate rice in some way, either mixed with other types of crops as mentioned above or exclusively. (Figure 8, Table 2)

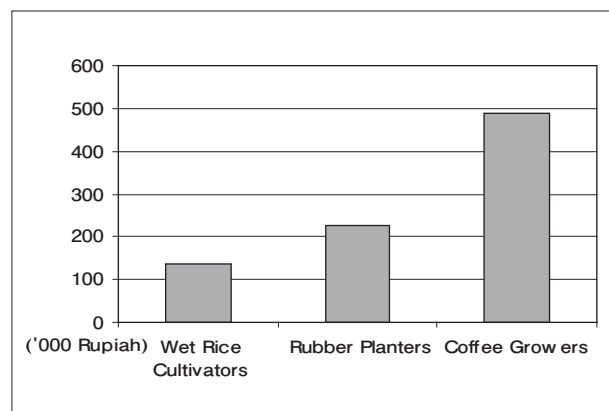


Figure 8. Average monthly income for different crops in Radak I and Radak II

Source: Survey Data, 2007

Table 2. Income discrepancies under different agricultural land use practices in the study area ¹⁾

Types of Agricultural Land use practices	Average Monthly Income (IDR)
Wet rice	135,000
Rubber	225,000
Coffee	488,000
Wet rice and coffee	750,000

The majority of the farmers cultivating only wet rice are found as the poorer lot in the two villages (see figure above). A big factor for the high monthly incomes of the wet rice cultivators who also practice coffee plantings is because the

productions of the cash crops are sold to the outside market whereas the rice grown in the family farms are consumed by the farmers family themselves. Thus they do not need to buy their principal food source in exchange with what they cultivate, like the plantation farmers. The wet or dry rice growers consume the food crop what they cultivate and thus they do not depend on the market to buy their main food source. This is the reason for the low income of the farmers exclusively cultivating either wet or dry rice. As far as the selling of the food crops is concerned the farmers prefer to consume the production. Even the majority of the farmers do not show their interest to sell the surplus rice. This is shown in the graph below, where about 63% of the population prefers to eat the crop surplus for the next growing season, 21% prefer to sell the surplus food crops and 15% either sell or eat the surplus food crops depending on their economic situations for that year. (Figure 9)

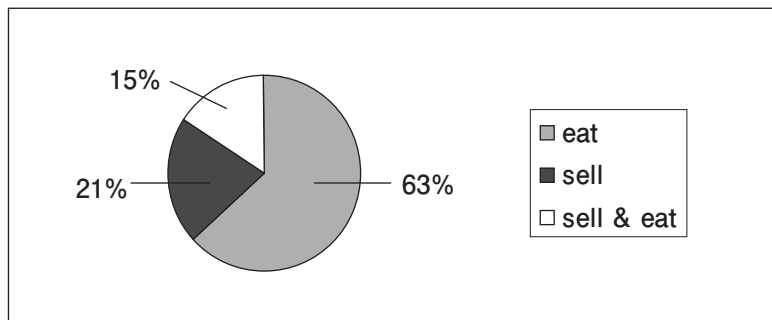


Figure 9. The decision of the farmers regarding the surplus food crops
The fate of surplus food crops in Radak I and Radak II

Source: Survey data, 2007

The intensive wet rice cultivation methods uses the canal systems either dug by the government or the local people from the principal drainage lines i.e. Sungai Terentang and Sungai Kapuas for the case of the current study area. The very technique of cutting the canal supports the findings of Abe (2003) and Furukawa (2004). The canals are dug more or less perpendicular to the principal drainage lines with smaller canals off-shooting from their bigger counterparts and so on. The villagers use tidal irrigation to cultivate their agricultural fields. This is evident from the figure below. As of 2001, only 60 hectares of land was cultivated under simple canal irrigation provided by the public works department in Radak I, Radak II however did not have any irrigation facilities done by the public works. Of the total irrigated field of 788 hectare in Radak I, 718 hectare is tidally irrigated. The area of tidal irrigation in Radak II is 515 hectare among its total of 521.6 hectare of irrigated lands (Badan Pusat Statistik Kabupaten Pontianak, Kecamatan Terentang dalam Angka, 2001). The tidal irrigation has a vital two way function for cultivation. One, it helps in opening up the swamp forests by draining the peat as noted earlier. Second, the tidal characteristic of Sunda Shelf Rivers is used to irrigate the agricultural areas even as far as a hundred kilometer away from the sea. The tidal effect in Sungai Terentang (River Terentang) and Sungai Kapuas (Kapuas River) is used in the two villages. (Figure 10)

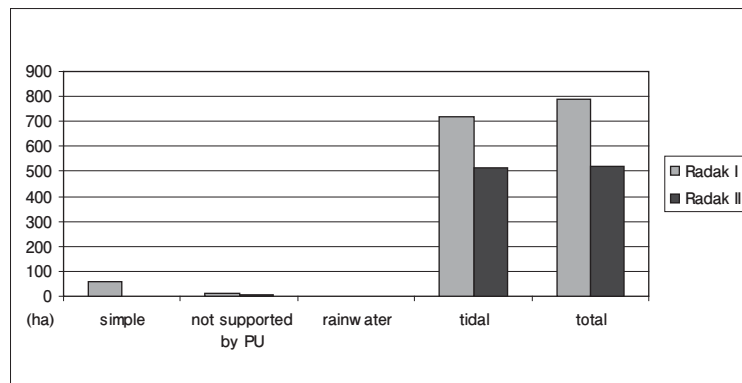


Figure 10. Types of irrigation in Radak I and Radak II in 2001

Source: Badan Pusat Statistik, 2001

The practice of wet rice cultivation by canal irrigation in small family farms is the dominant land use scenario in Radak I and Radak II. Radak I, having situated between the principal natural drainage i.e. river Terentang and the principal irrigation canal, have more farmers who cultivate wet rice, whereas in Radak II the proportion of dry or shifting rice cultivators (*padi ladang*) increase (see Figure 11). As Radak II still have some forestlands of about 300 hectares in total (Badan Pusat Statistik, 2001), allows the farmers to practice more shifting rice cultivation as the practice needs a certain period of fallow land. This land use scenario is quite similar to the one in Java from the middle of 18th century to the later half of 19th century, as identified by Donner (1987). The principal forces acting towards this 'Java Style' cultivation is the transmigration project that indirectly induced facilities to not only allow the transmigrants to use the land in Java style wet rice cultivations, but also it attracted a lot of internal migrants who preferred to settle in this part of the country for better facilities. (Figure 11)

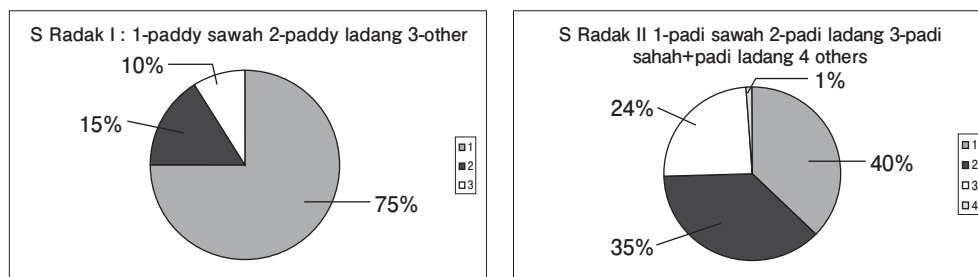


Figure 11. Comparison for land use under different crops in Radak I and Radak II

Source: Survey Data, 2007

It has been found that the villagers of Radak I and Radak II prefer to follow an unusually short fallow period for the dry rice cultivation, which is about 6 months on the average follows Boserup's model of annual cropping (see above). The shading cycle for Java's shifting cultivation is however, much shorter, about 1- 2 months citation. This short shading cycle is possible in Java because of the sheer fertility potential of its rich volcanic soil. However, much of Kalimantan, as per with the outer islands of Indonesia, have low fertility soil and needs a longer fallow period. This was known in traditional shifting cultivation techniques practiced by the Malay inhabitants, as they used to follow the 5 – 8 years fallow period (Seavoy, 1973). As noted earlier, the soil of the low lying peat swamp areas are infertile because they are highly acidic with average pH value exceeding 4.5 (Lindert, 2000). This implies that a longer shading cycle is needed to make a given parcel of land cultivable, and this fallow period should be at least more than 5 years.

The soil of the study area covering the village boundary of Radak I and Radak II falls under 'strongly acidic peat' which is not suitable for the cultivation of wetland rice. In fact according to the map prepared by the Soil Research Institute, Bogor

in 1973, only 40% of the land area of this type of soil is cultivable due to the high pH value as noted earlier. Only the narrow belt of wet alluvial soils along the principal drainage lines, i.e. Kapuas, Ambawang and Kapuas Kecile Rivers have fertile wet alluvial soils about 90% of which is cultivable. (Figure 12, Table 3) The same fact is revealed by the land suitability map for wetland rice prepared by Soil Research Institute, Bogor in 1973. In this map as illustrated in figure 13, reveals that the lowland swamp areas are unsuitable for wetland rice with 'severe limitation imposed by flooding'. This zone is referred as P – IV f. This group shows the peat land areas of the study area as well. The land group P – II refers the fertile wet alluvial soil noted above. This acidic peat soils are bound to have some negative influence on the fertility of the soil as far as agriculture is concerned.

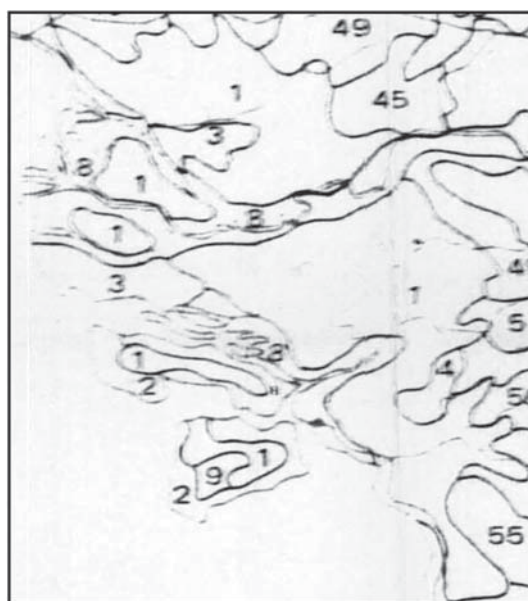


Figure 12. Section of the land development unit map for Java Bali and Kalimantan

Source: Soil Research Institute, Bogor; 1973

Table 3. Certain Distinguishing Characteristics and Cultivable Land

Development Unit No	Certain Distinguishing Characteristics of the Units	Cultivable Land (% of Unit)
1	Wet strongly acidic peat	40
2	Wet neutral peat	40
3	Wet acidic humic clays	50
4	Wet extremely acidic sandy alluvial soils	20
5	Complex of alluvium and wet acid peat	60
6	Wet acid alluvial soils	95
7	Wet alluvial neutral soils	95
8	Slightly acid wet alluvial soils	95
9	Extremely acid wet alluvial soils	30
10	Neutral alluvial soils, imperfectly drained	95
11	Strongly acidic sandy clays, imperfectly drained	95
12	Strongly acid sandy clays	95
13	Slightly acid clays	95
14	Strongly acid sandy loams	90
15	Cracking clays	90

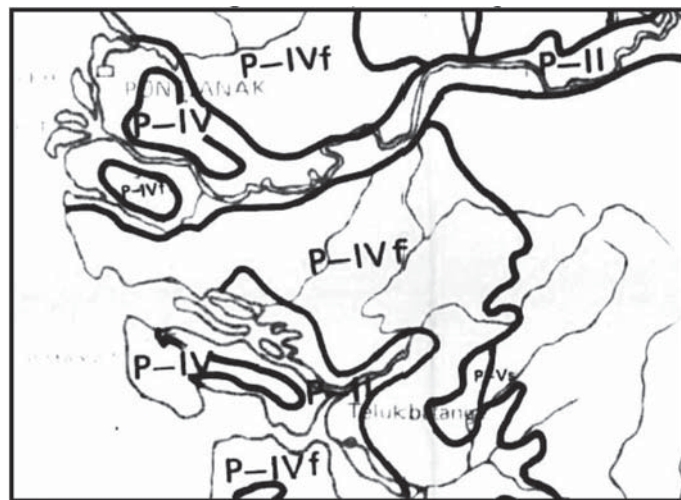


Figure 13. A section of the land suitability map for wetland rice for Java, Bali and Kalimantan

Source: Soil Research Institute, Bogor; 1973

Accordingly, the villagers perception study about the past land characteristics and land quality give a rough picture of deteriorating soil quality for agriculture, especially wetland rice. When asked about the quality and characteristics of past human and natural landscapes, concerning agricultural fields and forestlands respectively, about 20% of the households answered that they know about the existence of lands which were previously fertile whereas only 5% of the respondents answered that they knew land which were infertile before. Moreover, 30% of the respondents knew about the existence of forest land use before which were changed to agriculture while 25% of the respondents answered they knew about the existence of virgin forests. (Figure 14)

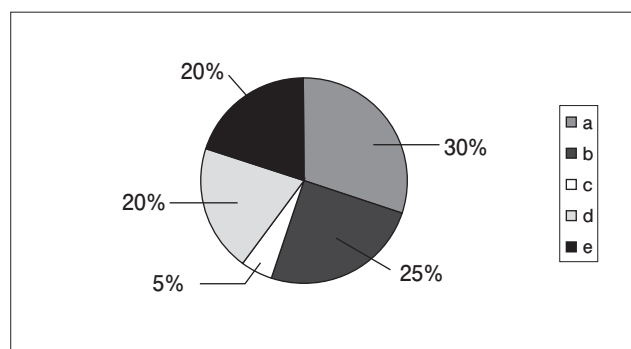


Figure 14. Information among the villagers for the characteristics and quality of village land in the past

Note: a – change of previous forest lands to agricultural lands, b – existence of virgin forests before, c – existence of infertile land before, d – agricultural land which used to be fertile, e – no comments

Source: Survey Data, 2007

This implies that the generally the people are unaware of any infertile land before. This is not a surprising fact as the peat soils can produce good yields initially (Abe, 2003; Furukawa, 2004). However, the fertility of the peat soils decrease with the passage of time. This means that there is an increase in the area of land growing infertile. The implication of villagers' perception about the above inquiry to reality is quite considerable after taking into account about 20 years of residency and agricultural activities in the field, besides it is also revealed that a considerable portion of the forest land has been cut and opened to perform agricultural activities in the past. This is not surprising after considering the findings of the previous chapter. However, it is interesting to note the present trend of forest conversion among the villagers.

When asked about whether they cut trees to open the forests for agricultural purposes, 50% of the households replied that they do, whereas 45% said they do not cut the forests for agricultural purposes, while 5% of the respondents did not make any comments. (Figure 15)

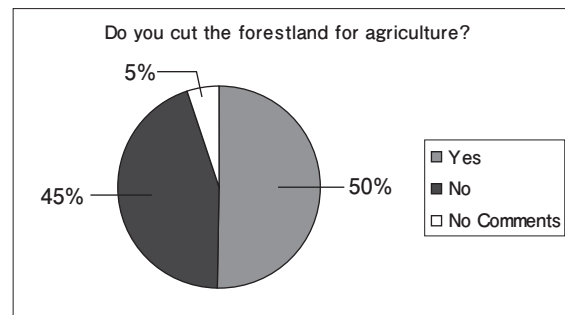


Figure 15. Villagers Response for their Ability to cut Forestlands for Agriculture

Source: Survey Data, 2007

The existence of swamp forests or hutan rawa for production and conversion purposes (Departemen Kehutanan dan Perkebunan, 1998; Badan Planalogi Kehutanan dan Perkebunan, Departemen kehutanan dan Perkebunan, 1999) allows the villagers to open the forests freely, whereas the main economic need they take from the forests are fuel-wood at present as very few of the respondents answered that they sell the wood in the market. The answers to the inquiry that whether they can cut the forests for expanding agricultural practices reveals a mixed response, as noted above. However, cutting of the trees from the remaining small forest cover in Radak II mainly (as Radak I has already lost its original forest cover) is very much practiced, which mainly is used for the fuelwood as far as the response of the villagers are concerned. However, it is worthwhile to mention here that fuelwood gathering does not need the whole tree to be felled. A majority of its portion can be gathered from the base of the parent tree. For additional needs, usually, branches are cut and dried later for better results. The major two possibilities of the fate of the felled trees are that either the villagers sell the timber to the market, or they really need a huge amount of fuelwood for their daily purpose given the large population density of the villages.

V. Discussion and conclusion

Stages of land use changes in Radak I and Radak II

To concentrate the study of village level land use change, two topographic maps on 1960 prepared by Army Map Service, U.S. Corps of Engineers, Washington D.C. and 1972 topographic maps prepared by National Coordinating Agency for Survey and Mapping. Three LANDSAT images were consulted, namely, the LANDSAT Multi Spectral Scanner (MSS), False Color Composite (FCC) image of path 121, row 60, taken on 1972, LANDSAT Thematic Mapper (TM), FCC image of path 121, row 60, taken on June 29, 1989 and LANDSAT Enhanced Thematic Mapper Plus (ETM+) image of path 121, row 60, taken on June 22, 2001 respectively.

As is evident from the interpretation of the 1:250,000 topographic maps by Army Map Service, U.S. Corps of Engineers, the swamplands of the lower Kapuas river basin, at least until 1960 was covered by continuous stretches of lowland swamp forests with no plantations. The plantation crops, mainly consisting oil palms, were much concentrated in the coastal plains of river mouths. Some plantations were extended at both sides of the tributaries of the main rivers. (Figure 16)

The areal extension of the plantations were accompanied, in addition to the river systems, by road systems, necessary to carry the harvest to the outside markets, in exchange with which the food crops were purchased. These plantations

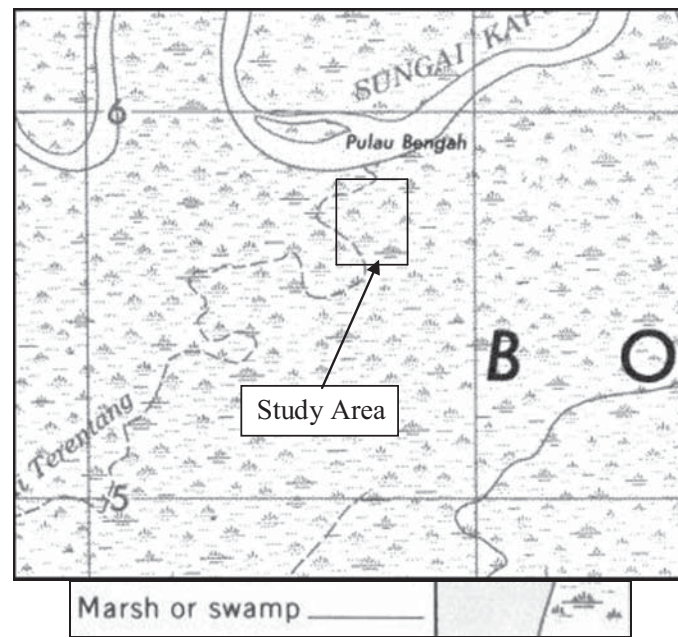


Figure 16. Section of the topographic map prepared by U.S. Army in 1956

actually helped to open up the impenetrable swamp forests of lowland Indonesian Borneo. This was the picture of the land use in the area where districts of Sungai Raya, Kuala Mandor and the Pontianak city now situate. The whole district of Terentang on the other hand, was covered by lowland peat swamp forests as mentioned before with no significant populated places as in 1960.

The LANDSAT 1972 false color composite image shows vast and largely unspoilt tracts of lowland tropical forests, a picture that is pretty much similar to the 1972 topographic map. (Figure 17)

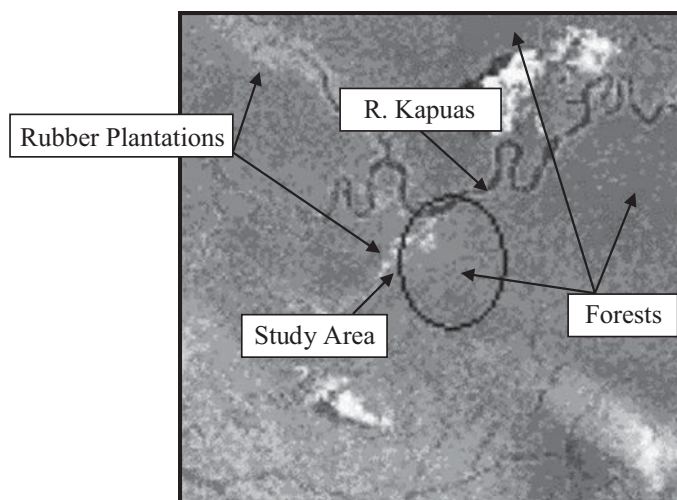


Figure 17. A section of the LANDSAT MSS image taken in 1972

The coconut, oil palm and rubber plantation fields can be seen along the coastline as well as along both sides of the principal drainage lines easily identified by their light red color in contrast to the darker red tone of red for the swamp forests. The retreat of the lowland tropical swamp forests can be seen along both sides of the drainage lines. This retreat has been of greater extent along the Kapuas Kecile River as well as Sungai (river) Ambawang. The Kapuas River on the south of these former two drainages is seen relatively unaffected by the development of plantation fields. Along both sides

of the Kapuas River narrow belts of rubber plantations with isolated villages can be identified. Another notable feature understandable with the lighter tone of red is the lesser moisture content of the soil. As peat is drained with tidal irrigation as mentioned before (Abe, 2003; Furukawa, 2004), the soil becomes drier. This creates a better condition for the cultivation of plantation crops.

During this time, i.e. 1972, the villages of Radak I and Radak II did not exist because the transmigration project was not yet undertaken. As noted earlier, the district of Terentang had only 6 villages. The area of these six villages as well as where Radak I and Radak II now are, was covered with forestlands except a narrow belt characterized by rubber plantations with scattered housing clusters and small villages to the both sides of Terentang River.. This image taken by the LANDSAT in 1972, along with the topographic map of the same year suggests that the district of Terentang was relatively unaffected by the large scale oil palm, coconut and rubber plantation developments which mainly took place to the north side of the district and the study area. However, it should be noted that this was the time when the lowland forests along the Terentang River were being opened up for plantation agricultures. (Figure 18)



Figure 18. A section of the topographic map as prepared by National Coordinating Agency for Survey and Mapping in 1970

There were significant land use changes to the Northwest of the study area as well, with mixed coconut and rubber plantations replacing the oil palm plantations as observed in the 1960 topographical map. Two significant changes are the extension of numerous canal networks to the both sides of Kapuas Kecil River extending into the swamp forests. These canals were accompanied with wet rice cultivation or sawah, coconut plantations mixed with rubber or rubber plantations alone. The lowland swamp forests remained only in patches surrounded by human made land uses along with mixed secondary forests known as belukar. The wet rice cultivation took place nearer to the commercial center i.e. Pontianak city. Gradually these wet rice fields merged into plantation agricultures.

The scenario of opening of the swamp forests by canal building and plantation agriculture increased in areal extent by the year 1989. By this time the villages of Radak I and Radak II came into being, with a total transmigrated population of 1895 and 1466 respectively. Two villages are characterized by building of a canal 11 km in length from the Kapuas main flow to the north side of the village and River Terentang to the west of the villages. The increase in the proportion of arable land can be seen in accordance with the existence of the canal system. This land use change has been drastic in contrast to the LANDSAT 1972 image where only a small portion of the study area was covered by rubber plantations. This land use associated with the canal system is the wet rice cultivation fields practiced by both the transmigrated population. The

state of the forestlands however, remains fragmented as revealed by LANDSAT ETM+ image taken on June 22, 2001. The lowland swamp forests have become fragmented to a considerable extent, especially in the lowland floodplains of the large river system i.e. Kapuas, Kapuas Kecile and Ambawang. The retreat of lowland swamp forests has been to the greatest extent to the both sides of River Ambawang also. This characteristic can be directly related with a greater number of distributaries of the Ambawang River which allowed additional natural drainage channels from which canals can be dug. Moreover, changes can be detected in the area covered by considerable extent of forestlands shown by the continuous dark brown patch in the lower part of the image. (Figure 19)

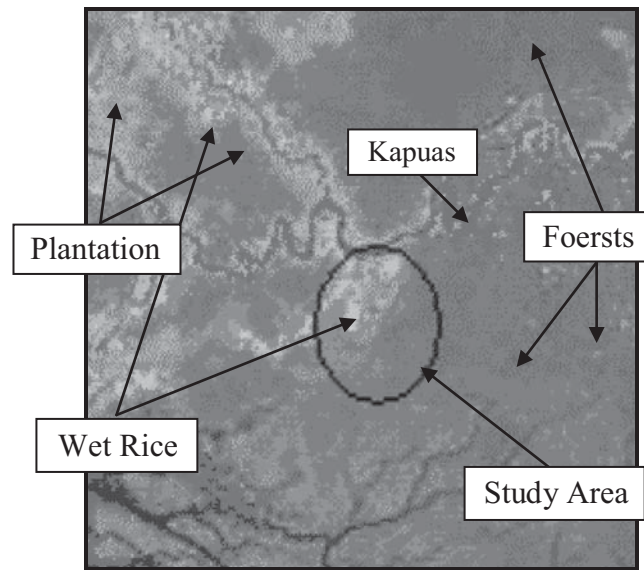


Figure 19. A section of the LANDSAT TM image taken in 1989

The comparatively intact forestlands, as seen in the 1972 LANDSAT image, can be seen as quite fragmented even inside the forestland area, given by lighter patches of brown. Thus, in contrast to the drastic land use changes to a greater extent of plantations and wet rice cultivation, which can be easily identified along both sides of the drainage channels, the changes in land use is explicit inside the forestland area with higher fragmentation of natural landscape or forestland, surrounded by human landscape or cultivation fields. (Figure 20)

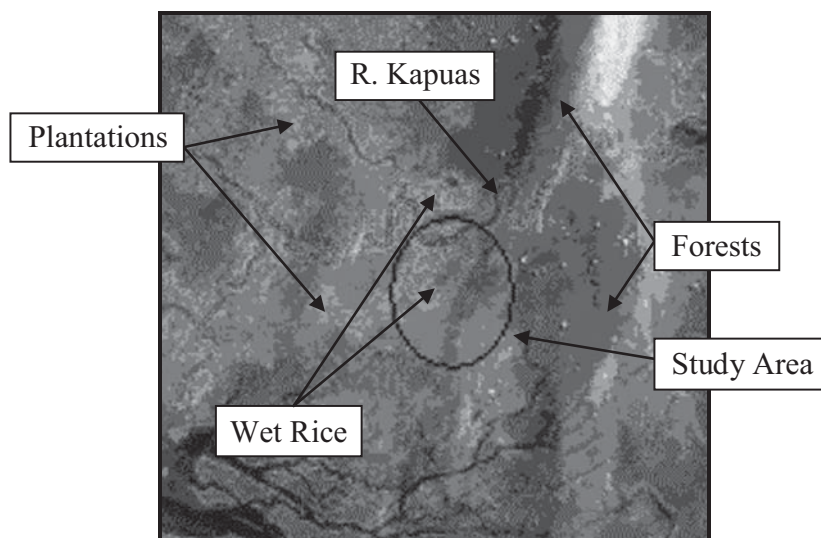


Figure 20. A section of the LANDSAT ETM+ image taken in 2001. Circle Indicates the Study Area

Based on the above discussion, it is evident that in the past 41 years, the bigger picture of land use change around the study area is given by the expansion of plantation agricultural systems that has been the characteristic of Indonesian Borneo since the colonial times. With the passage of time these plantation systems change into continuous cultivations of wet rice through irrigation systems which drain the excessive water from the peat soil. As far as the retreat of lowland swamp forests from the vicinity of the study area is concerned, has been caused by an array of different factors; the mother of all was a transmigration project which took place during the end of 3rd five year plan to the beginning of 4th five year plan.

The arable land use practices are the main reason for the retreat of lowland swamp forests in the study area. This arable land use is particularly concerned with wet rice cultivations with the help of tidal irrigation methods by using canals. The major push for the retreat as well as the fragmentation of the lowland swamp forests are detected in the 1989 period, just 4 years after the realization of the transmigration project which ended in 1983/84 period. The high density of population due to the transmigration project is a major characteristic of the study area, revealing the direct effect of population pressure on the natural landscape i.e. the lowland swamp forests. The other characteristics have been small land holdings, with family farming in an individual basis mainly for subsistence. No significant market forces involved in the study area as far as the food crops are concerned. The retreat of the lowland swamp forests has been greatly affected by these subsistence farmers since they were resettled about 20 years ago under the 3rd and 4th five year planning period by the Indonesian government. Therefore, the transmigration project carried out about 20 years ago was the major stimulus for the retreat of natural landscapes from the vicinity of the study area.

Moreover, the project resettled the certain number of families in a land with unsuitable soil quality as far as wet rice cultivation is concerned. As the soil of the study area comprises acidic peat, theoretically only 40% of the land is cultivable. This infertility of soil is already starting to show up. As there are more agricultural lands which was fertile before but have grown infertile at present. On the other hand farmers can hardly remember any infertile agricultural land in the past. Here it is worthwhile to mention that a farmer's sense of fertility is concerned with the crop output. Initially cultivations in the peat soils with suitable irrigation may lead to good harvests however; this decreases with the passage of time.

The farmers in the study area practice a short fallow period of about 6 months with continuously opening up new tracts of arable land through forest cutting. The short fallow period matches with Boserup's (1965) model of farming systems of annual cropping under a high population density. However, this short fallow period considerably shorter than as was followed by the traditional Malay inhabitants who used to follow 5 to 8 years fallow period depending on the soil characteristics.

Annexure Questionnaire

1. Your Name
2. What is your current monthly income?
3. How many members are there in your family?
4. How many livestock are there in your farmland?
5. What was your previous residency?
6. What is your current profession
7. Are you satisfied with your current profession?
8. If not, what kind of profession you want to have?
9. Why did you choose your current profession?
10. What kind of agriculture you practice now?
 - (a) Wet rice (Padi sawah)
 - (b) Dry rice (Padi Ladang)
 - (c) Both
 - (d) Any other type of rice
 - (e) Any other type of crops
11. For padi ladang how much is the average shading cycle that you follow?
 - (a) < 2 months
 - (b) 2 – 4 months
 - (c) 4 – 6 months
 - (d) 6 – 8 months
 - (e) 8 – 12 months
 - (f) > 12 months
12. What do you think about the fallow period that you follow?
 - (a) Just right
 - (b) Short
 - (c) Long
13. Have you experienced any decrease in the yield of your harvest?
 - (a) Yes
 - (b) No
14. If answered (a) to the above question, then mention the type of crop whose yield has decreased.
 - (a) Wet rice
 - (b) Dry rice
 - (c) Multiple
 - (d) Other type of rice
 - (e) Others
15. Are there any crop surplus?
 - (a) Yes
 - (b) No
16. If answered (a) to the above question, then how much is the crop surplus?
 - (a) < 50 kg
 - (b) 50 – 100 kg
 - (c) 50 – 100 kg
 - (d) 150 – 200 kg
 - (e) 200 – 250 kg
 - (f) 250 – 300 kg
 - (g) > 200 kg
17. What do you do with the crop surplus?
 - (a) Consume
 - (b) Sell
 - (c) Both sell and consume
18. Do you use any fertilizer in your field?
 - (a) Yes
 - (b) No
19. If answered (a) to the above question, then have you experienced any change in the use of fertilizer?
 - (a) Yes
 - (b) No
20. If answered (a) to the above question, then how much for the following crops?
 - (a) Wet rice
 - (b) Dry rice
 - (c) Both
 - (d) Other type of rice
 - (e) Other crops (specify)
21. Are you satisfied with your current production?
 - (a) Yes
 - (b) No

22. If answered (b) to the above question, then what would you like to cultivate in the future?
23. Is there any specific reason for your choice?
- (a) Yes (b) No
24. If answered (a) to the above question, then please explain the reason.
25. Have you experienced any soil erosion in your agricultural field or in the vicinity?
- (a) Yes (b) No
26. If answered (a) to the above question, then which place the soil erosion is more in amplitude?
27. Please choose the type of forest as you know in your village
- (a) Protection forests (b) Production forests (c) Limited production forests
(d) Conversion forests
28. Are you allowed to cut and burn forests for agriculture and other purposes?
- (a) Yes (b) No
29. If answered (a) to the above question, then have you ever cut the forest by yourself?
- (a) Yes (b) No
30. If answered (a) to the above question, then do you need any licenses to cut the forests?
- (a) Yes (b) No
31. Do you extract woods from the forests?
- (a) Yes (b) No
32. If answered (a) to the above question, then what do you do with the wood that you extract from the forest?
- (a) Sell (b) Use for the household needs (c) Both
33. How much agricultural land do you have?
- (a) < 1 ha (b) 1 – 2 ha (c) 2 – 3 ha
(d) 3 – 4 ha (e) > 4 ha
34. Do you have any information of the following in the past?
- (a) Existence of virgin forests (b) Forestlands being changed to agricultural fields
(c) Existence of infertile land (d) Infertile farmland which used to be fertile before

Note

This paper is depend on the study by the Monbukagakusho Kaken Research Fund(Oveseas Survey)"Environmental Impact Assessment for the Development of Kapuas river basin, West Kalimantan, Indonesia"(Represetative Researcher Prof.YAMASHITA Takao(Hiroshima University))

Acknowledgements

I thank the people of Radak I and Radak II villages, the government officials in the BPS statistics office for their openness in data provision and responses to the interviews, to Chito, for his assistance in translating and help during my fieldwork. Thanks to Prof, Dr. YAMASHITA Takao of Hiroshima University for guidance and help and for allocating research funds. I also thank the Ritsumeikan Center for Asia Pacific Studies for making funding for the fieldwork possible.

Reference

Abe, K. (2003). Peat Swamp Forest Development in Indonesia and the Political Ecology of Tropical Forests in Southeast Asia. In T. P. Lye, W. De Jong & K. Abe (Eds.), *The Political Ecology of Tropical Forests in Southeast Asia* pp.133–151. Kyoto: Kyoto University Press, Victoria: Trans Pacific Press.

- Army Map Service, Corps of Engineers, U.S. Army. (1960). *Pontianak, East Indies, 1:250,000* (Publication No. SA 49 – 2. Series, T503). Washington, D.C.
- Badan Koordinasi Survey dan Pemetaan Nasional. (1972). *Terentang, Kalimantan Barat, 1:50,000* (Jantop T.N.I. AD. TH. 1972. Halai, 11/VII – g).
- Badan Koordinasi Survey dan Pemetaan Nasional. (1972). *Pontianak, Kalimantan Barat, 1:50,000* (Jantop T.N.I. AD. TH. 1972. Halai, 10/VII – f).
- Badan Planologi Kehutanan dan Perkebunan, Departemen kehutanan dan Perkebunan. (1999). *Peta Penutupan Lahan, Propinsi Kalimantan Barat*.
- Badan Pusat Statistik Kabupaten Pontianak. (2001). *Kabupaten Pontianak Dalam Angka 2001* (Katalog BPS: 1403.61.04). Mempawah.
- Badan Pusat Statistik Kabupaten Pontianak. (2001). *Kecamatan Terentang Dalam Angka 2001* (Katalog BPS: 1403.61.04.020). Mempawah.
- Badan Planologi Kehutanan. (2002). *Peta Penutupan Lahan, Propinsi Kalimantan Barat*.
- Boserup, E. (1965). *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. London: Earthscan.
- Brookfield, H., Potter, L. & Byron, Y. (1995). *In Place of the Forest: Environmental and Socio-economic Transformations in Borneo and Eastern Malay Peninsula*. Tokyo: United Nations University Press.
- Cramb, R. A. (2005). Farmers' Strategies for Managing Acid Upland Soils in Southeast Asia: An Evolutionary Perspective. *Agriculture, Ecosystem and Environment*, vol. 106. (2005), pp 69-87.
- Departemen Kehutanan dan Perkebunan. (1998). *Peta Tata Guna Hutan Kesepakatan, Propinsi Kalimantan Barat*.
- Departemen Kehutanan dan Perkebunan. (1998). *Peta Penutupan Lahan dan Penggunaan Lahan, Propinsi Kalimantan Barat*.
- Dewi, S., Belcher, B., Puntodewo, A. (2005). Village Economic Opportunity, Forest Dependence and Rural Livelihoods in East Kalimantan, Indonesia. *World Development*, vol. 33, no. 9. pp. 1429-1434.
- Donner, W. (1987). *Land Use & Environment in Indonesia*. London: C. Hurst & Co. Ltd.
- Furukawa, H. (2004). The Ecological Destruction of Coastal Peat Wetlands of Insular Southeast Asia. In H. Furukawa, M. Nishibuchi, Y. Kono & Y. Kaida (Eds.), *Ecological destruction, Health and Development* pp. 31–72. Kyoto: Kyoto University Press, Victoria: Trans Pacific Press.
- Jakobsen, J. et al. (2006). The Effects of Land Tenure Policy on Rural Livelihoods and Food Sufficiency in Upland Village of Que, North Central Vietnam. *Agricultural Systems* (2006). Retrieved March 20th 2007 from www.sciencedirect.com
- Kartawinata, K., Soedjito, H. et. al. (1984). The Impact of Development on Interactions Between People and Forests in East Kalimantan: A Comparison of Two Areas of Kenyah Dayak Settlement. *The Environmentalist*, vol. 4, no. 7, pp 87 – 95.
- LANDSAT Multi Spectral Scanner. (1972). *Ortho, GeoCover, Indonesia* (WRS – 2, Path 121/Row 060). Retrieved February 11th 2007 from www.gicf.umiacs umd.edu
- LANDSAT Thematic Mapper. (1989). *Ortho, GeoCover, Indonesia* (WRS – 2, Path 121/Row 060). Retrieved February 11th 2007 from www.gicf.umiacs umd.edu
- LANDSAT Enhanced Thematic Mapper Plus. (2001). *Ortho, GeoCover, Indonesia* (WRS – 2, Path 121/Row 060). Retrieved February 11th 2007 from www.gicf.umiacs umd.edu
- Lindert, P. H. (2000). *Shifting Ground: The Changing Agricultural Soils of China and Indonesia*. Cambridge, London: The MIT Press.
- Myllyntaus, T., Hares, M. & Kunas, J. (2002). Sustainability in Danger? Slash-and- Burn Cultivation in Nineteenth-Century Finland and Twentieth-Century Southeast Asia. *Environmental History*, vol. 7, no. 2. (April 2002), p 267.
- Primack, R. & Corlett, R. (2005). *Tropical Rainforests: An Ecological and Biogeographical Comparison*. Blackwell Publishing.
- Pingali, P. L., Binswanger, H. P. (1987). Population Density and Agricultural Intensification: A Case Study of the Evolution of Technologies in Tropical Agriculture. In D. G. Johnson, R. D. Lee (Eds.), *Population Growth and Economic Development: Issues and Evidence* pp. 27-56. Madison: University of Wisconsin Press.
- Republic of Indonesia, Ministry of Agriculture, Directorate General of Agriculture, Soil Research Institute. (1973). *Land Development Unites for Java, Bali and Kalimantan* (Plate A, 2). Bogor.
- Seavoy, R. (1973). The Transition of Continuous Rice Cultivation in Kalimantan. *Annals of Association of American geographers*, vol. 63, no. 2. (June 1973), pp 218 – 225.
- Seavoy, R. E. (1973). The Shading Cycle in Shifting Cultivation. *Annals of the Association of American Geographers*, vol. 63, no. 4.

(December, 1973), pp. 522-528.

Suprpto, A. (2001). Proceedings of the Regional Consultation, Bangkok, Thailand, 3 – 5 October 2001. *Investment in Land and Water*. Bangkok, Thailand: RAP Publication.

Tirtosudarmo, R. (2004). A National Project that Failed: A Tale of Population Resettlement Policy in Indonesia. In H. Furukawa, M. Nishibuchi, Y. Kono & Y. Kaida (Eds.), *Ecological destruction, Health and Development* pp. 31–72. Kyoto: Kyoto University Press, Victoria: Trans Pacific Press.

Tomich, T. P., Thomas. D. E. & Noordwijk. M. (2004). Environmental Services and Land Use Changes in Southeast Asia: From Recognition to Regulation or Reward? *Agriculture, Ecosystem and Environment*, vol. 104. (2004), pp 229-244.

Whitmore, T.C. (1984). *Tropical Rainforests of the Far East*, 2nd ed. Oxford: Oxford University Press.

World Bank (1988). *Indonesia: The Transmigration Program in Perspective*. Washington D.C. The World Bank.