Smallholder Rubber and Swidden Agriculture in Borneo: A Sustainable Adaptation to the Ecology and Economy of the Tropical Forest

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# SMALLHOLDER RUBBER AND SWIDDEN AGRICULTURE IN BORNEO: A SUSTAINABLE ADAPTATION TO THE ECOLOGY AND ECONOMY OF THE TROPICAL FOREST[1]

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**Dove, Michael R.** *(East–West Center, Honolulu, HI 96848).* SMALLHOLDER RUBBER AND SWIDDEN AGRICULTURE IN BORNEO: A SUSTAINABLE ADAPTATION TO THE ECOLOGY AND ECONOMY OF THE TROPICAL FOREST. *Economic Botany 47(2):136–147. 1993. This is a study of the role of Para rubber cultivation in a system of swidden agriculture in Indonesian Borneo. Such smallholdings produce most of Indonesia's rubber, which is the country's largest agricultural generator of foreign exchange. Rubber integrates well into Bornean systems of swidden agriculture: the comparative ecology and economy of Para rubber and upland swidden rice result in minimal competition in the use of land and labor—and even in mutual enhancement—between the two systems. Rubber occupies a distinct niche in the farm economy: it meets the need for market goods, while the swiddens meet subsistence needs. The intensity of production on these smallholdings is, as a result, characteristically low (and may even vary inversely with market prices). This reflects the independence of these smallholders from external economic and political influences, which has been the key to their historical success. The special virtues of such "composite systems" merit greater attention by development planners.*

Karet Rakyat dan Sistem Perladangan di Kalimantan: Suatu Adaptasi Yang Baik Terhadap Ekologi dan Ekonomi Hutan Tropika. *Penilitian ini mempelajari peranan karet rakyat sebagai pasangan bagi sistem perladangan di Kalimantan-Indonesia. Perkebunan karet rakyat merupakan penghasil utama karet Indonesia, yang merupakan penyumbang pertanian terbesar bagi devisa negara. Karet rakyat membaur dengan baik dalam sistem perladangan di Kalimantan: pembandingan ekologi dan ekonomi antara karet rakyat dan sistem perladangan menunjukkan persaingan yang minimum dalam pemakaian lahan dan tenaga kerja—dan bahkan saling menguntungkan—antara kedua sistem tersebut. Karet rakyat menempati kedudukan yang penting dalam ekonomi usaha para peladang: yaitu memenuhi kebutuhan barang-barang pasar, sedangkan sistem perladangan memenuhi kebutuhan pokok hidup. Intensitas produksi perkebunan karet rakyat oleh karena itu, brasanya agak rendah (yang kadang-kadang berbeda berbalikan dengan harga pasar). Hal ini menggambarkan ketidak-bergantungan petani karet pada pengaruh-pengaruh ekonomi dan politik dari luar, dan ini merupakan kunci sukses mereka. Hal-hal khusus yang menguntungkan dari sistem terpadu ini patut mendapatkan perhatian yang lebih besar dari perencana-perencana pembangunan.*

**Key Words:** rubber; smallholder; swidden agriculture; Kalimantan or Borneo; Indonesia; *Hevea brasiliensis.*

Rubber is one of Indonesia's major resources: a major source of household income for over eight million people, and the country's largest agricultural generator of foreign exchange (Government of Indonesia 1991); it makes Indonesia the world's second-largest rubber producer. Some of this rubber is produced on large plantations or estates, which employ modern agricultural technology, heavy capital investment, and a wage labor force. But the bulk of Indonesia's rubber, 75 percent at the most recent count (Government of Indonesia 1991:215–216), is produced in tiny gardens of a hectare or so, with century-old technology, by "smallholders"—ordinary farmers (typically owning less than 25 hectares [Barlow and Muharminto 1982:86]) who produce rubber with household labor to meet part, typically not

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the major part, of their household's income requirements. Rubber is ideally suited to this purpose. In the words of Barlow (1990:35), it offers "flexible management . . . limited reliance on skill . . . easy disposal of output . . . and a good cash potential."

General analyses of smallholder agriculture are found in historical studies of Indonesian economics by Boeke (1953), Booth (1988), Lindblad (1988) and Pelzer (1978b). Studies focussing specifically on the contemporary smallholder sector include those by Barlow and Jayasuriya (1984), Barlow and Tomich (1991), Collier and Tjakrawedaya (1972), and Seavoy (1980); and studies devoted to smallholder rubber in particular have been carried out by Barlow and Muharminto (1982), Chamala (1985), Cottrell, Ip and Western (1985), Dillon (1985), and Effendi (1985). A number of studies have noted that smallholder rubber cultivation often is associated with swidden cultivation of food crops (Best 1988; Chin 1982; Colfer, Gill and Fahmuddin 1988; Cramb 1988; Dove 1983; Padoch 1980; Pelzer 1978a; and Thomas 1965). (Valuable data on rubber cultivation by swidden agriculturalists also are presented in broader analyses of tribal agriculture and economics by Drake 1982, Freeman 1970, Geddes 1954, and Hudson 1967.)

There is one major shortcoming in these latter studies: there is little analysis of the relationship between the two systems—rubber on the one hand and swiddens on the other—and thus little understanding of why this combination historically proved to be so successful. This failure is notable, given the great deal of research that has been done on swidden communities in Southeast Asia. Scholars have almost uniformly defined these communities in terms of their swidden activities alone, in spite of the fact that one of the most important characteristics of these communities—in terms of explaining their place within the broader national and international economic system—is the combination of subsistence-oriented swidden agriculture with export-oriented cash crop cultivation. The practical and theoretical implications of composite swidden economies like this merit more attention than they have received.

The purpose of my study is to analyze the role of rubber in swidden ecology and economy, focusing in particular on one of Indonesia's outer islands, Kalimantan, and one of its tribal groups, the Kantu'.

## The Kantu' and Their Rubber

The Kantu' are an Ibanic-speaking tribe of West Kalimantan (Fig. 1). They grow dry rice (as well as some swamp rice), maize, cassava, and a wide variety of non-rice cultigens in swiddens cut from both primary and secondary forest. In addition to cultivating annual food crops in their swiddens, the Kantu' cultivate several perennial cash crops in the fallowed swidden land. These include a variety of trees yielding edible fruits and oils, the pepper plant (*Piper nigrum*), and, especially, the Para rubber tree (*Hevea brasiliensis*). Rubber is the Kantu's primary source of cash or tradeable commodities, used to obtain the basic trade goods of salt, tobacco, clothing, and kerosene (cf. Hudson 1967:305). This combination of market- and subsistence-oriented agricultural activities is quite common in Indonesia (and indeed among forest dwellers throughout the tropics). Other examples are swidden agriculture and rattan gathering/cultivation in East Kalimantan (Lindblad 1988:59–60; Peluso 1983a,b; Tsing 1984; Weinstock 1983), and swidden agriculture, coffee and damar in Sumatra (Mary and Michon 1987).

The rubber trees of Kalimantan and the rest of Southeast Asia are descended from seedlings that the British gathered in Brazil in 1876 and planted in Singapore. The first seedlings from the Singapore trees arrived in Sarawak in 1882 (Tremeer 1964). By 1908, the Sarawak government was distributing rubber seedlings to natives in the interior (Cramb 1988:111; Tremeer 1964). On the Dutch side of the border, in West Kalimantan which today ranks fifth among Indonesian provinces in terms of rubber acreage (Barlow and Tomich 1991), the introduction of the rubber tree occurred in 1909 (Uljee 1925:74 cited in King 1988:237). Rubber was first planted in West Kalimantan by coastal Chinese and Malay farmers (Ward and Ward 1974:36). The Kantu', however, for whom communication was, and remains, easier across the border to Sarawak than to the distant Kalimantan coast, obtained their first rubber seedlings from Iban tribesmen in the Saribas drainage of Sarawak, and from a Catholic mission downriver on the Kapuas in the late 1920s. The Mualang of the Belitang river system to the West of the Kantu' territory started planting rubber trees in the early 1930s (Drake 1982: 169–170). A majority of Kantu' households had


**Fig. 1.** The Kantu' territory in Kalimantan, Indonesia.

planted some rubber by World War II, although households with mature rubber were still in the minority.

At the time of the fieldwork for this study, the fourteen households in the Kantu' longhouse of Tikul Batu owned a total of 66 separate rubber *kebun* "gardens" (see Fig. 2), for an average of almost five gardens per household. The gardens average a little less than a hectare in size and contain 200–400 trees, for a total of over four hectares and 1000–2000 trees per household. At the time of this study, 61 percent of these gardens

contained mature trees, and 39 percent contained immature trees. Production characteristics are summarized in Table 1.

## Rubber and Swidden Agriculture

The rubber gardens of Borneo's swidden agriculturalists have been called "managed swidden fallows" (Cramb 1988:112; Padoch 1988). Smallholder rubber is not simply cultivated by people who also happen to be shifting cultivators, it is integrated into the shifting cultivation cycle (Barlow and Jayasuriya 1984; Barlow and Muharminto 1982; Effendi 1985:108)—an integration that most observers have characterized as an easy one (Muzzall 1925 cited in Booth 1988: 205; Cramb 1988:112). The most significant aspect of this integration of swidden and rubber cultivation, for the purpose of the present study, is that swidden cultivators use surplus land and labor resources within the swidden system to cultivate rubber. This is not always the case for tree crops in swidden systems: Eder (1981) described a case of arboricultural development in the Philippines, in which tree crops became competitive with swidden food crops.

### Rubber and Swidden Labor

A salient characteristic of swidden agriculture is the variable and seasonal nature of its labor demands (see Dove 1985a; Drake 1982; Freeman 1970; and Padoch 1978 on the practice of swidden agriculture among Ibanic peoples). Labor is in great demand during some stages of the swidden cycle, in less demand in other stages, and not in demand at all during the periods between stages. In the Kantu' case, the greatest demands for labor occur during planting, weeding, and harvesting (Dove 1984:111; cf. Drake 1982: 141). These three stages together account for approximately four months of work. During the remaining eight months of the year, swidden labor is in surplus (by definition, since if swidden cultivators have sufficient labor to meet the demand during the three intensive stages, they will automatically have more than sufficient labor to meet demands during the remaining less intensive stages). The number of potential surplus days per year ranges from 163, for swiddens made in secondary forest, to 211 for swiddens made in primary forest (Dove 1984:111). Since labor and not land is the primary factor of production in swidden societies, the productive use of this surplus labor is a major economic challenge.

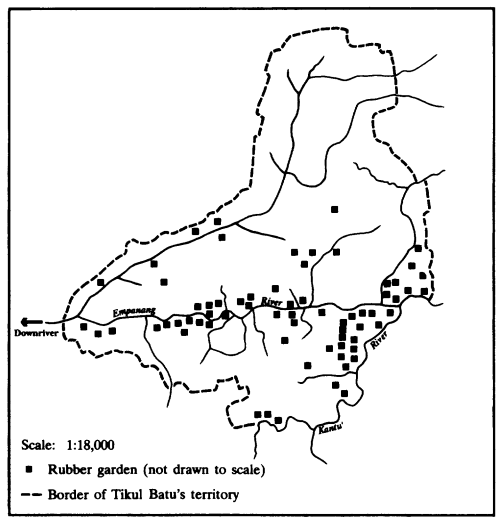


**Fig. 2.** The rubber gardens of the Longhouse Tikul Batu. This figure includes some rubber gardens that lie within the territory of Tikul Batu but belong to households in other longhouses, and it does not include a number of gardens that belong to Tikul Batu households but lie within the territories of other longhouses.

Rubber cultivation is well-suited to meeting this challenge, because it is uniquely adapted to intermittent exploitation (Geddes 1954:98). Periodic idling of rubber trees actually benefits them and results in higher peak latex flows when tapping is resumed. Barlow (1978:146) suggested that tapping ideally should be limited to 15–19 days per month to achieve maximum latex flows. The only cost entailed in intermittent exploitation (and then only after relatively long periods

Table 1. Rubber production at the Longhouse Tikul Batu.[1]

| | Per day | | Per year | |
|---|---|---|---|---|
| Per person | Per 100 trees | Per garden | Per ha. | Per household |
| 1.0–1.5 kg | 1.5–3.5 kg | 2–7 kg | 150–350 kg | 150–350 kg |

[1] All figures are given in kilograms of dried sheet rubber. The Kantu' produced only wet slabs until the 1950s, when they acquired their first rubber mangles, after which they have produced only dried, sheet rubber.

of idling) is a reduced flow of latex during the first few days after resuming tapping (cf. Chin 1982; Colfer, Gill and Fahmuddin 1988). (The Kantu' say that the flow of latex re-attains its maximum on the third day after tapping is resumed.) This characteristic allows the Kantu' to start and stop tapping as labor is freed from or required in their swiddens. As Hudson (1967: 308) wrote of the Ma'anyan in Southern Kalimantan: "Tapping operations are begun or terminated as the rhythm of the dangau family's activities may dictate . . ."

This meshing of the rubber and swidden cycles is facilitated by a variety of cultural and silvicultural factors. For example, when work is halted in the swiddens due to ritual proscriptions (following ritual sacrifices, curing ceremonies, or ill omens), tapping usually is permitted in the rubber groves (cf. Freeman 1960:87n). The number of days of swidden work proscribed by ritual is considerable. In one twelve-month period during the study, just two sources of ritual proscriptions—the phases of the moon and curing ceremonies—accounted for a total of 51 proscribed days (Dove 1985a:28–29).

On the other hand, when tapping of rubber is not possible because of rain, work can still be done in the swiddens. This is an important advantage in Kalimantan, where I recorded an average of 16.2 days per month on which more than one millimeter of rain fell, and a total annual rainfall of 4,290 millimeters (Dove 1985a: 43). In peninsular Malaysia, which is considerably drier than Kalimantan, Barlow (1978:137) estimated that rain interferes with tapping on 30–40 days per year. Rain in the morning or even the previous evening can over-fill the latex collection cups, bring about premature coagulation of the latex, and also, according to the Kantu', over-stimulate the flow of latex to the point of harming the tree.

Finally, when labor is possible and necessary in both swidden and rubber garden on the same day, the day can be divided in two. Rubber is tapped by preference early in the morning, when—because of lower air temperature and correspondingly lower evapo-transpiration—the hydrostatic pressure in the latex vessels, and the speed of the latex flow, is greatest (Purseglove 1968:162). The Kantu' say that a garden that yields six kilograms of latex when tapping begins at dawn, will yield just four kilograms if tapping is not begun until 10:00–11:00 A.M. Households with severe rice shortages, that need to tap rubber at the same time as they are working in their swiddens, thus may tap in the morning and work in their swiddens in the afternoon. While this schedule is possible, it is onerous, which Drake (1982:299) recognized by terming it "self-exploitation." The need for labor on the same day in both rubber grove and swidden is, in any case, the exception rather than the rule.

In practice, the Kantu' time most of their tapping during those months of the year when there is little or no work in the swiddens (cf. Geddes 1954:95, 98) They especially try to avoid tapping during the three most intensive swidden stages: planting, weeding, and harvesting. The average Kantu' household does just four percent of its yearly tapping during these three stages, while doing the other 96 percent during the remaining eight months of the year. This inverse association of rubber tapping and intensive swidden labor is statistically significant (Table 2). The tapping calendar is determined not only by when the Kantu' *can* tap, of course, but also when they *need* to tap. The most intensive tapping occurs during January, the time of year closest to the next rice harvest and furthest from the last one. This is the traditional *musim rapar* "famine season" of the Kantu', the time when the proceeds of rubber tapping are most needed for the purchase of rice for daily subsistence.

The use of surplus swidden labor in rubber cultivation is facilitated by a special characteristic of this labor: its exceptional productivity—which is ultimately based on an energy subsidy from the tropical forest. The swidden system, by means of axe and fire, releases and then exploits the energy stored up by the tropical forest, or by forest regrowth during the swidden fallow (cf. Hecht, Anderson and May 1988; McGrath 1987; Rambo 1980). This energy subsidy contributes to returns on labor in swidden agriculture that are relatively high for systems of tropical food crop agriculture. The returns on labor in Kantu' swidden agriculture average 7.9 kilograms of unmilled rice per man-day, which compares, for example, with just 4.2 kilograms in the irrigated rice fields of Java (Dove 1985b). It permits the swidden system to guarantee basic household subsistence, during most years, using only a portion of the available labor. This, in turn, permits the household not only to devote surplus labor to rubber cultivation, but to accept low returns on this labor during periods of low rubber prices,

TABLE 2. TIMING OF INTENSIVE SWIDDEN LABOR AND RUBBER TAPPING.[1]

| Days on which rubber tapping carried out | Days of intensive swidden stages | |
|---|---|---|
| | No | Yes |
| No | 79.5 days | 120.5 days |
| Yes | 158.0 days | 7.0 days |

[1] n = 365 days in the year, $\chi^2 = 124.6$, $P < .001$.

or to cease tapping entirely, while still preserving the rubber gardens for future use. As Geddes (1954:98) wrote, one of rubber's advantages as a cash crop is that "it is not a crop which needs constant attention, so that an owner may go about any other urgent business while still keeping an account at the rubber bank to be drawn upon whenever he finds time to do so."

## RUBBER AND SWIDDEN LAND

A second characteristic of swidden agriculture, in addition to the varying and seasonal nature of its demands on labor, is that it requires this labor in widely-dispersed locations, which change from one year to the next. Each Kantu' household owns approximately two dozen plots of land, two or three of which are cultivated in any give year, while the remainder recuperate under a fallow, forest cover. The dynamics of land-use and inheritance ensure that each household's two dozen plots are scattered all over the ten square kilometer longhouse territory. The distances and travel times that result from this scattering are so great that during at least one-half of each year, most households do not live in the central longhouse but rather in farmhouses built in or near that year's swiddens. It would be difficult during this seasonal dispersal for the Kantu' to tap rubber in any central location.

The Kantu' avoid this difficulty by dispersing their rubber gardens (each household owns an average of five) around the longhouse territory (Fig. 2) and exploiting them in a rotation that matches that of the swiddens. Selection of which garden to tap in a given year is determined by proximity to that year's swiddens. As the Kantu' say: *Asa nadai bumai din, kami nadai motong din* "If we do not make a swidden there, we do not tap rubber there" (cf. Hudson 1967:308). (Freeman [1970:163n] maintained that the Iban of the Baleh river system in Sarawak follow a different system, planting their rubber close to the longhouse and exploiting it by dividing the household labor force between the longhouse and the rubber gardens on the one hand, and on the other the distant swiddens.) This determinate role of the swiddens vis-à-vis the rubber gardens may be reversed under conditions of economic duress. If a Kantu' household reaps an exceptionally poor swidden harvest, it may base its decision on which plot of forest to open for the next year's swidden on proximity to their most productive rubber garden, to assure itself of a source of income to buy rice until the next harvest. The non-exploitation of gardens not located near any swidden in a given year is beneficial: the Kantu' maintain that long-term idling of a garden gives tapping scars a chance to heal and ultimately enhances the garden's longevity and productivity. (Barlow [1978:137] estimated that it takes the bark of a rubber tree 6–9 years to renew itself after tapping.) These benefits are another reason given by the Kantu' for having multiple rubber gardens.

The periodic, long-term idling of rubber gardens is possible, in part, because there are no important alternative uses for the land (viz., no significant "opportunity costs"). Much of the land that is planted in rubber has little or no value within the swidden system (cf. Geddes 1954:99). Rubber is planted by preference along the banks of major streams and rivers (Fig. 2), because access to water is essential for processing and transporting the rubber (cf. Barlow 1978:165). The threat of periodic flooding makes this location highly problematic for swiddens (Dove 1985a: 44–46) but less so for rubber, which can tolerate temporary inundation by flowing water (Ghani, Huat and Wessel 1986:155). (Still, the Kantu' believe that rubber is generally healthier above the floodplain than in it, due to the greater prevalence of *sampok* "termites" [*Coptotermes* sp.] in the floodplain.) Geddes (1954:97) reported a case in the 1930s when some Dayak in Sarawak tried (unsuccessfully) to evade a government proscription on planting rubber on rice land by planting it on land prone to riverine flooding, meaning land that would not normally be thought of as potential rice land.

A second location that is problematic for swiddens but not rubber gardens is *kerangas* "heath forest." The low level of nutrients and absorption capacity of the soils in this forest is inimical to the cultivation of swidden rice (Brunig 1974:138–139) but not, the Kantu' say, rubber (so long as

no standing water is present). On the other hand, rubber does not grow well in some of the locations that are most productive for swidden crops, notably the marshy areas where the Kantu' practice their highly productive swamp rice cultivation (Dove 1980), but where the constant moisture stress is too much for rubber. Finally, even where rubber is planted on land that also could be used for swiddens, the overall impact on swidden cultivation is limited by the minimal amounts of land involved (cf. Geddes 1954:98–99). At the time of this study, just 8.5 percent (4.4 hectares) of the average Kantu' household's landholdings of 52 hectares was planted in rubber, 8.8 percent (4.6 hectares) was under swidden cultivation, and 82.7 percent (43 hectares) was under swidden fallow. Similarly, Hudson (1967:310) calculated that even if the planting rates that obtained at the time of his study among the Ma'anyan were maintained for 50 years, rubber would cover only 2.5–4.4 percent of their territory. He concluded "Therefore . . . fears that rubber trees will soon usurp all productive swidden land seem unfounded" (Hudson 1967:311).

There is one last consideration in the allocation of land to rubber that may surpass all others in importance: establishment of tenure. Under the adat "customary law" of the Kantu' (and many other of Indonesia's tribal minorities), rubber-planting establishes greater rights to land than does clearing the forest for a swidden (cf. Barlow and Muharminto 1982; Cramb 1988:122–123; Drake 1982:102). One of the reasons, and sometimes the sole reason, that the Kantu' plant rubber is to take advantage of this fact, to strengthen their claim to a particular piece of land (especially when this claim is being contested). This tactic is used against land usurpation not only by fellow tribesmen, but also by the government. Under colonial as well as postcolonial land laws, land without evidence of cultivation can be claimed as the property of the government. Successive Indonesian governments have consistently (albeit erroneously) perceived fallowed swidden land as lacking such evidence. In contrast, rubber and other perennial export crops generally are acknowledged as evidence of cultivation (cf. Weinstock and Vergara 1987) because of government interest in them as estate crops. This fact has not been lost on Indonesia's swidden cultivators, some of whom now plant rubber or other tree crops in fallows in large part to forestall their classification by the government as "uncultivated" (cf. Dove [1983:87] on the planting of fruit trees for this purpose by Banjarese in Southeast Kalimantan).

## Rubber and the Household Economy

Having discussed how rubber is integrated into the swidden cycle, it remains to show how it is integrated into the broader household economy. Of particular interest is the intensity with which rubber is exploited. The fact that the swidden system makes surplus land and labor available explains how rubber can be cultivated, but it does not explain how much is cultivated, how intensively. In practice the intensity of cultivation is relatively low, which is explained by a fundamental difference in character between the subsistence- and market-oriented sectors of the household economy.

### Intensity of Cultivation and the Household Economy

Resources available for use in the market-oriented sector of the household economy are not necessarily available for use in the subsistence-oriented sector, and the reverse also is true. Thus, rubber is never viewed as an "alternative" to rice (cf. Drake 1982:145). This dichotomy is heightened by a strong cultural emphasis not only among the Kantu' but throughout Indonesia, on the subsistence sector. Even during a rubber boom, when returns on rubber may rise to ten times that of rice (Barlow and Jayasuriya 1984), rice cultivation remains the first priority (Cramb 1988:115; Freeman 1970:269–270).

Rubber's role is to provide whatever subsistence agriculture cannot or does not provide (Chamala 1985:145; Ward and Ward 1974), and to fill discrete needs (cf. Geddes 1954:95; Hudson 1967:307). Geddes (1954:95) said that this is especially true when rubber is tapped "out of season," which is defined as the slack period in swidden cultivation. As the Kantu' say, they only tap rubber when they are *lapar* "hungry." Geddes (1954:95) wrote ". . . the rubber gardens are in the nature of a bank to be drawn upon when money is needed . . ." (on the use of rubber as a cash reservoir, see Chin 1982; Colfer, Gill and Fahmuddin 1988; Drake 1982:127; and Geddes 1954:95).

Rubber fills two basic categories of needs or "hungers." First, it satisfies the need to obtain basic trade goods and, increasingly, to pay chil-

dren's school fees and expenses (see Best 1988; Chin 1982; and King 1988:237). Among shifting cultivators like the Kantu', dwelling in the interior of Indonesia's outer islands, opportunities to obtain currency or tradeable commodities are otherwise limited. Local wage labor opportunities are restricted by the agricultural calendar and by the availability of households with sufficient surplus rice to pay wages. The advantage of owning a rubber garden is that a household can, in effect, pay itself a wage whenever desired. The second need that rubber fills stems from the economic consequences of misfortune, especially harvest failure (Freeman 1970:267, 271; see also Drake 1982:145, 293, 298; and Ward and Ward 1974:38). A great deal of rubber is used to purchase *beras ili'* "downriver rice" from traders to cover harvest shortfalls (cf. Freeman 1970:271; Geddes 1954:95; Hudson 1967:307; Thomas 1965). The prominence of this use is reflected in the common Kantu' statement *Agi' bisi' padi* "There is still rice," to explain why a household is *not* tapping rubber.

This intermittent nature of the need for rubber production explains one of the two most distinctive features of rubber cultivation among the Kantu' and other smallholders: its low level of intensity. The production figures given in Table 1 are far below the potential output of the Kantu' rubber groves. There are two aspects to this: not all mature gardens are tapped—in an average year only 60 percent of mature gardens are tapped—and those that are, are tapped irregularly. If all mature gardens were tapped, average production per household per year would rise by two-thirds; and if all mature gardens were tapped at a uniform intensity of 160 days/year, production would rise an additional 57 percent. This is calculated by comparing the Kantu' mean of 102 tapping days/year with the estate norm of 160 days/year (Barlow 1978:71). The practicality of this norm for smallholders is indicated by the fact that Collier and Tjakrawedaya (1972) obtained an average tapping intensity of 162 days/year in their survey of Sumatran smallholders.

## Intensity of Cultivation and Market Conditions

The intermittent nature of the need for rubber production also explains the second distinctive feature of smallholder rubber: the purportedly anomalous way that smallholder production sometimes responds to changing market conditions. (Market conditions for rubber are volatile, with rubber prices historically following a 48-month trading cycle [Ghani, Huat and Wessel 1986].) This response was most memorably recorded by the Dutch colonial economist Boeke (1953:40):

> Anyone expecting western reactions will meet with frequent surprises . . . when rubber prices fall the owner of a grove may decide to tap more intensively, where high prices may mean that he leaves a larger or smaller portion of his tapable trees untapped.

The most often-cited instance of an inverse supply curve occurred during the 1930s, when in spite of both low prices and high export taxes imposed by the Dutch, Indonesia's smallholders steadily increased their rubber production (Boeke 1953:125–126; cf. Lindblad 1988:71, 117). The production of the estate rubber sector, in contrast, fell during these years.

The evidence suggests that smallholders sometimes follow an inverse supply curve but not always. While Booth (1988:210–211) suggested that recent increases in smallholder production have been inversely related to price movement, for example, studies by Drake (1982:144) and Thomas (1965), among others, reported a direct relationship between production and price level. Geddes agreed that there is a direct relationship but maintained that, due to the nature of rubber cultivation, increases in prices do not prompt "commensurate" increases in tapping. Geddes wrote (1954:96): "Since the money is generally sought for specific ends, the amount of rubber tapping tends to be governed more by the nature of these particular cash demands than by the value of rubber itself." Some of this variation in observations is probably due to differences among the smallholders themselves, in particular the extent to which production is determined by conditions in the market as opposed to conditions in the household economy (cf. Drake 1982:289–290; Kahn 1982).

The fact that swidden cultivation both meets subsistence needs and frees land and labor for use in rubber cultivation permits the Kantu' to pursue a consumption orientation instead of a production orientation. They can produce not as much rubber as possible, but as much rubber as they need or want. This may result in an inverse production curve, during a time of declining market price, when estate production is following a direct curve. It may also result in a direct pro-

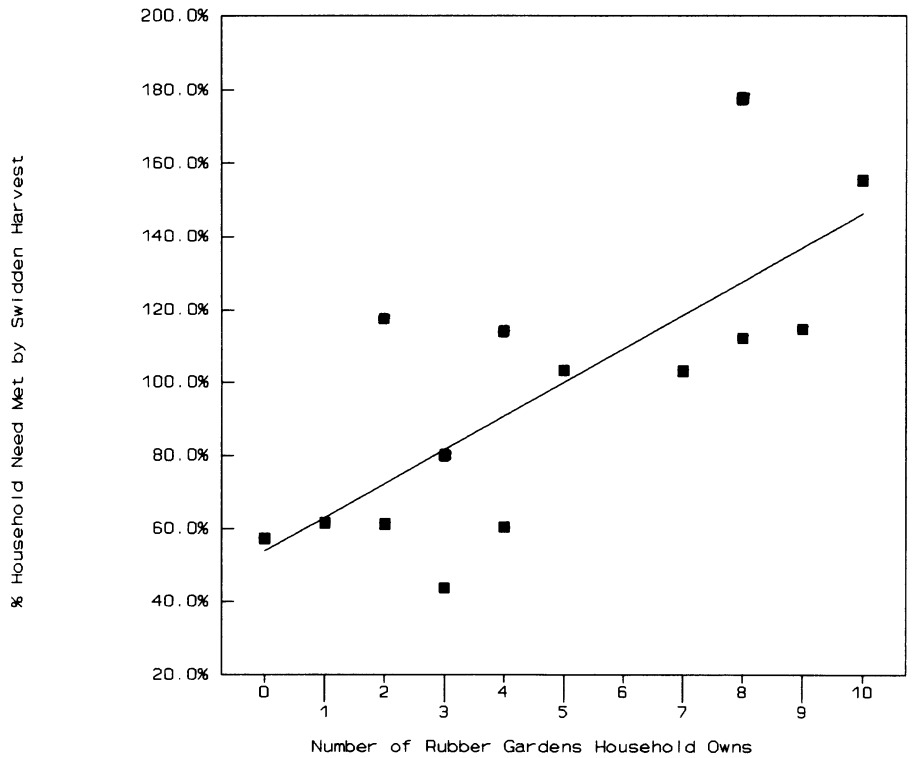


**Fig. 3.** Rubber ownership and swidden success. A regression analysis of the independent variable (number of rubber gardens) and the dependent variable (harvest sufficiency) yields the following results: $r^2 = .562084$; the standard error of coefficient = .023512; and the X coefficient = .092277.

duction curve among smallholders, during a time of rising market price, when estate production is following an inverse curve. Estate production of rubber is characterized as "inelastic" with regard to market demand, because of the long lag time (viz., 7–8 years) between the planting of rubber trees and their readiness for tapping. This lag time is much less relevant in the case of smallholders, however. Since smallholders like the Kantu' typically have almost as many trees out of production as in production at any given time, and since they typically tap at only two-thirds the average attainable frequency, increasing production in response to rising prices is a simple matter of tapping more trees, more often.

## Overall Impact

The ability to exploit rubber at this low and variable level of intensity has an overall, beneficial influence on the household economy: households with rubber tend to be "better-off" than those without. This is true not just because the combination of rubber and swiddens is superior to swiddens alone, but because even swidden cultivation itself, when pursued by rubber-owning households, is superior to swidden cultivation by non-owning households. Figure 3 shows that the more rubber gardens a household owns, the greater the likelihood that its swiddens (alone, without drawing on the production of the rubber groves) will fulfill its subsistence requirements for rice. Geddes (1954:96) also found this to be true in Sarawak in the 1950s: villages and households with rubber tended to be better off in rice than those without. The basis for this association is easily understood. When rubber-owning households experience swidden failures, they can tide themselves over to the next swidden cycle by tapping rubber whenever their labor is not needed in the preparation of the new swiddens. Non-rubber-owning households do not have this luxury: their search for wage labor and other means of meeting harvest shortfalls may disrupt their labor inputs into their new swiddens, which may in turn jeopardize the next swidden harvests (and so on, in a process of pos-

itive feedback). Further, rubber-owning households that have not experienced swidden failure can tap rubber during slack periods in their swidden preparation, and then use the proceeds to hire wage labor during the intensive, constraining periods, thus partially overcoming the major techno-environmental constraint on swidden production.

The principles that make joint rubber and swidden production so beneficial for the farm household also apply, to a varying extent, to the other major export tree crops (e.g., coconuts, coffee). This is reflected in co-variation, among Indonesia's provinces, between the amount of land area under swidden agriculture and the amount under tree crops. When Indonesia's 24 provinces are ranked (using data from Barlow and Tomich [1991:32, Table 3]) according to percentage of agricultural land devoted to swiddens (viz., the relative importance of swiddens in the farming system), and then ranked according to the percentage of agricultural land under tree crops, a comparison of the two rankings yields a Spearman's rank-order correlation coefficient of 0.61, demonstrating a positive association that is significant (for the sample of 24 provinces) beyond the .01 level.

## Conclusions

The great value of the rubber-swidden combination is that it achieves not just minimal competition for resources but mutual enhancement of resource use. This, in turn, enables politically and economically marginal farmers to participate in the market economy to a remarkable extent on their own terms as opposed to the market's, thereby avoiding many of the risks that the latter entails (cf. Hudson 1967:309). Hudson wrote (1967:311):

> Most villagers feel that the rubber market is a chancy thing. World demand varies and prices fluctuate. No one of them wants to be totally dependent on factors over which they have no control.

This is a sensible view. As Booth (1988:231) wrote: "Faced with uncertain world markets, and discriminatory treatment from government, the most obvious 'survival strategy' for smallholders has been to diversify their holdings so that they are not dependent on any one crop."

The dynamics of this diversification have not been well understood in swidden agricultural societies. A number of observers, including some of the most astute, have suggested that the most appropriate cash crops for these societies are those that least disturb, or most mimic, the swidden cycle. Thus, it has been suggested that crops that are cultivated for only a short time before the land has to be abandoned (e.g., as in a swidden cycle), like coffee or pepper, are preferable to those that result in semi-permanent plantings, like rubber or coconut (Pelzer 1948; Wolf 1982: 330). This is a simplistic approach to the problem. As I have tried to show in this study, the role that cash crops play in swidden agricultural societies is determined not by the extent to which they (fail to) "disturb" the swidden cycle, but by the extent to which they *complement* it, in a variety of ways—political and economic as well as agronomic. The focus on disturbance rather than complement is perhaps a product of the past view of these societies as less familiar with commodity production and trade than was in the fact the case.

The implications of this analysis for government policy are being discussed in another study in progress. Suffice it to say here that the combination of swidden agriculture and smallholder rubber cultivation merits greater attention, both in Indonesia and elsewhere. For example, large-scale planting of Para rubber is currently being carried out in China's Yunnan province, but no attempt is being made to integrate it into the existing, sophisticated system of swidden agriculture (the possibility of which is suggested by a highly successful and obviously analogous indigenous system of planting of rattan in swidden fallows [Chen, Pei and Xu n.d.]). I hope that my study may suggest new policy alternatives in the future in development situations like this.

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