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Abstract

Studies of shifting cultivation in relation to forest-pioneer continuum and to loss of forest cover in developing countries are not well documented. This paper analyzes the system of shifting cultivation practices in communal forest area in Jambi Province of Sumatra, Indonesia. It emphasizes on the economic adjustment process of how shifting cultivators might adopt bush-fallow rotation system as a means to naturally improve agricultural productivity or apply more permanent and intensive land-use systems as a response to increasing real wages and growing market economy in rural area. The standard method of land-rent-capture is used to explain the economic rationale behind shifting cultivation practices.

The results suggest that shifting cultivation actually differs from a simple forest clearing which normally involves slash-and-burn, logging and other related timber-production activities. Shifting cultivation could be considered as an early stage in the evolution of agricultural systems. Provision of modern agricultural inputs such as seeds, fertilizer, and pesticides; quality rural infrastructure, and non-farm employment generation in rural areas are necessary condition for economically sound policy strategies in the future. In addition, agroforestry systems involving high-yielding variety of rubber and upland rice and management of forest lands by local communities also can be more effective means of sustainable forest-resource management.

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1. Introduction

Shifting cultivation is often associated with forest clearing, leading to a decline of forest area or deforestation. Negative consequences of deforestation are widely known. Deforestation is one of the major factors of land degradation, loss of biological diversity and endangered species, thereby contributing to global warming. In the literature, shifting cultivation has played a central role in the debate of deforestation. Most studies blame shifting cultivation practices as the main cause of deforestation, but overlook policy-induced incentives that might drive that behavior (Gillis, 1988, Dick, 1991). Even the World Commission on Environment and Development (WCED, 1987) suggests that deforestation and other environmental destruction especially in developing countries is positively correlated with poverty and the presence of shifting cultivators. According to the report, those who are poor and hungry will often destroy their immediate environment in order to survive, they will cut down forests, they overuse marginal land, etc.

This is clearly a case of "blaming the victim" since the smallholder seems to be the only immediate responsible party for environmental degradation. This argument is trapped in a simple-deterministic paradigm such as Neo-Malthusian or Neo-Marxian paradigm. The Neo-Malthusian paradigm suggests that population growth causes poverty inducing environmental degradation, while Neo-Marxian paradigm postulates that poverty causes population growth resulting in environmental destruction. If blame must be appointed, it is equally, if not more, appropriate to charge the rural land tenure system that allows rich landlords to monopolize the best resources in the region and often to use them wastefully (see Arifin, 1993).

This misunderstanding could be associated with little empirical work about the economic mechanism of shifting cultivation system. Most of the studies that have been published on this issue are case studies of particular communities or regions that provide valuable insights, but do not provide a basis for comparative analysis and economic policy formulation towards the sustainability of forest resource management. The present article is an attempt to address this gap in empirical knowledge by examining thoroughly the case of shifting cultivation in forest area in Rantau Pandan, Bungo Tebo of Jambi Province, Sumatra-Indonesia.

The ultimate objectives of this paper are, therefore, to analyze the system of shifting cultivation practices in forest area and to examine the economic adjustment process of how shifting cultivators might adopt bush-fallow rotation system as a means to naturally improve agricultural productivity or apply more permanent and intensive land-use systems as a response to increasing real wages and growing market economy in rural area.

The remaining sections of the paper will be organized as follows: Section 2 examines the theoretical arguments on the relationship between shifting cultivation and deforestation. Section 3 develops a conceptual framework for undertaking the study of shifting cultivation system, followed by the description of study sites, field works and data collection of the present study in Section 4. Section 5 analyzes the general features of the study sites, focusing on the land-use systems found in the study area of Rantau Pandan in Jambi Province, at Sumatra. Section 6 presents the results of micro-level analysis of shifting cultivation, and finally Section 7 exhibits the discussion and implications of the study results.

2. Shifting Cultivation and Deforestation

Classical literature on forest ecology suggests that human intervention threatens the balance of nature of forest ecology. For example, Mikesell (1960) suggests that the major causes of deforestation have been and continue to be: domestic and industrial consumption of wood, burning to clear land for cultivation, and destruction of palatable plants by livestock. Sauer (1967) suggests tropical rain forests are not resistant to penetration and modification by agricultural practices which are usually preceded by the use of fire. Even in modern literature, major causes of deforestation are believed to include population pressure inducing forest conversion into agricultural land and the demand for fuelwood, development project, logging and forest concession and fire loss (World Bank, 1990;World Resources Institute, 1991).

The generalization about population pressures and poverty being the root cause of deforestation would distract the attention from other issues about which it is often much more possible to do something in a relatively short time. Bromley (1990) argues that simply blaming population growth would allows inept or corrupt governments to shift the blame for either their behavior or their inaction, as the case may be - to "promiscuous" peasants. It further allows governments to appear helpless in the face of forces beyond their control. And, it allows them to attract international assistance for projects to correct certain resource insults, the better to appear more beneficent to their citizenry.

For the case of deforestation in Indonesia, there are essentially two extremes in the on-going debate over the causes of deforestation. On the one hand, deforestation is argued to have been driven by the growing number of shifting cultivation, smallholder production activities (FAO, 1990; World Bank, 1990; Barbier, et al., 1993; and Fraser, 1996) such as in the classical ecology arguments. On the other hand, deforestation has been driven by the government policies and its development, and particularly misdirected policies in the timber sector industry, while also acknowledging the important contribution of shifting cultivation in the forest-cover removal (Dick, 1991; WALHI, 1992; Angelsen, 1995; and Arifin, 1996).

The extent of deforestation in developing countries is actually far beyond the presence of shifting cultivators. A more holistic and interdisciplinary approach suggests that deforestation or environmental degradation in general is not a simple technical issue, but a more complex problems involving institutional and political structures within the overall economic system. Several policies, both in the forestry and non-forestry sectors, significantly contribute to forest destruction. These policies include: the ban on log exports; fees and taxation in the forestry sector; the forest concession policy; and timber-plantation industry policy, and transmigration or agricultural colonization (see Arifin, 1995)

Whether or not the presence of shifting cultivators really cause deforestation still depends on the type of forest. The Indonesian government has designated the 120 million hectares of government forest land into conservation forest, natural parks and nature reserves (13%), watershed protection forest (21%), limited and regular production forest (35%), and conversion forest (21%) (see Arifin, 1993). In addition, there is a considerable zone of overlap (and conflict) between these "government forest lands" and "village land" which is owned by villagers. It may be that shifting cultivators or smallholders in general account for much of the conversion at the margins of conservation and protection forests, where large-scale actors (at least formally) are not supposed to operate. Conversion may also occurs because of interaction between policy-induced activities or logging companies that

build roads and the smallholders occupying this land as spontaneous migrants; or shifting cultivation practices really take place at the conversion forests.

However, one should note that "conversion forest" is government forest that has been officially designated for conversion to other uses, usually involving agricultural production, such as transmigration projects and large-scale plantation agriculture. To large extent, the "conversion forest" policy problem rests with a greater problem of market failure: lack of mechanisms to compensate resource users (including national governments, companies, and smallholders) for supplying the (global) externalities. The present study is of course, not trying to address this global problem, rather is an attempt to digest the complexity of shifting cultivation systems in relation to the loss of forest cover, including the conversion forest.

Shifting cultivation actually differs from a simple forest clearing which normally involves slash-and-burn, logging and other related timber-production activities. Shifting cultivation could be considered as an early stage in the evolution of agricultural systems. Initially, the system is based on cutting and burning vegetation in the dry season. Declining soil productivity and increasing weed problems lead farmers to abandon fields after few years. Other types of vegetation take over, and the field eventually grows into secondary forest or bush-fallow, before the cycle is repeated. The length of bush-fallow varies considerably, generally 5 - 20 years but sometimes not even five years, and inversely correlates with population pressure and the level of technology (Boserup, 1989). Shifting cultivation has low productivity in terms of output per hectare, compared to most other "modern" agricultural systems, but relatively high return to labor (Angelsen, 1995).

Studies of shifting cultivation in relation to forest-pioneer continuum and to loss of forest cover in Indonesia are not well documented. Weinstock and Sunito (1989) even suggest a distinction between shifting cultivators and forest pioneers. Shifting cultivators are defined as people who practice a from of rotational agriculture with a fallow period, longer than the period of cultivation. Unless faced with population pressure or other constraints, land is used only one to three years and fallowed for a relatively long period. Forest pioneers are defined as people who may utilize slash-and-burn of the existing vegetation but with the primary intention of establishing permanent or semi-permanent agricultural production. They choose primarily cash crops (mostly perennial), although they grow food crops for subsistence purposes.

The growing debate on a continuum of farming systems in Indonesia in terms of policy implication results in two extremes as well. One extreme refers to traditional shifting cultivation's which involve very long fallows and long-term conservation of forest land, as has been practiced by traditional people of Semendoe, Ogan and Melayu in Sumatra, Dayak in Kalimantan, etc. The other extreme refers to forest pioneer cultivation which involve long-term degradation and deforestation. This extreme often associated with spontaneous transmigration which may also correlates with a government policies to boost regional development in some remote areas. The government position condemns forest pioneer cultivation as environmentally destructive, even it does not differentiate it from traditional shifting cultivation. While the non-governmental organization (NGO) activists insist that if the government is serious about forest conservation, then it must support those traditional farming systems that are consistent with the aim of long-term forest conservation (see Sunderlin and Resosudarmo, 1996).

Empirical estimates show a significant variation in the share of shifting cultivation in deforestation in Indonesia, primarily because of the definition differences of shifting cultivation and the specific (political) purposes of a particular study regarding shifting cultivation practices. The World Bank (1990) estimates that the shifting cultivation for three provinces in 1990 was 14 million hectare in

Sumatra, 11 million hectare in Kalimantan and 2 million hectare in Irian Jaya. The total area of 27 million hectare expands at the annual rate of 2 percent, implying deforestation of roughly 500 thousand hectare per year, by far the largest cause of deforestation.

Dick (1991) criticizes the World Bank estimates and suggests that traditional shifting cultivators account for 21 percent of total deforestation, rather than the largest share. The main reason is that many forests being cleared are part of long-standing rotation on clan-lands (*tanah marga*), and the traditional cultivators lack the tools necessary to convert all but the most open primary forest. The World Bank (1994) then acknowledges that shifting cultivation may be less damaging than previously thought. A thorough observation on shifting cultivation in Kecamatan Siberida of Riau Province, Sumatra by Angelsen (1995) suggests that simply increasing population is not necessarily the main cause of deforestation. Changing proportion of households practicing swidden accounts for 7 percent of the total forest clearing; the total population of households account for 23 percent of the total; and the average size of swiddens accounts for 7 percent of the total forest clearing.

For Indonesia as a whole, the area of shifting cultivation increases at a rate of 2.9 percent per year in the last decade. The increase occurred primarily because of a vast increase in the area of rice and secondary food crops (*palawija*) in the upland land. Sumatra and Kalimantan experienced a rapid increase, 9.1 and 4.4 percent per year and upland rice and secondary food crops are extensively grown in these islands. A similar increase is also found in Sulawesi, Bali-Nusa Tenggara and Java which experienced a change in upland cultivation of 1.1, 0.8 and 0.1 percent per year respectively (CBS, various issues). However, these data should be interpreted with cautions. The term shifting cultivation used by the Central Bureau of Statistics (CBS) for the Statistical Yearbook of Indonesia refers to either simply upland cultivation (*ladang*) which might be as a permanent basis or actual shifting cultivation (*huma*). It is very unfortunate that the CBS data available do not provide enough information to distinguish between these categories. Consequently, the term "shifting cultivation" by itself cannot be used specifically to examine the environmental consequences of agricultural operations that shift the land base or use forest fallow to restore fertility. One can assume that in Java, Bali and part of Sumatra, the term "shifting cultivation" will refer to *ladang* but outside these areas it refers to *huma* or the actual shifting cultivation (see Arifin, 1995).

3. Conceptual Framework for Studying Shifting Cultivation

The approach of land-rent-capture developed by Angelsen (1995, p: 1716-1717) is relevant to explain the mechanism of shifting cultivation and deforestation under an open economy argument. Land rent is defined as the surplus or profit to the owner of the land, that is the gross value of production minus all costs of production, except for land. In this case, the costs related to the *location* of the land (von Thunen hypothesis) such as transport of output, walking distance back and forth, as the main factors, rather than the costs associated with the *quality* of the land (Ricardo hypothesis) which are difficult to quantify. The land rent increase with land accessibility, primarily because the location or distance costs are directly correlated with the distance form the village center. The land rent can be formally defined as follows:

$$r = pX - wL - qD$$

where r is land rent per hectare; p price per unit of output; X output per hectare (reflecting the technological level, soil fertility, etc.); w opportunity cost per unit of labor (wage in alternative

employment); L labor input per hectare; q costs per hectare and per kilometer distance or location of field; and D distance in kilometer from the village center to the field.

Therefore, the land rent declines as distance increases, and eventually reaches zero. The distance at which land rent is zero declines the agricultural frontier or margin of cultivation. Given that people are free to move and open new land, the basic premise is that all forest land with a positive land rent will be cleared and transformed to agricultural production. The policy implication of this approach can be formulated as follows: Any changes in the variables which increase the profitability of frontier agriculture will augment deforestation. This includes higher output price (p); technological progress (X up and/or L down); lower opportunity cost of labor (w), including self employment, wage labor and income of farming; and lower transport cost (q), also influenced by the availability of roads and other infrastructures.

Further implication of the land-rent-capture into the property rights issues could be incorporated. As clearing gives property rights, farmers not only look at the immediate benefits, but also at the future surplus from production. In economic terms, this future surplus is formulated in the net present value (NPV). The expected NPV, at a particular time k, of an infinite stream of expected rents r_t^e , discounted at a rate i, can be written as follows:

$$NPV_k^e = S^{\infty}_{t=k} (1+i)^{-t} r_t^e$$

As a result, competition among farmers for new land will ensure that all forest with a positive NPV is cleared. Forest is cleared even if it has a negative rent the first years. This loss will be outweighed through a positive land rent some time in the future. Early clearing is necessary to establish property rights; otherwise the land would be taken by others.

Even though the land-rent capture approach is useful in explaining the economic mechanism of shifting cultivation system of particular communities or regions, the concept does not provide a basis for comparative analysis of the profitability of the system compared to other land uses. The comparative analysis becomes so important that the policy formulation could be directed towards searching the alternatives to a more sustainable land-use and forest management. Given that previous studies on shifting cultivation were generally based on the absence of trade and international markets and other types of close economy argument, the present study is relaxing the close-economy assumption and viewing the changes in land-use system as the economy is more opened to international markets and even to government-policies. The policy formulation on land-use alternatives would be more comprehensive once the policy options are more thoroughly examined and the sensitivity of scenarios are carefully analyzed.

4. Study Sites, Field Works and Data

The works presented here emerge out of my recent involvement with a broader research project of Alternatives to Slash-and-Burn (ASB) Indonesia Consortium, which was organized by the International Centre for Research in Agroforestry (ICRAF) Indonesia office. Study sites were focused on the regions where the majority of farmers are practicing shifting cultivation system in and around the piedmont area of conservation forest of Kerinci Seblat National Park which is administered by the Subdistrict (Kecamatan) Rantau Pandan, District (Kabupaten) of Bungo Tebo, in the Province of Jambi, Sumatra-Indonesia.

The subdistrict Rantau Pandan is located at the northeastern valley of the very famous Bukit Barisan Mountain in Sumatra. The distance from city center of Muara Bungo, the Capital of Bungo Tebo, is about 31 km, and from Jambi City is about 267 km by a very good quality state road. The study location was selected for a number of reasons. It provides a good example of shifting cultivation in different length of fallow system, of changing forest area to dryland agriculture with rapidly increasing population, and adaptation of more permanent agriculture along with fast improvements in the living standards of the people in the last decades or so. In addition, the district of Bungo Tebo is a primary study region of the project of Alternatives-to Slash-and-Burn (ASB) where ICRAF Indonesia takes a major lead.

The field survey has been undertaken in July of 1997 and focused on collecting information on shifting cultivation activities in the presumably forest area for the 1996-1997 crop season. These data include cropping patterns and activities in crop production, i.e. the use of land, labor, capital and the yield, amount of works and labor calendar spent on on-farm and off-farm, type of off-farm activities, and other physical and socio-economic information.

In addition, the historical aspects of shifting cultivation system were investigated carefully, such as where and how long the farmers cultivate the previous farms before the current site, the length and types of bush fallow, factors affecting the farmers' choice in the previous cropping patterns and the next choice to cultivate, etc..

Secondary and supporting data were collected from a wide range of secondary sources such as Central Bureau and Regional Offices of Statistics, Department of Agriculture, of Forestry, of Public Works, the World Bank, International Centre for Research in Agroforestry (ICRAF), Center for International Forestry Research (CIFOR) related agencies and organizations, and from previous studies of shifting cultivation and deforestation. Time series data on population, labor-force wage level in the region were collected from the Central Bureau of Statistics; yield and cultivated area of particular crops and other resource-based data were obtained from the Department of Agriculture, of Forestry, Environmental Impact Assessment Agency, etc.

The data collected and other related information were analyzed thoroughly using both quantitative and qualitative frameworks. The standard method of land rent calculation for shifting cultivation system will be employed to obtain the economic returns on output after taking into account all costs and related expenses, and in light of the travel cost from the field to village center. Qualitative information such as property rights regimes and institutional factors relating to "the working rules of going concerns" on shifting cultivation practices and social arrangements of labor force will be evaluated using previous studies available information and from the additional interviews with key informants from the village level, district level and the provincial level.

5. General Features and Land-Use Systems

Based on the information available currently, the Subdistrict of Rantau Pandan consists of 21 villages. The total population of this subdistrict in 1995 are 22,884 (11,084 men and 11,800 women) and the total households are 5,238, most of which are involved in agricultural activities. The area of the whole subdistrict is about 1,278,140 square kilometer, implying that population density of Rantau Pandan is only about 18 per square kilometer (Bungo Tebo Regional Office of Statistics, 1997), which is quite common for an outside-Java standard.

Population growth in Rantau Pandan have increased tremendously in the last decade. Based on the data of national census, the population growth in the period of 1980-1990 was 1.42 percent per

year. This amount is actually far below the national average of growth, which was 1.97 percent per year. In the period of 1990-1995, the population growth in Rantau Pandan have risen to 1.70 percent per year or about similar to the 1.69 percent growth of national average. This increase could affect the cropping pattern and the length of bush-fallow in the shifting cultivation practices.

Kecamatan Rantau Pandan is located in the piedmont zone, ranging from 100 to 500 meter above sea level (asl). Soils of the area are composed of latosol-litosol complex with fine texture. During the last decade, annual rainfall varied from 1,656 to 2,868 mm where December and January are the wettest and June and July are the driest (van Nordwijk, *et al*. 1995). Typical for this type of soil, the largest part of the area is dominated by secondary or logged-over forest where large-scale (and notably illegal) logging practices have taken place for years. However, most of the forest area in the southern part or upper portion of Rantau Pandan were claimed as a part of Kerinci Seblat National Park (KNSP). In fact, local people have grown rubber in that forest area long before the government declared the area as a conservation forest. In addition, given the ecological function of rubber, cinnamon and other tree crops around the National Park, the watershed protection functions of the Park may be adequately covered.

Major food crops in Rantau Pandan are upland and lowland rice, corn and soybean. The productivity of these crops is about the average of which in other regions of Sumatra. According to the Official Statistics, the productivity of upland rice in Rantau Pandan is only 1.2 ton/ha, and that of lowland rice and corn is about 4.2 ton/ha and 3.2 ton/ha respectively. While the productivity figure of upland rice is about comparable with that of observed figure in the present study, the official productivity of lowland rice is overestimated by about three degrees of magnitude. Even though the productivity is only 0.8 ton/ha, soybean is becoming more popular among farmers in Rantau Pandan recently and could be prospective in the future.

Major cash crops in Rantau Pandan are rubber, coffee, cassiavera and tall coconut. The area of these crops spread over the subdistrict, reaching more than 14 thousands hectare of rubber, more than 900 hectare of coffee and about 230 and 160 hectare of cassiavera and tall coconut, respectively. As explained above, local people have been accustomed to planting the rubber with local varieties since many years within the forest, particularly for property right purposes. In addition, market information and other pressing factors have caused local farmers in Rantau Pandan to become more alert and allocate their lands to a more prospective cash crops such as cassiavera (cinnamon).

Field observation for this study has focused on two villages in the subdistrict: Muarabuat and Senamat Hulu and some additional information along the road in the village of Laman Panjang. Muarabuat and Senamat Hulu has been known for typical *ladang* land use of Sumatra using a shifting cultivation for upland rice, with bush-fallow system, where more than 60 and 90 percent, respectively of the households in these two villages are involved. The village center of Muarabuat is located in the main road of the subdistrict, adjacent to the village of Rantau Pandan, the main village or the capital of the subdistrict. The land-use observed in study sites for economic analysis of shifting cultivation system in the lowland Sumatra can be summarized in the following Table 1.

Table 1. Land Use Observed and Other Key Variables for the Study Sites

Key Variables \ Villages	Muarabuat	Laman Panjang	Senamat Hulu
Land-Use Observed	Shifting Upland Lowland Rice	Lowland Rice	Shifting Upland
Distance to Market (km)	10	14	26
Total Population	696	697	578
Population Density (pop/km)	28	7	6
Total Household	158	171	161
Household practicing shifting cultivation system (%)	60	20	90
Distance to shifting area (in hour walking distance)	1-2	0	2-4

Source: Field Observation and Bungo Tebo Regional Office of Statistics, 1997

As mentioned briefly above, major land-use systems in the subdistrict of Rantau Pandan consists of annual crops for food security purpose and perennial crops for cash income and other purposes. Land-use system for annual crops is mostly shifting cultivation of upland rice (*ladang*) using a bush-fallow rotation system and lowland rice cultivation (*sawah*). Land-use system for perennial crops is mostly local rubber, coffee and cinnamon (*kebun*). The physical boundary between these cash crops land-use system and the (natural and communal) forest is not clearly established because these crops are grown within the forest area. This complex system of land used is sometimes called "jungle rubber" given that the tree crops have been planted for years and no major crop care, except weeding, has been allocated for these trees.

Lowland Rice Fields

Lowland rice fields could represent the most "modern" land-use system in Rantau Pandan, and notably in most places in Sumatra. Even though the majority of farmers do not have certificate for their land in a formal manner, rice fields could be traded freely in land market, especially those located along the main road. The market price for land ranges between Rp 450,000 to Rp 500,000 per hectare, and tends to increase gradually depending on the market forces. However, the land market for lowland rice field does not take place "normally" since the majority of the land could fall in to "conservation forest status" boundary under the National Park.

As commonly found in the matrilineal system such as in the majority of Minang ethnic in West Sumatra, the lowland rice field is normally inherited by women. Other forms of land transfer include a

gift or charity (*tanah wakaf*) for religious purposes, and regular selling and purchasing involving the outsiders. Significant influence of "modernization" has changed the attitude of people of Jambi regarding the rice field. Ten years ago or so, selling the land was considered against the rules of *adat* law because the land was deliberately considered as "*harta berat*", normally controlled by the communal land system. It implies that the food security of the society was in danger and the sustainability of agricultural system and of the livelihood in the area was in trouble. The complete institutional mechanism of the communal system in land-use allocation would probably an interesting subject for future research in this area.

Average lowland rice farmers in Rantau Pandan normally use local variety of rice (*padi panjang*), under the reason of easier to manage and better in taste. Some farmers have applied modern technology such as fertilizer (Urea) and some new high-yielding variety of rice such as IR-64 and IR-50 (*padi Bimas*). Other modern inputs such as pesticide and herbicide have been known by the farmers in Rantau Pandan, but most farmers do not use them in the 1996/1997 planting season because of unavailability in the surrounding area. The growing period of local variety of lowland rice is about six month, therefore farmers are only able to cultivate their field once a year. Some farmers have grown corn and other secondary food crops at the same field such as soybean.

The average area of rice field-holding in the subdistrict ranges from 0.4 to 2.0 hectares, using mostly their-own family labor. The average yield of rice field in Rantau Pandan is only 1.5 ton/ha, or about one-third lower than the official statistics reported by the local government. This productivity is also about or below the subsistence level of the society in the subdistrict, while the rate of rice consumption increases steadily due to population growth and increasing income in other sectors of the economy. The "modern" notion of lowland-rice farmers is also shown by the fact that the majority of farmers in fulfill their food need by buying the rice in local market around the sites such as in July and August when the field observation for this study took place. During regular harvest season, the price of milled rice is about Rp 1,000 per kilogram, while during planting season or long-drought such as at the present time, the price of rice could reach as high as Rp 1,400 per kilogram or may be more.

Upland-Rice Shifting Cultivation

The term shifting cultivation used in this study refer to the standard definition developed by the Alternative to Slash-and-Burn (ASB) Indonesia consortium. Shifting cultivation is a land-use system involving a form of rotational agriculture with a bush-fallow period, longer than the period of cultivation. The land, locally known as *ladang*, is used for growing food crop, particularly upland rice, for only one to a maximum of three years and fallowed for a relatively long period. The particular argument for the above definition is that the length of fallow period becomes shorter as population pressures continue.

In the study sites of subdistrict Rantau Pandan, there are is a large amount of communal forest land, more precisely it is shrub land, or locally called *sesap*. These lands have been designated for shifting cultivation, particularly for upland rice, and some presently are left fallow and covered by small trees and bush/shrub. It is not clear whether or not the area of communal forest land, overlap with the state-owned forest land under concession of forest plantation (HTI) or the conservation forest of the Kerinci Seblat National Park, or even with newly developed for oil-palm plantation.

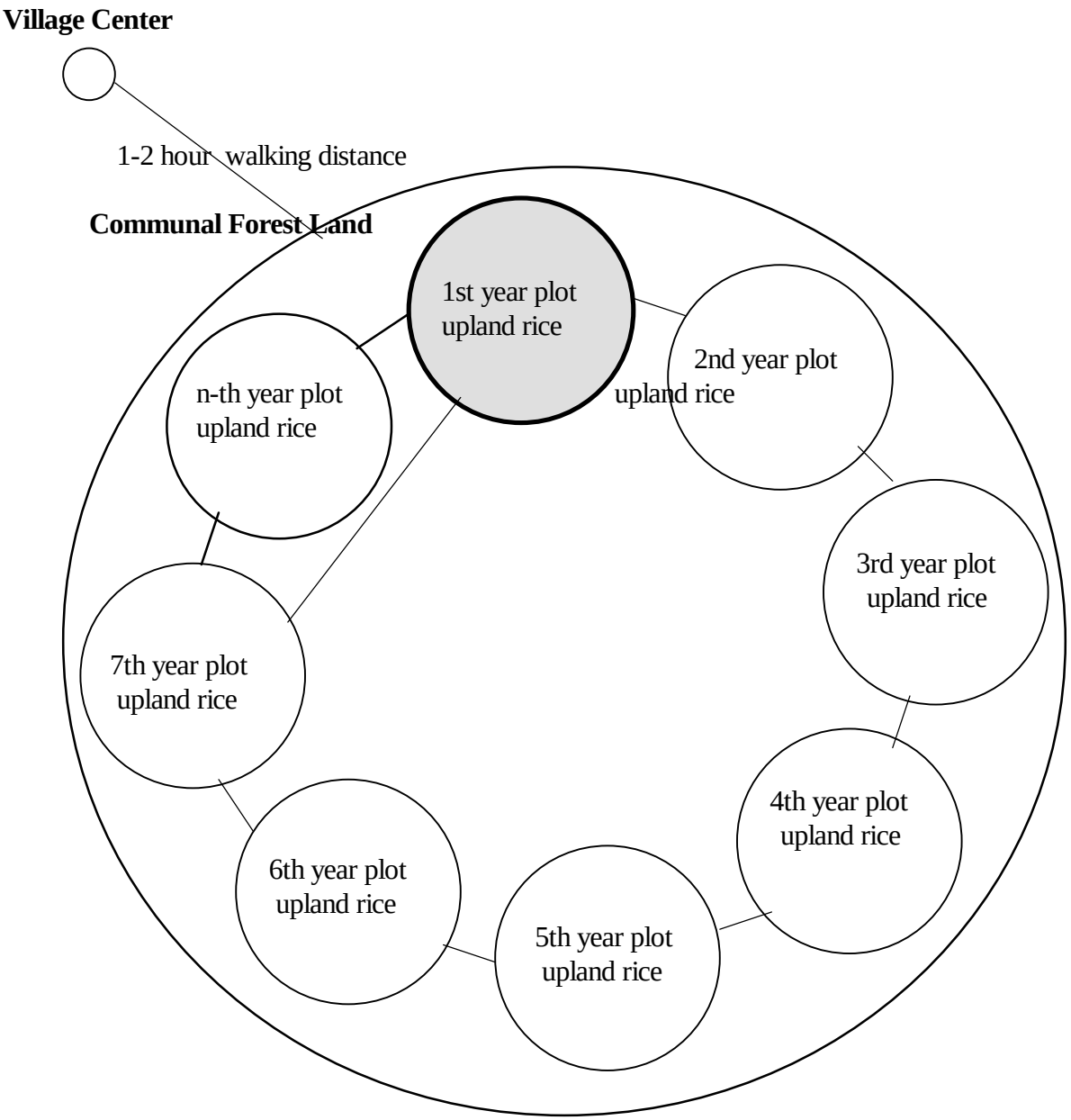


Figure 1. Shifting Cultivation System in Communal Forest Land in Sumatra: Upland Rice followed by Bush-Fallow

According to the rural standard, this land is relatively fertile, located nearby the village, about 1-2 hour walking distance from the village center. Local people believe that the lands located further from the village center, or about 4-6 hour walking distance, thus it is a natural forest, are more fertile than their present land. In the village of Muarabuat, tenurial security is strongly enforced, in order to maintain the existing *ladang* system and the availability of rice production, as a part of food security strategy in rural area. About 1,000 hectares of communal forest land have been "preserved" for upland rice field under shifting cultivation practices. No tree crops are allowed in these particular communal land, and shifting cultivation system is managed by the community. 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. The mechanism of shifting cultivation system, followed by a bush-fallow rotation in the communal forest land could be summarized in Figure 1.

Generally, one household is able to cultivate about 1-2 hectares of upland rice per year by shifting cultivation system in the communal land. Bush-fallow rotation ranges between 5-10 years or could be short, medium and long depending on the labor allocation decision among household and on the land availability to support the shifting cultivation system. At present, it is very difficult to employ a long fallow of 20 years or more such as it was commonly found in the last ten or twenty years. Agricultural or rural sector in general has experienced a serious labor shortage since the opportunity cost of labor has increased tremendously in the last decades.

Meanwhile, in the village of Senamat Hulu communal property of forest land under the shifting cultivation system is not strongly enforced. The community can freely buy and sell their land, such it has happened in the last decade or so. Probably, in addition to the communal land, this village has a number of private plots of bush land belong to clans or families. The owners usually plant upland rice for 1-2 seasons and then move to another plot within the bush land. However, there has been some changes in land-use patterns in the last decades after the second rotation of shifting cultivation. The choice of not adapting the bush-fallow system is more open, meaning that farmers could replace the land allocated for shifting cultivation into a more attractive land use system. If the land is suitable for planting rubber or cassiavera, these tree crops are interplanted in the first or second year of cropping.

Most likely, the land-use change from rotational system into a more permanent land-use system takes place in the private and family lands, rather than in the communal forest lands. Once the land-use changes, the land becomes more tradable and the market price for land increase significantly. The market price for the land ranges from about Rp 420,000 per hectare for *sesap* or for upland *ladang* under shifting cultivation and about Rp 2 million per hectare for tree crops such as rubber, cassiavera and probably for oil-palm plantation. However, interpretation for the land-use change phenomena should be made with caution, given that the present study does not attempt to identify factors affecting the change in a comprehensive way. This should be a leading priority in the future research about land-use change.

The mechanism of shifting cultivation system in the private and family land, which is likely to be transformed the system to a more permanent cash-crop practices after second rotation, could be summarized in the following Figure 2.

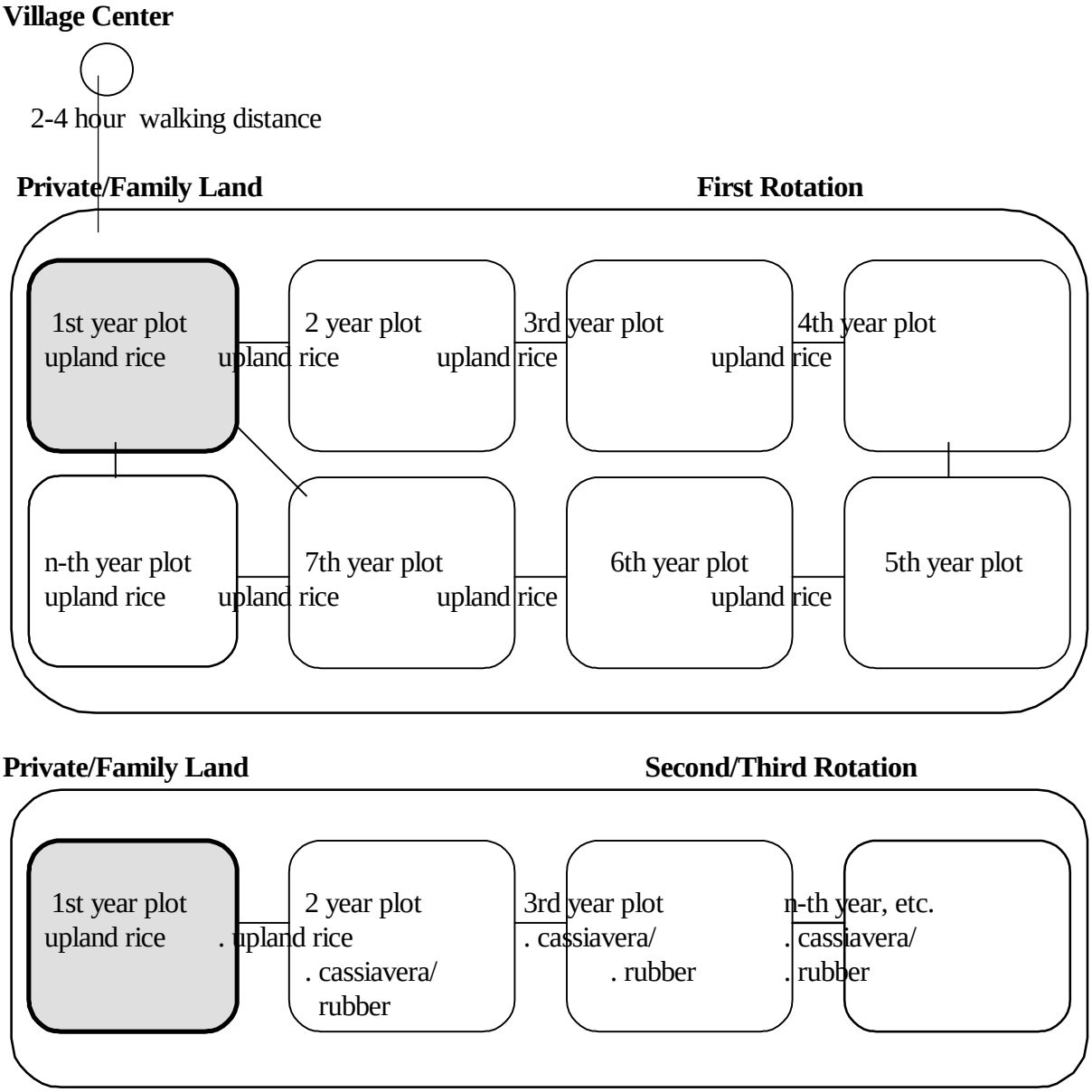


Figure 2. Shifting Cultivation System in Private/Family Land in Sumatra:
First rotation: upland rice followed by regular bush-fallow
Second or third rotation: upland rice changed into tree crop

Figure 2 above is probably a typical case of land-use change from a traditional shifting cultivation system into more permanent agricultural practices in response of a growing market economy and other external economic forces. In the system where markets exist and all prices, including the wage rate are parametrically given, the decision to increase the area of cultivation and to change to existing land use system are primarily determined by the relative profitability of expected farming practices, including those in the frontier with the expense of natural forest. Also, if labor can be sold or hired at a constant wage, the land-use change and production decisions by a rational and utility-maximizing household can be analyzed by a typical profit-maximizing production behavior. A higher relative price of rubber and cinnamon than that of rice, a better road and transportation infrastructure, and an open-access like tenurial land rights are among important factors contributing to the change.

The recent tendency is an increased tension between the tenurial system of communal forest land or related customary (*adat*) rights on land and a more uniform or centralized "modern" legal system on forest land. According to the Basic Forestry Act of 1967, all forest in Indonesia is state property, while the customary law on land gives usufruct rights to forested land planted with perennials crops after clearance. In the absence of clear boundary between state forest and communal forest land, and due to weak management of communal forest , a large portion of Indonesian forest could fall into an open-access like tenurial land rights. Consequently, the attractiveness of economic profitability of tree crops combined with a property-rights security purpose on forested land have also lead to land-use change into a more permanent cash crop practices in the last decade or so.

The average yield of upland rice in Rantau Pandan is about 1.3 ton/ha, or similar to the official statistics published by the local government. In this study, the following category was used to classification the length of bush-fallow period. A five year fallow or less is considered a short fallow; 5-10 year is medium, and more than ten year is classified as long-bush fallow system. As expected, the yield of long fallow is higher than that of medium and short fallow. Therefore under existing condition of input use and market price for input and output, the shifting cultivation under long-bush fallow is the most promising for food security purposes. The question is then "is it still possible to adopt the long-fallow system of shifting cultivation given the land is not unlimited anymore and a more permanent land use system is more attractive for the household and has been adapted by some household in the village?" Table 4 shows the performance of shifting cultivation system under different length of fallow.

Table 4. Performance of Shifting Cultivation under Different Length of Fallow System

	Shifting Cultivation		
Important Characteristics	**Short Fallow**	**Medium Fallow**	**Long Fallow**
Input use:			
Seed (kg/ha)	25	25	25
Labor (man-day/ha)	152	167	167
Working Capital (Rp/ha)	140,600	153,600	171,600
Yield (kg/ha)	1,200	1,333	1,800
Profit excluding land (Rp/ha)	596,400	678,000	1,130,400

Notes: At the time of study, one US dollar equals 2,400 Indonesian Rupiah.
Source: Field observation and authors' calculation

One should note that a detailed information on long fallow system is difficult to obtained because most of current plots are under a short-fallow system. A seven year bush-fallow could be a

maximum possibility that could be materialized by farmers in Rantau Pandan, given the availability of land and other production factors. In the present study, respondents were asked a historical-type of question -- but somewhat hypothetical -- such as how much the yield were obtained by their parents at the very same land, and what the yield of upland rice would be if the current cultivation in the bush (*sesap*) land took place 15 or 20 years ago, etc. In the future research, a more comprehensive methodology, involving an extensive exploration of available data and documents on particular plots should be employed in order to draw more complete and reliable information on estimated yield of shifting cultivation system.

Crop and Labor Calendar

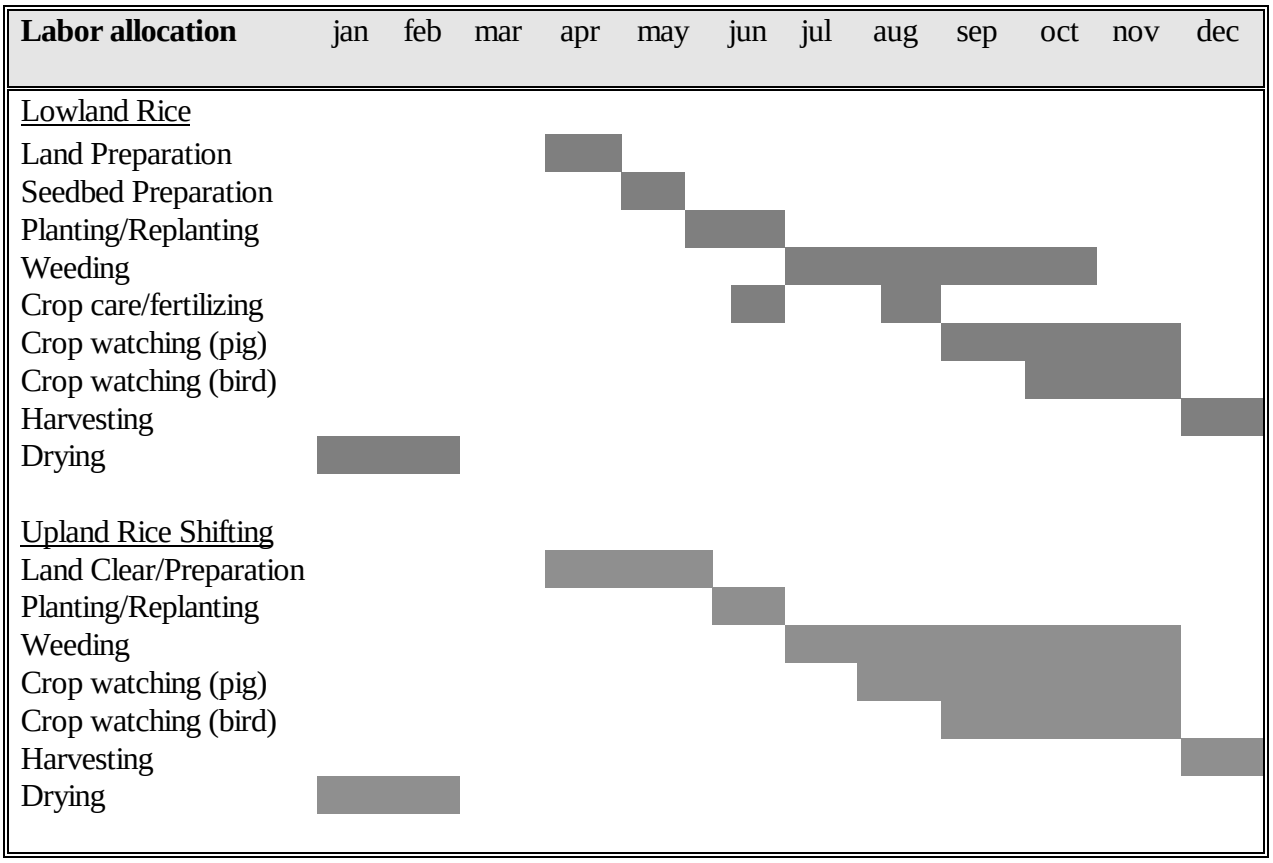
In this section, crop and labor calendar will be analyzed, emphasizing on the labor allocation by household on particular crops and activities. As commonly found in traditional agricultural practices, crop watching from the pig and from the bird, and forest/bush clearing or land preparation take time the most. In the study sites, the normal average working hour is between 7-8 hour, starting at 7:30 and ending at 4.00 p.m. with one hour break for day-time praying and lunch between 11:30 and 1:00 p.m.. This schedule is normally imposed for non-family labor force; while the schedule for family labor could be far more intensive, though not necessarily more flexible.

One should note, however, that the standard working hour explained above is for arithmetic calculation only and for the purpose of economic analysis. It does not imply a rigid formal schedule such as in the office or factory working hour. Villagers hardly put a monetary value on their own labor, even though their labor allocation decisions are driven by rational economic principles of allocation. Some activities in the shifting cultivation system such as crop watching from the pig could continue, even more intensively during night times. The villagers might think that both upland rice under shifting cultivation and permanent lowland rice cultivation have taken their labor the most. Heavy duty of crop care, and labor shortage in rural areas, combined with rice availability for consumption in the local market due to tremendous development of road and transportation infrastructure could be among the reasons of land-use change into a more permanent tree crop types of activities.

Average wage rate for forest clearing, land preparation and other man-job in Rantau Pandan is about Rp 5,000 per man-day, including lunch, coffee and cigarette. This wage rate is actually a lot higher compared to that two-three years ago, averaging only Rp 3,500 - Rp 4,000 per man-day. In the subdistrict, wage differentials are imposed according to particular types of job, meaning no gender segregation in wage rate. If a man does a woman's job such as weeding, and replanting, he would receive a wage rate as high Rp 4,000 as what was received by a woman.

Table 5 summarizes the crop and labor calendar of a household in the study sites of Rantau Pandan subdistrict in Jambi Province. A full month shade in the table does not imply that the labor is spent for the whole month, rather it represents the period of activities or labor allocation. In any of these months, farmers in Rantau Pandan could have spare times for weeding in their rubber or cassiavera field, rubber tapping, and harvesting the wood of cassiavera for cash income, collecting non-timber forest product, working in someone's less field or in off-farm employment, or simply migrating temporarily to the nearby town of Muarabungo as laborers in other sectors of the economy.

Table 5. Crop and Labor Calendar of Farmers' Household in Rantau Pandan



Notes: The figure for upland rice shifting cultivation is for short and medium bush fallow. Labor calendar for long fallow system is about the same, except that land clearing and preparation takes more time and weeding takes less time than that in short and medium fallow.

6. Micro-Level Economic Analysis

Under the system of shifting cultivation, farmers adopting a short and medium bush fallow receive only Rp 1.4 and 1.6 million gross revenue respectively for one hectare land. This amount is much less than that is received by those adopting a long-fallow system who could obtained at Rp 2.2 million and those under wetland rice. The cost structure among upland shifting cultivation and lowland rice land-use does not differ very much, except for long-fallow shifting cultivation. The cost structure for land preparation differs as much as RP 60,000 because wetland rice system requires a seedbed preparation.

Weeding activities in upland rice take a cost of Rp 100,000 in average, or a Rp 40,000 higher than that in wetland rice. In addition to weed problem, the degree of sensitivity of pest attacks in upland rice shifting cultivation is also higher than that in lowland rice field. Labor allocation for applying the fertilizer does not contribute significantly to the farm cost structure. In the study sites, fertilizer is only used in the lowland rice. It is applied at 15 days after planting/replanting and few days before the period of generative growth or before the rice grain is ready to fill up. This crop-production management is far below the standard or recommended best management practices in rice

production. Normally, during the phase of generative growth, NPK fertilizer application is necessary to ensure the growth of grain and increasing yield.

The cost of other crop care activities, in general, are lower in a more permanent lowland rice cultivation. Crop watching from the pig and the bird is less extensive in the rice field close to housing compound than those located 1-2 hour away from human settlement. Therefore the total cost of farm-production activities in lowland rice field is about Rp 810 thousand, which is lower than all types of different length bush-fallow system. The total cost of short-fallow system is about Rp 844 thousand per hectare, while the cost of medium and long fallow system is Rp 922 and 1,030 thousands, respectively .

The economic profitability of different land-use system can be summarized as follows. The profit, excluding land, for lowland rice cultivation is the higher than that in shifting cultivation, except for long bush-fallow. This is mostly because the yield in lowland rice is 1.5 ton/ha, which is higher than 1.2 ton/ha and 1.3 ton/ha, the yield of short fallow and medium fallow, respectively. However, these yield measurements are lower than the yield of long-bush fallow which is 1.8 ton/ha. Therefore, the profit excluding land of lowland rice is Rp 990 thousand, which is also higher than that of short and medium fallow which are Rp 596 thousand, Rp 678 thousand respectively; but lower than the profit of the long bush fallow system which is Rp 1.1 million.

Table 6. Economic Profitability of Lowland Rice and Shifting Cultivation (Rupiah)

	Lowland	**Shifting Cultivation**		
Items	**Rice**	**Short Fallow**	**Medium Fallow**	**Long Fallow**
Total Revenue	1,800,000	1,440,000	1,599,600	2,160,000
Total Cost	809,880	843,600	921,600	1,029,600
Land Price	470,000	450,000	420,000	400,000
Profit, excl. land	990,120	596,400	678,000	1,130,400
Net Profit	520,120	146,400	258,000	730,400

Source: Author's calculation

7. Conclusion and Policy Implications

This study has presented the profitability of shifting cultivation system in communal forest area in Jambi Province of Sumatra, Indonesia. The land rent approach has explained the economic adjustment process of how shifting cultivators might adopt different length of bush-fallow rotation system. The results of micro-economic analysis using both single year and multiple-year simulation show that lowland rice is more profitable than the short and medium fallow of the shifting cultivation system but less profitable than the long-fallow of system. Under an open economy argument, farmers are trying to adopt a more permanent and more intensive land-use practices in accordance with the increasing pressure and the existence of market forces and the growing market economy in rural area.

Even though a long fallow shifting cultivation system is also profitable and an indication of domestic resource use efficiency, but probably it is not a wise choice given the pressure on land have increased over time. Since the long bush-fallow system is hardly found in the lowland Sumatra at present time, the policy challenge is then how well-prepared the supporting systems such as transportation infrastructure, irrigation, provision of modern inputs, etc. that could maintain the efficiency and profitability of lowland rice cultivation system? Or this preliminary finding could be taken as another assured indication that farmers adopting an upland shifting cultivation under "normal length" of bush fallow (short and medium) is a pre-requisite to establish the property rights on land under a tree crop or cash crop system such as rubber and cassiavera.

Therefore, provision of modern agricultural inputs such as seeds, fertilizer, and pesticides; quality rural infrastructure, and non-farm employment generation in rural areas are necessary condition for economically sound policy strategies in the future. In addition, agroforestry systems involving high-yielding variety of rubber and upland rice and management of forest lands by local communities also can be more effective means of sustainable forest-resource management.

References

Angelsen, Arild. 1995. "Shifting Cultivation and "Deforestation": A Study from Sumatra, Indonesia". *World Development* Vol. 23 (10). pp: 1713-1729.

Arifin, Bustanul. 1993. "A Closer Look at Deforestation in Indonesia". Paper presented at "The Fourth Global Warming International Conference", April 17 -21 1993, Chicago USA.

Arifin, Bustanul. 1995. *The Economics of Land Degradation: A Case Study of Indonesian Upland.* Ph.D. Dissertation. The University of Wisconsin- Madison (USA).

Arifin, Bustanul. 1996. "Misconception about Environmental Degradation: Lesson from Deforestation in Indonesia". Paper presented at the Sixth International Conference on Society and Natural Resource Management at the Pennsylvania State University, May 18-23, 1996.

Boserup, Ester. 1989. "Agricultural Growth and Population Change", in J. Eatwell, M. Milgate, P. Newman (eds.), *Economic Development*: *The New Palgrave*. New York: W.W. Norton, 1989, pp: 21-34.

Barbier, Edward B., N. Bockstael, J.C. Burgess and I. Strand. 1993. "The Timber Trade and Tropical Deforestation in Indonesia". LEEC Paper DP 93-01. London Environmental Economics Center.

Bromley, Daniel W. 1990. "Arresting Renewable Resource Degradation in the Third World: Discussion" in Duane Chapmen (ed.) *Arresting Renewable Resource Degradation in the Third World.* Environment Working Paper No. 44. Washington, D.C.: The World Bank.

Central Bureau of Statistics (CBS). various issues. *Statistical Yearbook of Indonesia.* Jakarta: Central Bureau of Statistics.

Dick, John. 1991. "Forest Land Use, Forest Zonation and Deforestation in Indonesia: A Summary of Existing Information". Background paper to the UNCED Conference, prepared for the Ministry of Population and the Environment, Jakarta, Indonesia.

Food and Agricultural Organization (FAO). 1990. *Situational and Outlook of the Forestry Sector in Indonesia*, Technical Report of Forestry Studies, Food and Agricultural Organization and Ministry of Forestry, Government of Indonesia, Jakarta.

Fraser, A.I. 1996. *Social, Economic, Political Aspects of Forest Clearance and Land-Use Planning in Indonesia*. Unpublished manuscript.

Gillis, Malcolm. 1988. "Indonesia: public policies, resource management, and tropical forest", in Repetto, R. and M. Gillis (eds.) *Public Polices and the Misuse of Forest Resources.* Washington, D.C.: World Resources Institute, pp:10-23.

Mikesell, Mike W. 1960. "Deforestation in Northern Morocco", *Science* 132 (1960), pp:441-445.

Monke, Eric and Scott Pearson. 1989. *The Policy Analysis Matrix for Agricultural Development.* Ithaca: Cornell University Press.

Sauer, Carl. 1967. "Man in the Ecology of Tropical America". In: J. Leighly (ed.) *Land and Life.* Berkeley: University of California-Berkeley, 1967, pp. 43-52.

Sunderlin, William and Ida Aju Pradnja Resosudarmo. 1996. "Rates and Causes of Deforestation in Indonesia: Towards a Resolution of the Ambiguities". Bogor: CIFOR Occasional Paper No.

Van Noordwijk, *et al*. 1995. Alternatives to Slash-and-Burn in Indonesia. Summary Report of Phase 1. Bogor: ICRAF Indonesia.

Weinstock, J.A. and Satyawan Sunito. 1989. *Review of Shifting Cultivation in Indonesia.* Jakarta: Directorate General of Forest Utilization, Ministry of Forestry and FAO of the United Nations.

World Commission on Environment and Development (WECD). 1987. *Our Common Future.* Oxford and New York: Oxford University Press.

World Bank. 1990. *Indonesia: Sustainable Development of Forests, Land and Water.* Washington, D.C.: The World Bank.

World Bank. 1992. "Development and the Environment", *World Development Report 1992,* Washington, D.C.: The World Bank.

World Bank. 1994. *Indonesia. Environment and Development: Challenges for the Future.* Washington, D.C.: The World Bank.

World Resources Institute. 1991. *World Resources 1990-1991*. New York: Oxford University Press.