Slash-and-burn as land clearing method for rubber smallholders: results of a social economic agronomic survey*

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Key Words: fire, wood prices, ashes, soil fertility, *Hevea brasiliensis*

Abstract

The search for alternatives to slash-and-burn agriculture and slash-and-burn as a land clearing method requires in-depth knowledge and diagnosis of the problems that arise from the present management system. A social/economic/agronomic survey of slash-and-burn (S&B Survey) as a land clearing method was conducted among 30 rubber smallholders in the Sepunggur area, Jambi Province, Sumatra, Indonesia. This paper presents the results of this survey.

The objectives of this survey were to:

- characterize slash-and-burn techniques,
- characterize farmers' perspectives on the land clearing methods related to agronomic aspects (soil fertility, plant growth, production), and
- evaluate the present and future importance of slash-and-burn (and alternatives to slash-and-burn) as a land clearing system at both the smallholder and community levels.

Introduction

On September 10, 1997, Indonesian President Soeharto banned the practice of burning forests to clear land. Severe land clearing related forest fires in Kalimantan and Sumatra caused a thick haze not only on both islands but also in neighboring Malaysia, Singapore, Brunei, the Philippines, and Thailand. These land clearing related fires in Indonesia have been described as the worst in Southeast Asian history. In some regions, the Air Pollutant Index (API) exceeded the 600 level (101-200 is considered unhealthy, 201 up to 300 very unhealthy, and 301 to 500 hazardous). In Indonesia, the provinces worst affected by the haze were West, Central, South, and East Kalimantan, Riau, Jambi, and South Sumatra. Reduced visibility, down to 30 meters in Jambi, closed down airports. The Indonesian Minister of the Environment estimated that more than 300,000 hectares of forest were destroyed by fire in these provinces in 1997. Al-

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* This manuscript was reworked and appeared in Forest Ecology and Management under the following reference: Q. M. Ketterings, T. T. Wibowo, M. van Noordwijk, E. Penot (1999). Farmers'perspectives on slash-and-burn as a land clearing method for small-scale rubber producers in Sepunggur, Jambi Province, Sumatra, Indonesia. Forest Ecology and Management 120: 157-169

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though large logging companies as well as small slash-and-burn farmers have been blamed for starting some of the fires, the government lays most of the responsibility on the shoulders of plantation and forestry companies.

The haze caused by these fires is a visible problem. A less visible aspect of fire-induced pollution is the release of greenhouse gasses and the loss of biodiversity. Together haze formation, greenhouse gas emission, and loss of biodiversity call for the development of alternatives to slash-and-burn agriculture.

Fire has traditionally been used as a means to clear land for agricultural production. As such it is part of the slash-and-burn agricultural system in which forest is converted for agricultural use for a few years and then left in favor of a newly opened plot (shifting cultivation agriculture). Slash-and-burn agriculture as a land use system is disappearing in Sumatra, but slash-and-burn as a technique of converting forested land to rubber gardens, rejuvenating old rubber gardens, and converting either forested land or existing rubber gardens to oil palm gardens is still widely used, both by large plantation holders and by smallholders.

Small slash-and-burn farmers are only considered a minor subgroup of those responsible for the forest fires and the haze that threatened millions of people in six different countries and that in September 1997, had already inflicted over 30,000 people with severe respiratory problems in Indonesia alone. However, a total ban on using fire as a land clearing method would severely affect them. Slash-and-burn as a land clearing method is still the cheapest way of converting one land use system into another. Fire eliminates field debris, reduces regrowth of weeds and trees, adds fertilizer in the form of ash, loosens the soil making planting easier, and reduces chances of diseases and pests.

Alternatives to slash-and-burn for these smallholders should address these benefits of using fire. One alternative would be a replacement of slash-and-burn by slash-sell-and-burn. Removal of the largest pieces of wood from the field prior to burning would reduce the smoke development while still maintaining the benefits of fire and in addition providing an extra source of income for the farmers. However, before such alternatives can be suggested, in-depth knowledge and diagnosis of the problems that arise from the present management system and the alternatives that could alleviate these problems are required. This will entail research on a combination of social, economic, agronomic, biological and environmental aspects at the farm household level.

A social/economic/agronomic survey (S&B Survey) was conducted among 30 rubber smallholders in the Sepunggur area, Jambi Province, Sumatra, Indonesia. This survey aimed to characterize slash-and-burn techniques, farmers' perspectives on the land clearing methods related to agronomic aspects (soil fertility, plant growth, production), and to evaluate the present and future importance of alternatives to slash-and-burn as a land clearing system at both the smallholder and community level. Rubber smallholders were selected since rubber gardens form the mayor land use type in this area and most of the forest and bush fallow that is presently converted (slashed-and-burned) for agricultural use is being planted with rubber seedlings.

Objectives

The objectives of this study are:

- to characterize slash-and-burn practices as exercised by farmers in the Sepunggur area;
- to characterize reasons behind farmer's management decisions related to establishing new fields for agricultural production; and
- to establish the importance of slash-and-burn as land clearing method for rubber smallholders in this area now and in the near future.

With the results of this survey, we will be able to answer questions, such as:

a) What do farmers do?

b) Why do they do it?

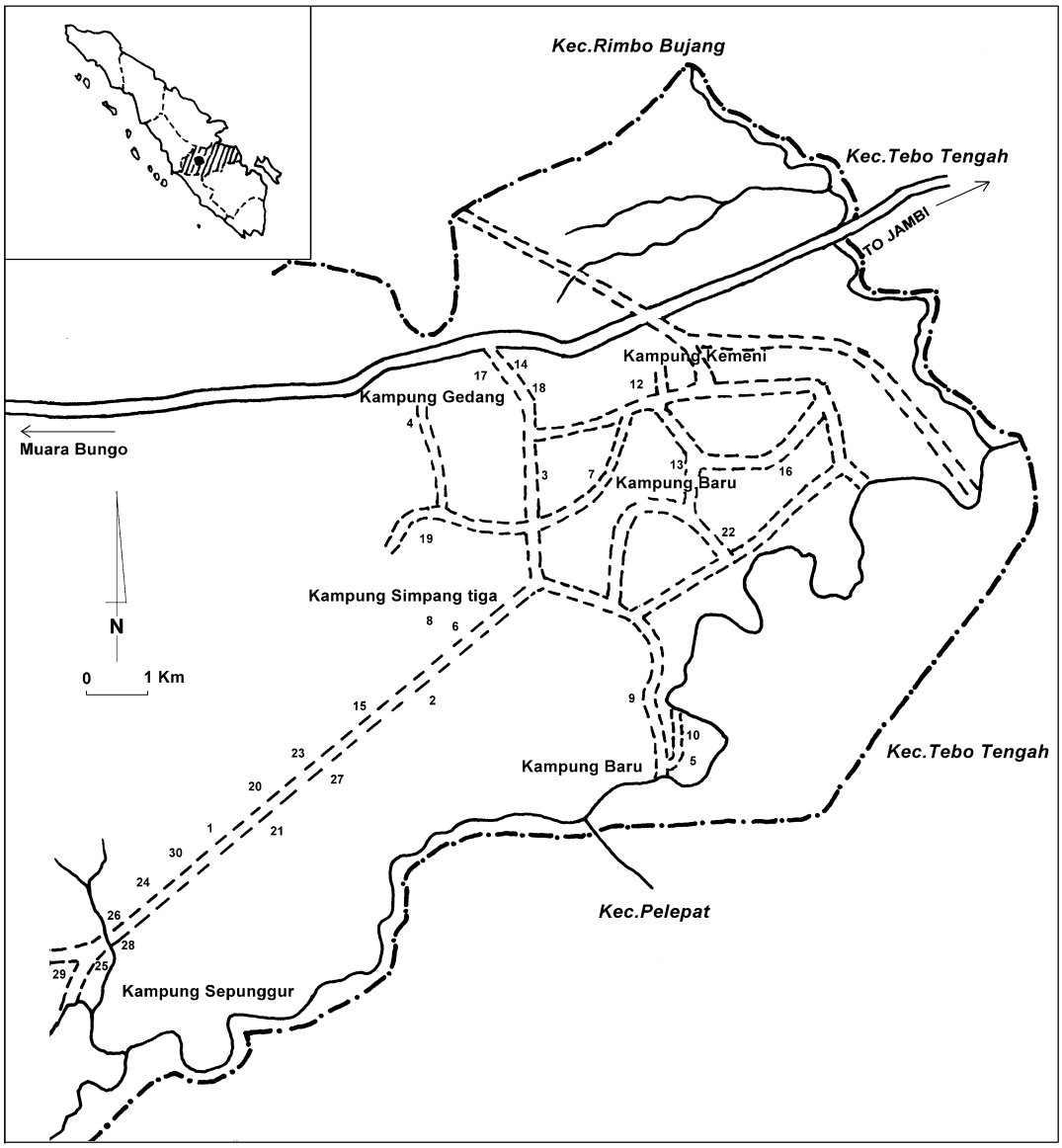
c) What are the alternatives? and

d) What do these alternatives mean for the farmers' economic status?

Characterization of the study area

The S&B-Survey was conducted in the Sepunggur administrative area (Figure 1). The administrative area of Sepunggur is located 31km southeast of Muara Bungo, the capital of subdistrict Muara Bungo, district Bungo Tebo, Jambi Province, Sumatra. This area includes five regions: Kampung Baru, Kampung Sepunggur, Kampung Simpang Tiga, Kampung Gedang and Kampung Kemini.

Figure 1. **The administrative area of Sepunggur**



The present-day Sepunggur administrative area was officially established in 1989 when two independent units, Kampung Sepunggur and Kampung Baru, merged into one administrative unit with one village head (kepala desa) who at present resides in Kampung Baru. In addition, the Sepunggur administrative area now comprises Kampung Simpang Tiga, Kampung Gedang, and Kampung Kemini, all three regions surrounding Kampung Baru and Kampung Sepunggur. In 1975, PT Gaya Wahana Timber logged large parts of the surrounding primary forest. This event initiated a local transmigration program that same year. A total of 144 families moved from Kampung Sepunggur and Kampung Baru to the areas surrounding the two Kampungs. Thus, Kampung Simpang Tiga, Kampung Gedang and Kampung Kemini were established.

The total population of Sepunggur is 3,038 (1,539 male and 1,499 female) with 632 family heads (Sepunggur Profile, 1997), which brings the average family size to 4.8 people per family. In 1995, a total of 42% of the population was younger than fourteen years old (Figure 2). The Sepunggur administrative units comprises 158.39 km^2 (BPS, 1995), which brings the population density to 19.2 people/km^2 and the average farm size to 5.2 ha/family.

Figure 2. **Population distribution in the Sepunggur administrative area (Source: BPS, 1995).**

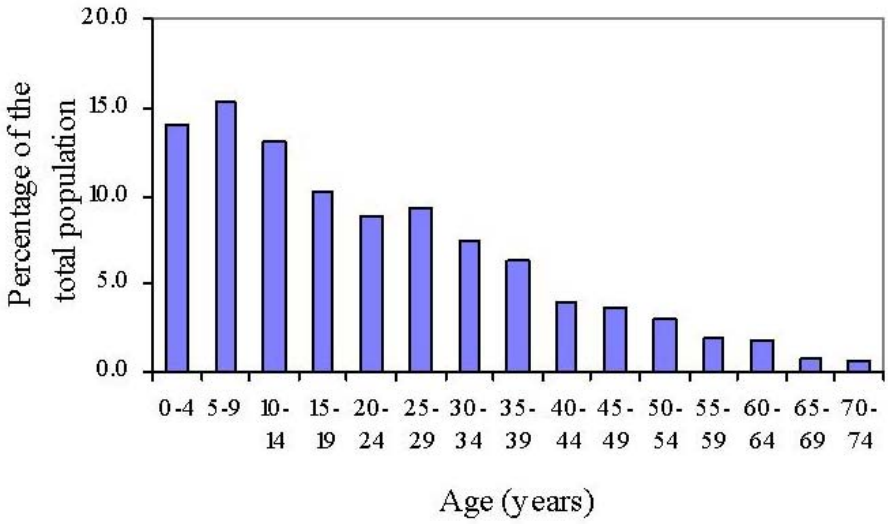
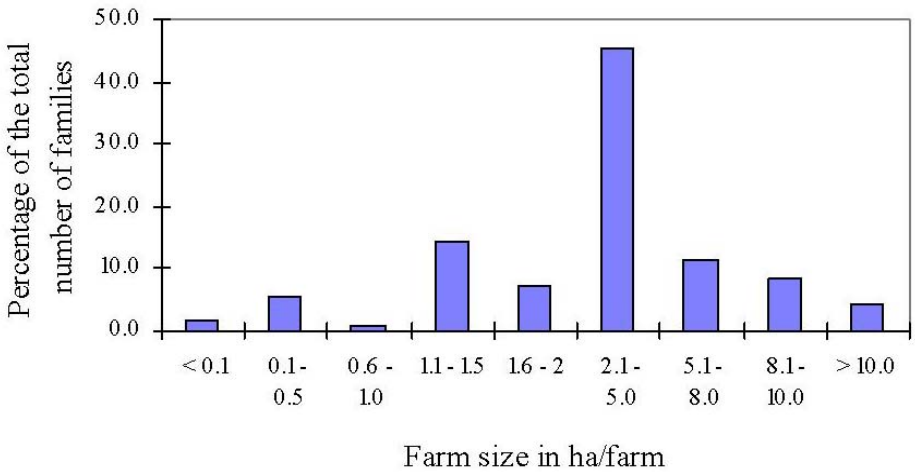


Figure 3: **Farm size distribution in the Sepunggur administrative area (Source: Sepunggur Profile, 1997).**



Of the total area in the Sepunggur administrative area, 0.27 km^2 is used for wet rice production, 47.87 km^2 for garden (rubber, fruit trees, oil palm, etc.), 1.5 km^2 for homegarden, 64.98 km^2 is forest, while a total of 43.77km^2 is used for other purposes (houses, roads, rivers etc.) (BPS, 1995). Figure 3 shows the distribu-

tion of land (farm size) among the 632 families in the area. There are 522 buildings in Sepunggur of which approximately eight percent are permanent. Only ten buildings have electricity. The main water supply is the river (Bungo Tebo) which supplies 396 houses with water whereas in the rainy season 242 households have access to well-water.

Materials and Methods

A total of 30 farmers was interviewed: nine farmers in Kampung Baru, six farmers in Kampung Sepunggur, nine farmers in Kampung Simpang Tiga, two farmers in Kampung Gedang, and four farmers in Kampung Kemini.

All respondents have in common farming as their main occupation and all own at least one rubber garden that is less than five years old. Of these selection criteria, the later criteria was added so that detailed questions could be asked about the land clearing method of the most recently opened field. Furthermore, since the Sepunggur administrative area includes five regions (kampungs), the number of respondents per region was chosen to reflect the distribution of households in the area.

The S&B-Survey contains questions that can be grouped into six main categories:

- farm characterization including information on total area and age of rubber gardens and fallow vegetation/secondary forest that could in the future be converted to new rubber garden;
- characterization of the slash phase (including land selection) in the slash-and-burn land clearing method (in general);
- characterization of the burn phase in the slash-and-burn land clearing method (in general);
- characterization of the slash-and-burn methods of the last opened field;
- farmers' perspectives on the importance of slash-and-burn as a land clearing method;
- farmers' perspectives on the importance and future of slash-and-burn in the Sepunggur administrative unit.

All interviews were conducted on an individual basis (no group interviews, household interviews only). Respondents can be grouped in three groups: local farmers, local transmigrants (transmigration program), and spontaneous transmigrants. External transmigrants all spontaneously migrated either from Java or from North or West Sumatra. Table 1 shows the survey respondents by site and stratum.

Table 1: **S&B Survey respondents by site and stratum**

Region	Local Farmers		Local Subsidized Transmigrants		Local Spontaneous Transmigrants		External Spontaneous Transmigrants	
	Number	%	Number	%	Number	%	Number	%
Kampung Baru	5	16.7	2	6.7	-	0.0	2	6.7
Kampung Simpang Tiga	5	16.7	3	10.0	1	3.3	-	0.0
Kampung Sepunggur	4	13.3	-	0.0	-	0.0	2	6.7
Kampung Kemini	3	10.0	1	3.3	-	0.0	-	0.0
Kampung Gedang	-	0.0	1	3.3	-	0.0	1	3.3
Total	17	56.7	7	23.3	1	3.3	5	16.7

Results

Slashing

Most farmers start slashing the vegetation in March, the first month of the dry season, and continue until the month of August. The majority of the farmers stated that time and labor constraints determine the length of the slashing period once the dry season has started. Slashing activities take place after other work (e.g., rubber tapping and working in rubber gardens) is finished. This way slashing one hectare of secondary forest may take up to one month when slashing is done manually using a machete. When slashing is done with a chainsaw, it takes one person one full day to slash one hectare of secondary forest. The cost of renting the chainsaw (Rp 35,000/day) generally prevents farmers with less than 20-year old forest from renting a chainsaw. Ten of the thirty farmers interviewed indicated that they had cleared their most recently opened field with a chainsaw. Each of them indicated that the vegetation of their last opened field was more than 40-year old jungle rubber or more than 20-year old secondary forest. Prior to cutting the big trees, all farmers in the area cut the underscore of shrubs and bushes using a machete and 'beliung' (an axe-like hand tool). Cutting one hectare of secondary forest undergrowth generally takes three to five days for one person. The daily income of a laborer for this type of work is Rp 5000/day (male) and Rp 3000/day (female). Hence, to cut one hectare of secondary forest in the Sepunggur area by renting a chainsaw and labor to cut the underscore will cost a farmer approximately Rp 60,000. Most farmers cut the entire field, not sparing any trees. Only one farmer did spare fruit trees, such as petai (locust bean), jengkol (stink bean), and rambutan. The same respondent also spared rubber trees that were less than 20-years old. All trees did survive the burn.

Wood use

In the past five years, the price of wood and rice have doubled in Sepunggur (see Table 2). All but two farmers indicated that this doubling in price is due to wood scarcity.

***Table 2:* Wood species and local prices when sold/bought by farmers in the Sepunggur area.**

Wood Species (Local Name)	Wood species (Scientific Name)	Price per m^3 (1997) in Rupiah	Price per m^3 (1992) in Rupiah
Rubber	*Hevea brasiliensis*	12,500	12,500
Kulim	*Scorodocarpus borneensis, Olacaceae*	180,000	80,000
Tembesu	*Fagraea spp., Loganiaceae*	300,000	150,000
Mersawa	*Anisoptera spp., Dipterocarpaceae*	150,000	80,000
Meranti	*Shorea spp., Dipterocarpaceaea*	140,000	75,000
Kempas	*Koompassia malaccensis, Caesalpiniaceae*	90,000	40,000
Jelutung	*Dyera costulata, Apocynaceae*	60,000	30,000
Medang	many species from different families	100,000	60,000
Sepat	*Vatica maingayi, Dipterocarpaceae*	125,000	60,000

Only five respondents sold wood from their most recently burned field. Species sold were *Hevea brasiliensis, Shorea spp., Koompassia malaccensis* and medang, which can contain species of one or more out of 36 families. Total income from selling wood for these five farmers ranged from Rp 200,000 to Rp 1,050,000 per cleared field. The trees were cut and converted to planks by the farmer prior to burning. When asked why more wood was not sold, farmers indicated that there was no more wood to sell (20), and that the investment in selling wood (hiring a chainsaw and labor and transporting the wood to the market) was too high (4). All investment in selling trees (cutting, sawing, transportation) is done by the farmer. Five farmers indicated that if they lived closer to the main road or market, they would be able to sell more wood due to a reduction in operating costs.

Wood for uses other than selling is generally removed from the field after burning. Wood is collected for use as a fuel for cooking and as material to build a field house or a fence to protect the new garden from invasions by pigs and goats (fence) and monkeys (field house).

Although pigs and monkeys form a big threat to the successful establishment of a new rubber garden, only 30 % of the farmers built a fence around their fields. The majority (26 farmers) indicated that they built a field house in the newly opened field and used that location as a watchtower for pigs, goats and monkeys. At present, farmers that do not have enough wood to build a fence yet would like to do so, can, when available, use wood from secondary forest or jungle rubber fields of neighbors with permission but without payment. Those that did pay for building a fence on average spent Rp 120,000 per ha of fenced land.

Burning

Slashed fields are generally burned in the months of May to September with most fields being burned in the month of August. Burning takes place in two steps: a broadcast burn followed by pile-and-burn of the remaining wood. The second step is occasionally omitted if after the broadcast burn the field was considered clean enough for planting. When a second burn is conducted (generally within one week after the first burn), farmers collect wood in heaps of 200-400 kg and stack it on a space of 3 to 4 meters diameter. This second burn leaves a field with clearly recognizable circle-shaped charcoal and ash spots over often red-turned topsoil. Depending on how effective the first burn was in removing wood from the field, second burn spots can amount to 40 locations per hectare.

The actual time of burning depends on the state of dryness of the slashed vegetation. Farmers estimate that one month is enough to dry a forest that is less than tens year old. To dry a forest that is between ten and thirty years old takes on average a minimum of two months whereas for older forest this period of drying can be extended to three months. The average period of drying for the most recently opened fields was considerably longer than what farmers consider necessary, averaging three months for all vegetation types. Fires that are too hot and turn the soil red are not feared.

Fields are generally burned in the afternoon when the wind is not too strong to enable control of the fire yet strong enough to let the fire continue on its own. Burning a field is a group activity in which the neighboring farmers generally participate. Occasionally, the borders of the newly opened field are cut clean to act as a fire break. Mostly, no precautions are taken apart from selecting the right time to burn.

When a fire does enter a neighboring rubber garden and no prior agreement with the neighbors was obtained, the farmer who burned the field has to pay for the damage. Generally, the payment amounts to Rp 1,000/seedling for one-year old rubber, Rp 2,000/seedling for two-year old rubber, etc., reaching a maximum of Rp 5,000rp/tree for five-year old or older rubber trees. Rubber older than ten years generally survives wild fires with a delay of a few months in production. With a rubber planting distance of 3 x 6 m per hectare, one hectare of an one-year old rubber garden that was destroyed by fire would require compensation for damages totaling Rp 560,000.

Why do farmers use fire as land clearing method?

Farmers were asked which crops they presently cultivate and with which crops they have had experience. For each crop mentioned, the farmer was asked if not burning would result in a delay until (first) production and/or a decrease in production. When the respondent indicated that there would be a difference either in production or in time until first production, he was asked the main reasons for this expected difference. Table 3 shows the responses of the farmers. The reasons for differences in time until production and/or yield per crop are mentioned in order of importance to the farmers that cultivate or previously cultivated that particular crop.

***Table 3.* Reasons why farmers in the Sepunggur area use fire as a means to clear land**

Crop	Number of Respondents	Advantages of Burning
Rubber	30	ash acts as fertilizer (15) weed and tree competition is reduced due to the burn (9) burning creates space to plant and walk (5) burning reduces occurrence of pests and diseases (5) burning loosens the soil resulting in faster establishment in loose soil (2)
Upland Rice	26	ash acts as fertilizer (21) weed and tree competition is reduced due to the burn (8) burning creates space to plant and walk (5) burning reduces occurrence of pests and diseases (2) burning loosens the soil resulting in faster establishment in loose soil (2)
Annual Crops (Not Upland Rice)	23	ash acts as fertilizer (18) weed and tree competition is reduced due to the burn (5) burning creates space to plant and walk (3) burning reduces occurrence of pests and diseases (3) burning loosens the soil resulting in faster establishment in loose soil (2)
Fruit trees	12	ash acts as fertilizer (7) weed and tree competition is reduced due to the burn (4) burning creates space to plant and walk (2) burning reduces occurrence of pests and diseases (2) burning loosens the soil resulting in faster establishment in loose soil (0)
Banana	2	ash acts as fertilizer (1) burning loosens the soil resulting in faster establishment in loose soil (1) burning creates space to plant and walk (0) weed and tree competition is reduced due to the burn (0) burning reduces occurrence of pests and diseases (0)
Cinnamon	14	ash acts as fertilizer (8)

Crop	Number of Respondents	Advantages of Burning
		weed and tree competition is reduced due to the burn (4) burning creates space to plant and walk (3) burning reduces occurrence of pests and diseases (2) burning loosens the soil resulting in faster establishment in loose soil (0)
Cassava	16	ash acts as fertilizer (11) burning creates space to plant and walk (2) weed and tree competition is reduced due to the burn (2) burning loosens the soil resulting in faster establishment in loose soil (2) burning reduces occurrence of pests and diseases (1)
Coffee	3	burning reduces occurrence of pests and diseases (1) ash acts as fertilizer (1) burning loosens the soil resulting in faster establishment in loose soil (1) burning creates space to plant and walk (0) weed and tree competition is reduced due to the burn (0)
Oil palm	1	burning creates space to plant and walk (1) weed and tree competition is reduced due to the burn (0) burning reduces occurrence of pests and diseases (0) ash acts as fertilizer (0) burning loosens the soil resulting in faster establishment in loose soil (0)
Chilies	9	ash acts as fertilizer (9) weed and tree competition is reduced due to the burn (2) burning creates space to plant and walk (1) burning reduces occurrence of pests and diseases (0) burning loosens the soil resulting in faster establishment in loose soil (0)

Crop selection and planting

A field can be planted within one week after burning. Soil temperatures are estimated to be back to prior-to-burn conditions two to three days after the burn. Fields are on average ideally planted one month after the start of the rainy season for two reasons:

- after one month the soil is really moist to guarantee quick establishment of the rubber seedlings, and
- the rains will move the ash left on the soil after burning into the soil thus increasing the soil fertility status.

All of the most recently opened fields (within the past five years) were planted with local rubber seedlings and at fixed planting distances (3 x 6 m). Only one farmer planted his field (one hectare) with clonal rubber. Costs of planting material prohibits all but one farmer from planting improved clonal rubber seedlings although farmers recognize that clonal rubber can produce up to three times as

much latex. Annual crops are planted within the young rubber trees by fifteen of the thirty respondents in the first two years. In 1997, six of the thirty farmers interviewed opened new fields. All six plan to plant local rubber seedlings and intercrop in the first two years with upland rice and vegetables. Cultivating annual crops any longer than two to three years is considered uneconomical since by then rubber trees cause too much shade for successful cultivation of annual crops (14), the soil is not fertile anymore (9), there are too many problems with pigs and monkeys (7), and there is too much weed competition requiring intensive weeding (6).

Off all the new plots established by the respondents in the past five years, Table 4 shows the initial suitability for five indicator crops: corn (*Zea mais*), rice (*Oryza sativa*), groundnut (*Arachis hypogea*), cassava (*Manihot esculenta*), cinnamon (*Cinnamomum zeylanicum*), and vegetables. In addition, this table shows the main reasons for considering specific plots as unsuitable for one or more of the indicator crops at the moment of land clearing.

Table 4: **Initial suitability assessment for crop cultivation of the 70 operated plots by the 30 respondents in the Sepunggur area**

Reason Why a Certain Plot is Not Suitable for Cultivation	# of Plots (out of 70) Not Suitable for Cultivation of the Following Crops					
	Corn	Upland Rice	Groundnut	Cassava	Cinnamon	Vegetables
The Soil is Not Fertile Enough	3	1	9	0	33	2
The Soil is Too Dry	6	0	0	0	0	0
Crop Needs Intensive Cultivation	0	6	3	0	6	1
Problems with Pests (Pigs, Monkeys)	40	8	28	28	0	2

Cinnamon is described by farmers as the soil fertility indicator. According to most respondents, if cinnamon can grow, the soil is fertile enough to grow any of the other crops. The cultivation of groundnut and cassava is restricted due to damage by pigs, whereas cultivation of corn requires more regular rainfall in addition to protection from pigs and monkeys. Upland rice cultivation suffers from attacks by pigs in addition to requiring intensive weeding. Most plots (65 out of the 70) are considered suitable for cultivation of vegetables although on average only for a period of one to three seasons.

Of the 70 plots owned and operated by the respondents, 33 were classified as not fertile enough for cinnamon cultivation. Of those 33 plots, 18 were converted to rubber gardens from more than 30-year-old forest. Of the 37 plots that were

considered fertile enough for cinnamon cultivation, only 19 were slashed that had 30-year old or older vegetation. Twenty-five farmers indicated that if they had a choice, they would select jungle rubber or primary or logged over forest that was older than 30 years old for conversion to new rubber gardens, since the soils supporting these vegetation types are the most fertile. Hence, although cinnamon is considered a crop that requires fertile soils, and soil under primary forest is generally considered to be more fertile, soil fertility does not seem to be correlated with the age of the original forest vegetation.

Farmer's perceptions on the effects of burning on soil fertility and plant responses

Fields are rarely homogeneously burned. Slash-and-burn generally leaves a patchy pattern of unburned litter and biomass, ash, charcoal, and red (combusted) soil. Tables 5 and 6 show farmers' perceptions of soil fertility status of these patches on upland rice and rubber.

For an annual crops like upland rice, almost all respondents indicated that black soil covered with ash is more fertile and results in faster growth and higher production. For rubber trees, a delay in yields is mentioned by more farmers than a reduction in yield.

***Table 5:* Comparison of farmers' perspectives on *Oryza sativa* response to differences in burning intensity: unburned soil, once burned soil (black with ash), and soil exposed to high temperatures in a second burn (red soil deprived of organic matter).**

Time until First Production			Yield		
Unburned Soil	Black/ Ash Soil	Red Soil	Unburned Soil	Black/ Ash Soil	Red Soil
longer (28)	control	longer (25)	higher (0)	control	higher (0)
same (2)		same (4)	same (1)		same (4)
shorter (0)		shorter	lower (29)		lower (25)
don't know (0)		don't know (1)	don't know		don't know (1)

Table 6: **Comparison of farmers' perspectives on *Hevea brasiliensis* response to differences in burning intensity: unburned soil, once burned soil (black and with ash), and soil exposed to high temperatures in a second burn (red soil deprived of organic matter).**

Time until First Production			Yield		
Unburned Soil	Black / Ash Soil	Red Soil	Unburned Soil	Black / Ash Soil	Red Soil
longer 25	control	longer 20	Higher 0	control	higher 0
same 5		same 9	same 12		same 13
shorter 0		shorter 0	lower 18		lower 16
don't know 0		don't know 1	don't know 0		don't know 1

Reasons for the delay in production and yield reduction in non-burned soil as compared to burned soil (black soil) are the observations that ash acts as a fertilizer (28) and that burning reduces problems with regrowth of trees and weeds (21). Red soil is considered less fertile (24) and described as not being able to contain water (16). For these reasons, several farmers indicated that it was less desirable to burn a second time (pile-and-burn methods). Still, 14 of the 30 respondents indicated that they piled and burned wood after the first burn, while 16 farmers only burned once (broadcast burn). Temperatures measured during a burn in second burn locations in agronomic experiments in the same area reached over 600^0 C and these temperatures can be maintained for up to thirty minutes resulting in combustion of the soil. Still, the benefits of burning all wood from the field (easier planting and management of the newly planted trees) outweigh the expected decrease in soil fertility and water containing capacity of the soil.

Table 7 shows farmers' expectations towards growth and yield of the most important crops in the Sepunggur area as influenced by using fire as a land clearing method. Two of the respondents indicated that they expected a one or two year delay in the first production of latex. All other respondents that expected a delay could not indicate how long that delay might be.

Table 7. **Effect of using fire as land clearing method on time until (first) production and yield of the most important crops in the Sepunggur area**

Crop	Number of Respondents	Not Burning Results in Yield Delay		Not Burning Results in Yield Reduction	
		Yes	No	Yes	No
Rubber	30	25	5	18	12
Upland Rice	26	25	1	25	1
Annual Crops (not upland rice)	23	22	1	22	1
Fruit trees	12	11	1	10	2
Banana	2	2	0	2	0
Cinnamon	14	13	1	11	3
Cassava	16	14	2	11	5
Coffee	3	3	0	3	0
Oil palm	1	1	0	1	0
Chilies	9	9	0	9	0

Although farmers recognize these microscale differences in soil fertility after burning, the advantages of planting at fixed planting distances as mentioned by the respondents (faster growth, easier to tap and to keep clean, less root competition and hence stronger roots resulting in less problems with wind) outweigh the advantages of the expected shorter time until production and higher yields when rubber seedlings are planted in locations with black soil and ash (as compared to unburned and/or red soil).

Future field selection

All fields in the Sepunggur area have been assigned. There has been no community forest left since 1987. Those farmers that still own secondary forest or bush fallow (21 farmers) intend to slash-and-burn the remaining areas (on average three hectares per household) within the next five years.

As mentioned above, twenty-five farmers indicated that if they had a choice, they would select jungle rubber of primary forest that was older than 40 years since the soils supporting these vegetation types are most fertile. Five farmers prefer secondary forest that is less than 10 years old since slashing is easier. In addition, farmers prefer flat fields over sloped fields (easier to tap and keep clean) and dry fields over fields that are waterlogged for one week to one month (establishment of rubber is restricted in a waterlogged field).

Farmers can no longer select which field they will open since on average they own only one field that can yet be converted to rubber garden. Most forest still left in Sepunggur is less than ten years old. Only two farmer indicated owning

old jungle rubber (more than 40 years old) while one farmers owned 20-30 year old secondary forest. There is no primary forest, no secondary forest older than 30 years old and only a small area of old jungle rubber left. Farmers indicated that five years ago, there was still primary forest/logged over forest and old (more than 30 years old) secondary forest. All remaining secondary forest and old jungle rubber is expected to disappear within the next 5 to 10 years.

As indicated before, all newly opened fields in the past five years have been planted with rubber seedlings. Farmers expect the total area of rubber garden to increase in the coming five years due to conversion of the remaining bush fallow and secondary forest to new rubber gardens. After this conversion, there will be no more forest left and slash-and-burn will only take place to rejuvenate or convert rubber gardens.

Although presently farmers converted all newly opened plots to rubber gardens and plan to do so with the remaining bush fallow and forest, a majority expects a reduction in the total area of rubber garden. The main reason for this expected decrease in total area of rubber garden in Sepunggur is that oil palm companies have shown interest in the area. None of the farmers would like to convert rubber gardens to oil palm, but seventeen of the thirty farmers indicated that they expect the total area under oil palm to increase in the next five years due to the buying power of the big oil palm companies. When asked if they would consider converting their rubber plantations to oil palm plantations in an agreement with an oil palm company, only three farmers replied they would join the oil palm project. All three own an above average size of land (9, 10 and 15 hectares total area and 6.5, 5, and 9 hectares bush-fallow/secondary forest, respectively). For two out these three farmers, converting this land to oil palm would still mean that they own an above average size farm (with crops other than oil palm) in the Sepunggur area. All other farmers said they would refuse to convert their rubber plots.

Rubber cultivation was introduced into the area early in the twentieth century and has been part of farmers' lives ever since, while oil palm is a new crop. Most farmers who expect rubber to remain the most important crop in the Sepunggur area in the next fifteen years indicated that this is due to the fact that farmers know how to cultivate rubber and can do so relatively independently. Establishing rubber gardens involves little cost whereas establishing an oil palm garden requires a large investment in the planting material. Not being able to use fire as a land clearing method would force them to slash-and-mulch. Only one of the 27 farmers that stated his refusal to join an oil palm project indicated that he would join an oil palm project if burning a field was no longer an option. Seven farmers would slash and remove the wood from the field if slash-and-burn was no longer permitted anymore.

Discussion and Conclusions

At present, rubber is the most important crop in the Sepunggur area. According to the farmers interviewed in this survey, rubber cultivation will still be the main

source of income in the next five years, while oil palm cultivation is likely to take off and consume some of the area presently under rubber cultivation after all land has been converted for agricultural use. No new land is available for conversion so changes will have to take place within the existing area. Although an increase in oil palm cultivation is expected, only two respondents believe that in ten years time oil palm will be more important than rubber. Seventeen respondents predict that rubber will still be more important whereas eleven respondents expect oil palm and rubber to be of equal importance ten years from now.

What would be the effect on smallholders of a ban on burning as a land clearing method?

Seven out of 30 farmers indicated that if slash-and-burn was no longer permitted as a land clearing method to establish new or to rejuvenate old rubber gardens, they would slash-and-remove-wood. Eighteen farmers would slash-and-mulch. Only one farmer would sell his forest if burning for conversion to rubber garden was no longer permitted.

Farmers mentioned five advantages of slash-and-burn as a land clearing method:

1) ash acts as a fertilizer;
2) weed and tree competition is reduced due to the burn;
3) burning creates space to plant and walk;
4) burning reduces occurrence of pests and diseases; and
5) burning loosens/crumbles the soil, resulting in faster establishment of the seedlings.

Mulching does not address any of these five benefits of burning. Slash-and-remove-wood addresses only the third advantage and requires a tremendous effort in labor. Mulching and slash-and-remove-wood does not contribute to air pollution, however, farmers expect a reduction in income due to difficulties in establishing new rubber gardens (increased occurrence of pests and diseases), and/or a reduction in yield (lower soil fertility status due to absence of ash addition), and an increase in labor costs (more time needed for removing the wood, planting and weeding). An increase in poverty is expected if burning is banned. The following response from two of the farmers is characteristic: “If the government does not permit using fire as a land clearing method anymore, it would kill us”.

The respondents of this survey indicated that all forest will be converted to rubber gardens with or without intercropping with other crops. After all forested land has been converted, the total area under cultivation will not increase anymore. Some form of land clearing will, however, remain necessary to rejuvenate those rubber gardens or to convert them into other land use systems. Selling wood to reduce the fuel loads and increase farmers’ incomes is no longer an alternative unless rubber trees could be sold. Slash-sell-and-burn would then be an alternative that could to a large extent maintain the advantages of using fire (even reduce the occurrence of topsoil completely deprived of organic matter due to extremely high temperatures during the burn), while supplying the farmer

with an extra source of income and the initiative to remove and not to burn the trees. By selling rubber wood, farmers can cover costs of land clearing and earn enough to be able to cover some of the costs of buying higher-yielding clones for rubber replanting (ICRAF Alternatives to Slash-and-Burn Summary Report 1995). This alternative does require a change in local trade regulations and taxes. At present, the high export levy for rubber wood and local trade regulations and taxes severely restrict the sale of rubber wood by smallholders.

In the second week of September (**NEED YEAR)**, a bulldozer entered the Sepunggur area. The sand roads to Kampung Sepunggur and to Kampung Baru are expected to be converted into asphalt roads before the end of the year. A recent map from the forestry department shows that the entire Sepunggur area has been assigned to PT Kharisma, an oil palm company that is likely to start drastically changing the situation for farmers in Sepunggur in the very near future. Of the total area of 180 hectares owned collectively by the 30 farmers interviewed, only 19 hectares are owned with an official land title.

If and when oil palm cultivation absorbs rubber cultivation, large areas of rubber gardens will need to be converted to oil palm. The problems of land clearing remain but is expected to shift from smallholders to large-scale plantation owners. Without development of alternatives, situations like the present day environmental disaster caused by the land-clearing operations of big plantation owners in Sumatra and Kalimantan are likely to reoccur. Whether we should focus on smallholders or large plantation owners depends on Indonesian development plans.

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