

Land tenure, agroforestry adoption, and reduction of fire hazard in a forest zone: A case study from Lampung, Sumatra, Indonesia

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Abstract

Clear land ownership and community involvement in managing forests are key determinants in securing sustainable land management. A recent study in Lampung in the province of Sumatra, Indonesia revealed that, even with the use of military force, forest policy and management has largely failed to protect forest resources when local communities were not involved. In contrast, with less government intervention but more secure land rights (as perceived by farmers), local communities have successfully rehabilitated degraded land, including that designated as state forest area, through establishment of coffee based agroforestry. The main incentive for local communities to manage land more sustainably was the expectation of secure land rights on state forest land through which livelihood and income could be realized. The study indicated that under such circumstances there is room for negotiation between the government forestry department and local communities to better manage state forest land. This not only can generate income for local communities but can also improve the overall environment through reduction of fire incidence. This indicates that legal land use rights for local communities on state forest land could be used as a 'reward' for upland farmers for their role in maintaining environmental services of forest land.

Introduction

A major problem in Sumatra's protected state forest land is incidences of repeated fire¹. This is both a symptom, as well as a cause, for increasing conflict between local people and the Forestry Department over tenure and use rights (Suyanto et al. 2000). If this tenure issue is not appropriately addressed, it will continue to result in unwanted fires and forest degradation leading to the creation of large amounts of smoke and gas emissions and environmental and economic losses. For example, the economic costs of

the 1997/1998 fires in Indonesia was estimated to exceed 9 billion USD as a result of the carbon emissions that elevated Indonesia to the position of one of the largest polluters in the world (ADB and BAPPENAS, 1999; Barber and Schweithelm, 2000).

Strengthening land tenure and use rights is a prerequisite for farmers to adopt better land use management. Feder and Noronha (1987) and Feder and Feeny (1993) strongly argue for the efficiency of secure private ownership in providing appropriate incentives to invest in land improvement. Even where the tenure is not a legal right (government title), but an

¹ Tomich et al (1998) developed three hypotheses regarding reasons for fire ignition and spreading. One of the hypotheses is fire used as a weapon in social conflict.

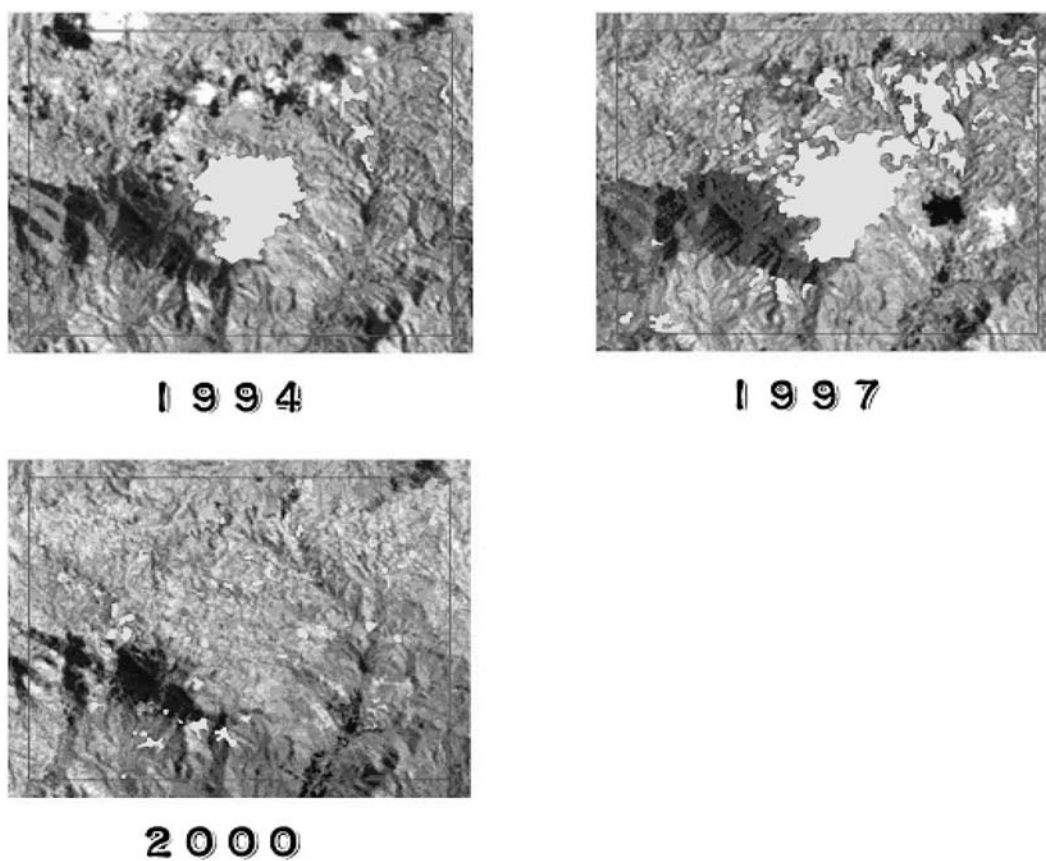


Figure 1. Change in burn scar pattern (indicated by white colour) in Trimulyo, Sumatra, Indonesia from year 1994 to 2000.

informal right, that is respected by community members, farmers may adopt better land use management².

This paper draws on a case study from a protected forest area in Lampung Province, Southern Sumatra, Indonesia, where incidence of repeated wild fires has been reduced in recent years. Burn scar patterns from 1994, 1997 and 2000 are shown in Figure 1. The burn scar pattern in 1994 is similar to the burn scars in 1997. Both burn scars were very large and contiguous. Suyanto et al. (2000) found that large burn scars in 1994 and 1997, and probably in earlier years, resulted from tenure conflicts, and were intentionally caused by discontented villagers. Since then the area had become unproductive grassland (*Imperata cylindrica*) that has been prone to annual fires.

Since 1975 villagers in this area have planted coffee. However, in 1983, 1991, 1993 and 1996, the

Forestry Department implemented a reforestation programme by cutting down the coffee trees planted by farmers and planting *Kaliandra* (*Calliandra calothyrsus*). The government also resettled people in transmigration areas in the lowland penneplain and swamp zone of Lampung, on much less fertile soil. The reforestation programme was largely unsuccessful, as indicated by repeated fires that have been followed by *Imperata* dominance in the landscape.

The burn scar pattern in 2000, however, was different. There is an indication that in small and widely scattered patches there have been controlled fires associated with stable agriculture practiced by small-holder farmers. This change of land management was influenced by a stronger informal land tenure that farmers had claimed in the protection forest since the 1998 *reformasi* era³ in Indonesia.

² See Suyanto and Otsuka (2001) for statistical analysis of determinants of land tenure (informal) on development of agroforestry in the customary land tenure areas of Sumatra.

³ The Reformasi era refers to the period following President Suharto's resignation in May 1998.

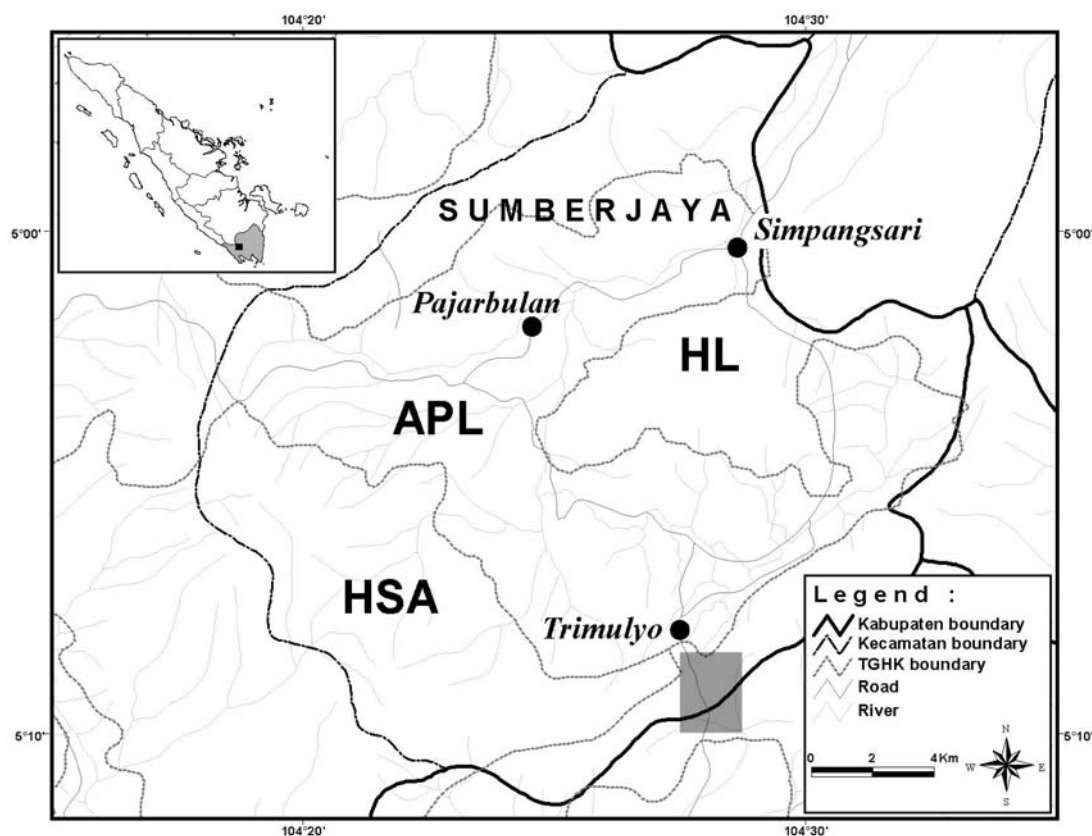


Figure 2. Location of study site (Grey Box) in Trimulyo, Sumberjaya, Indonesia.

The objective of this study was to investigate the influence of land tenure on incidence of wild fires and adoption of more sustainable land use practices. This study also explored the willingness of farmers to participate in community forestry programs.

Method

Data collection was done in two phases. In the first phase, a census of all households that claimed and/or used land at the Trimulyo site was carried out. Using Rapid Rural Appraisal tools, information on demography and migration patterns was collected. The results from the household census were then used as sampling frames for a more intensive household survey in the second phase. For sampling purpose, the households were divided into two categories: Previous migrants (migrated prior to 1998) and Recent migrants (migrated after 1998). Forty randomly selected sample households in each category were intensively

interviewed. Both the extensive and intensive surveys were conducted in 2001.

Site description and in-migration

The study site Trimulyo is located in the protection forest in Lampung Province, Sumatra (Figure 2). The site falls in two administrative districts: West Lampung and Tanggamus and covers an area of approximately 3,130 ha. The topography is mountainous with an elevation between 800 and 1,200 meters. Natural forest still exists in small patches, but the dominant land cover is young coffee plantation that covers almost 75% of the area. Before 1998, almost all land cover in this site was shrub and *Imperata*. Since 1998, however, farmers have actively reclaimed the land for planting coffee.

The history of migration into the area began when the Semendo people from South Sumatra started to settle in 1876. Between 1920-1930 the Semendo in

Table 1. Origin of immigrants in Trimulyo, Sumatra, Indonesia.

Group	N	% coming from villages around protection forest	% from outside the study area		% from Java
			From within Lampung Province	From outside Lampung but from Sumatra Island	
Migrated Prior to 1998	206 (45%)	99	0.5	0	0.5
Migrated After 1998	252 (55%)	0	35	7	58
Total	458 (100%)	45	19	4	32

West Lampung adopted coffee in their shifting cultivation system (Sevin 1989). Forests were cleared, usually through slash-and-burn, and coffee was planted. A ‘bumper’ harvest would be obtained in year 4 and 5, after which the plots were left to secondary forest development.

Lampung Province has been very attractive for migrants during most of the 20th century, with 50% of migrants to all of Sumatra settling in Lampung (Land Resources Department 1988). As the human population increased in the area, forest cover declined – from 647,800 ha in 1985 to 361,319 ha in 1997, a reduction of 45% in 12 years (World Bank, 2001).

Following Indonesia’s independence, in 1951, people from the densely populated island of Java were brought into the area under government sponsored special transmigration programs. Seeing their predecessors’ success in coffee cultivation, ‘spontaneous’ migrants (without government support) followed and settled in unoccupied land. Soon the Javanese population outnumbered the local Semendo population. Currently the Javanese form the majority ethnic group and account for 94% of all households in the area.

Among the 458 household members of the *Tribuana* farmer organization in Trimulyo, who have claimed and cultivated land inside the protection forest area, 55% had moved into the area since 1998 (Table 1). The majority of previous migrants (99%) came from nearby villages while around 58% of the recent migrants arrived directly from Java and other villages in Lampung. There was also a significant age difference between the two groups of migrants. Fifty percent of recent migrants were below 30 years of age, while 60% of the previous migrants were over 40 years old, indicating that recent migration typically involves younger families. Likewise, the education level of the recent migrants was also relatively lower.

A farmer organization called *Tribuana* consisting of 11 sub-groups had been established in 2000, primarily as a requirement for getting land use rights in the protected forest area under the community forestry program (HKM or *Hutan Kemasyarakatan*). The group is also active in monitoring farmers’ land management to ensure that farmers adhere to agreed rules and norms. It also helps its members to understand their rights and responsibilities and disseminates information and knowledge on agriculture, forestry and government policies.

Land holding and land use

Based on a survey of 80 households, the average land holding of previous migrant households was larger (2.5 ha) than that of recent migrants (1.8 ha). Recent migrants almost exclusively (95%) depend on land inside the protected forest area, while the previous migrants have only 68% of their land holdings located inside the protected area (Table 2). The coffee based system accounted for 89% of total land holdings for previous migrants and 65% for the recent migrants. The remaining land holdings (not yet planted), inside the protection forest area, is comprised of bush or *Imperata*. As most recent migrants were relatively poor, they worked as labourers in coffee gardens owned by the previous migrants, in order to fulfil their basic needs and to save money to establish their own coffee gardens. A higher proportion of fallow or *Imperata* on land belonging to recent migrants indicated capital and labour constraints for converting these areas into coffee plantations.

Forest encroachment or claims inside protection forest land intensified following the 1998 *Reformasi* when government control over forests weakened. The economic crisis in 1998 also led to a government

Table 2. Average land holding by type of respondents in Trimulyo, Sumatra, Indonesia.

Type of respondents	n	Coffee		Bush/Imperata land		Total	
		Ha	%	Ha	%	Ha	%
Migrated Prior to 1998	40	2.24	100	0.29	100	2.53	100
Inside Protection Forest		1.42	63	0.29	100	1.71	68
Outside Protection Forest		0.82	37	0	0	0.82	32
Migrated After 1998	40	1.2	100	0.64	100	1.84	100
Inside Protection Forest		1.11	93	0.64	100	1.75	95
Outside Protection Forest		0.09	7	0	0	0.09	5

Table 3. Land cover prior to conversion to new coffee gardens in Trimulyo, Sumatra, Indonesia.

Type of respondents	n	Land use before conversion (%)				
		Coffee garden	Bush fallow	Burn coffee garden	Primary forest	Secondary Forest
Migrated Prior to 1998	97	47	26	25	1	1
Inside Protection Forest	60	33	28	35	2	2
Outside Protection Forest	37	70	22	8	0	0
Migrated After 1998	48	10	67	23	0	0
Inside Protection Forest	45	4	71	25	0	0
Outside Protection Forest	3	100	0	0	0	0

announcement that encouraged farmers to use ‘uncultivated’ land for growing food. Uncultivated land was interpreted by farmers to include parts of the protected forest area that had been previously cleared and was then de facto under *Imperata* and bush.

Contrary to the generally held perception of direct forest clearing for coffee plantations in the Trimulyo area, it was actually the bush, *Imperata* grassland and old burned coffee gardens that were converted to more productive coffee gardens (Table 3). Primary and secondary forests accounted for less than 4% of land converted to coffee gardens. Expansion of coffee cultivation also coincided with a reduction in wild fires and a positive impact on the surrounding environment (Figure 1). However, as agricultural activities inside officially protected forest land continued, farmer activities were continued to be viewed as the cause of forest degradation and forest encroachment.

Based on the structure of existing vegetation, coffee gardens can be divided into three types: (1) Monoculture (or sun) coffee; (2) Shade coffee⁴, and (3)

⁴ Coffee with shade refers to the intercropping of coffee with at least one shading tree that has no direct economic benefit such as: Gamal (*Gliricidia sepium*), Dadap (*Erythrina subumbrans*) and Lamtoro (*Leucaena leucocephala*).

Multistrata coffee⁵. In the Trimulyo area, nearly 89% of coffee gardens inside the protection forest and 100% of coffee gardens outside the protection forest are under the multistrata system (Table 4). 90% of the coffee gardens that are in the protection forest, *Gliricidia sepium* is the most popular tree species used as shade for the coffee (Table 5). It is followed by avocado (*Persea americana*), pepper (*Piper nigrum*), jackfruit (*Artocarpus heterophyllus*) and *Kemiri* (*Aleurites moluccana*). *G. sepium* is also the most common planted species in coffee gardens outside the protection forest (98%), followed by pepper, jackfruit, *dadap* (*Erythrina subumbrans*), *randu* (*Ceiba pentandra*) and avocado. *G. sepium* is also used as a support tree for pepper, a favourite cash crop in Lampung that farmers grew to diversify their farm income, and especially important at times of low coffee prices.

Community-based fire management

The small and scattered patches of the 2000 burn scar (Figure 1) indicated controlled burning, which is a

⁵ Coffee multistrata refers to the intercropping of coffee with two or more shading trees and other trees that have direct economic benefit.

Table 4. Distribution of monoculture, shade and multistrata coffee in Trimulyo, Sumatra, Indonesia.

Type of respondents	Number of plots	Coffee system (% plots)		
		Monoculture (sun) coffee	Shade coffee	Multistrata coffee
Migrated Prior to 1998	97	4	3	93
Inside Protection Forest	60	7	5	88
Outside Protection Forest	37	0	0	100
Migrated After 1998	48	0	10	90
Inside Protection Forest	45	0	11	89
Outside Protection Forest	3	0	0	100

Table 5. Tree species in coffee-based agroforests in Trimulyo, Sumatra, Indonesia.

No	Local Name	Scientific name	Inside Protection Forest		Outside Protection Forest	
			Number of plots	Percentage of plots	Number of plots	Percentage of plots
1	Gamal/Ki Hujan	<i>Gliricidia sepium</i>	95	90	39	98
2	Pepper	<i>Piper nigrum</i>	63	60	39	98
3	Jackfruit	<i>Artocarpus heterophyllus</i>	62	59	35	88
4	Dadap	<i>Erythrina subumbrans</i>	63	60	33	83
5	Alpukat	<i>Persea americana</i>	69	66	27	68
6	Randu	<i>Ceiba pentandra</i>	50	48	28	70
7	Kemiri	<i>Aleurites moluccana</i>	52	50	10	25
8	Petai	<i>Parkia speciosa</i>	18	17	16	40
9	Cengkeh	<i>Eugenia aromatica</i>	20	19	8	20
10	Mango	<i>Mangifera indica</i>	19	18	9	23

positive indication of a community fire management system at work. Community-based fire management is defined in this paper as the conscious use of fire to meet a specific objective. From the perspective of a community or an individual, the objective could be the maintenance of livelihood (Suyanto et al. 2000). In the current case study, it involved clearing forest, bush or *Imperata* to plant coffee, or to secure rights to land.

Indonesian farmers, as farmers in many other parts of the world, have traditionally used fire to clear land, as it is often the least expensive, simple and effective means (Figure 3). This was also true for Trimulyo where 91% of recent migrants and 89% of previous migrants used fire as a tool to clear shrubs, *Imperata* or forest for coffee planting. Farmers also reported that using fire in land preparation provided them with a layer of ash that was an important source of plant nutrients. Fire was also effective in clearing all debris hence enhancing access and movement within the fields. For some

farmers, reduction in insect pests, diseases and weeds following burning was another important aspect. These findings corroborated research results of Ketterings et al. (1999) from rubber agroforests in Jambi Province, Indonesia.

In Trimulyo farmers had to follow community norms and understanding when using fire for land clearance; 97% respondents specifically mentioned the need to follow the rules. The most common rule was the requirement to construct firebreaks prior to burning their plots. Other important rules were that a farmer must burn wood residue in the middle of the field; consider wind direction and field steepness; and start fires at noon. It was also essential to inform neighbouring farmers and to work together to prevent fires from spreading beyond the plot site. In the event of a fire going out of control and damaging neighbours' fields, the farmer was obligated to compensate (in the form of money, labour or seed) for any loss incurred; however, the fire system was flexible, not strictly enforced and negotiable.

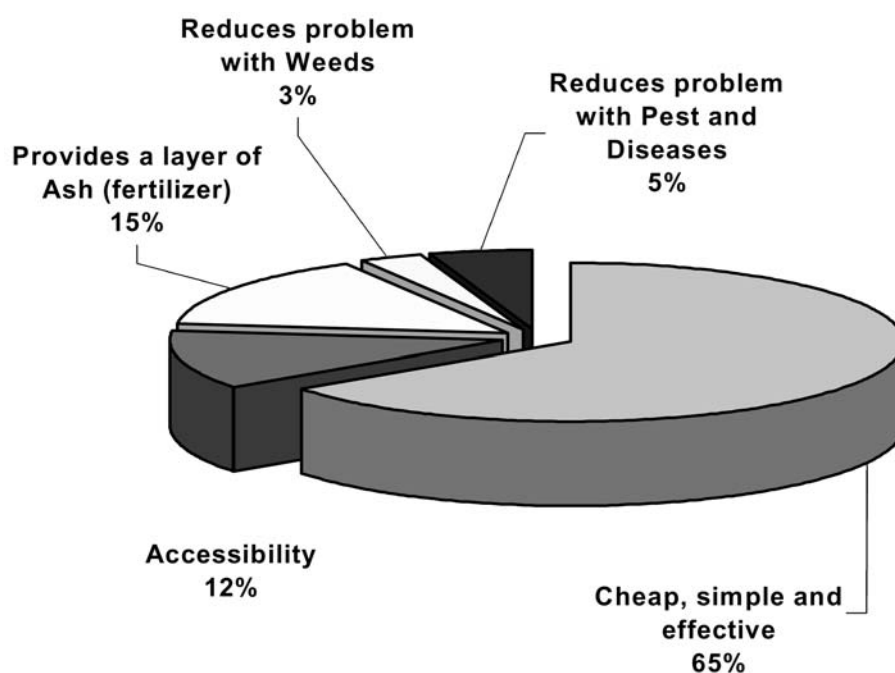


Figure 3. Farmers' reasons for using fire to clear land (percentage figures indicate respondents mentioning related reasons as the primary reasons).

Land tenure and adoption of multistrata coffee

Weakened government control and the post-1998 *Reformasi* movement indirectly strengthened farmers' informal tenure claims over land they had been cultivating. This heightening of tenure rights actually led to a reduction in repeated wild fires (Figure 1) in Lampung. To measure the perception of land tenure rights, informal queries were made on:

Farmers' response to a hypothetical government decision to stop their farming activities in the protection forest area, before and after *reformasi*; and

Value of land inside the protection forest compared to private land outside protection forest, in the post *reformasi* stage.

In the pre-*reformasi* era both previous and recent migrant groups said that if the government stopped farming activities in the protection area, they would have fully accepted, or accepted with compensation determined by the government, this decision. However, in the post *reformasi* context, most respondents, both previous and recent migrants, stated that they would only accept the government's decision to stop farming in the protection forest area upon receiving

compensation determined by farmers or through a process of negotiation. This indicated a substantial increase in farmers' perception of their tenure rights over cultivated land inside protected forest land.

In regards to the value of cultivated land inside protected forest area, 67% of previous migrants and 57% of recent migrants estimated it to be 50–75% of the value of equivalent land outside protected forest land. This is for the post *reformasi* context. Nearly 28% of previous migrants and 38% of recent migrants valued their land at more than 75%. The average land value was 70% of equivalent land outside protected area, indicating an uncertainty factor of 30% of land tenure inside the protection forest area.

The fact that farmers' confidence and feeling of secure tenure rights over their cultivated land inside the protection forest area implies that re-implementation of the government's previous plans to relocate people from the forest zone is likely to encounter much resistance from farmers. A more acceptable approach for protection of forest area is the community forestry (*HKM*) approach in which communities living around forests get involved in co-management of forest resources whereby certain accepted non-

Table 6. Basic statistics on explanatory variables for plot-level analysis of adoption of coffee multistrata system by farmers in Trimulyo, Sumatra, Indonesia.

	Mean	Std.dev.
Tenure (%) ^a	71.8	20.02
Age of household head (years)	36.1	12.01
Schooling of household head (years)	6.2	3.5
Walking time from house to field (minutes)	26.6	31.6
No. of male family workers (16-60 years old) ^b	1.41	0.76
No. of female family workers (16-60 years old) ^c	1.07	0.68
Dependency ratio ^d	0.48	0.44
Sample size	146	

^aequivalent land outside protected forest land; ^bNo. of male family members between 16 and 60 years of age; ^cNo. of female family members between 16 and 60 years of age; ^dRatio of the number of non-working members to the total number of household members.

Table 7. Summary results of Probit analysis of multistrata coffee adoption in Trimulyo, Sumatra, Indonesia.

Variable	Coefficient	Std.error	P-value
Intercept	-6.05 ²	15898	0.999
Tenure (%)	0.0002 ¹	0.001	0.971
Age of household head (years)	-0.018	0.015	0.224
Schooling of household head (years)	-0.043	0.036	0.242
Walking time (minutes)	0.002	0.004	0.573
No. of male family workers (16-60 years old)	0.005 ¹	0.18	0.978
No. of female family workers (16-60 years old)	-0.177	0.228	0.436
Dependency ratio	0.11	0.302	0.715
Plot location in protected forest area dummy	-0.778	0.697	0.264
Slope	6.97 ²	15898	0.996
Sample size	146		
Chi-Square	67.77		0.998

¹Significant at 5% level, ² Significant at 1% level.

forestry activities are permitted. Understandably, this requires a great deal of negotiation at village and local government levels. Conflicts can be resolved through appropriate negotiation and facilitation. Integrated research and development, including research on biophysical, socio-economic, institutional and policy aspects can greatly assist in the negotiation process (Pasya 2001). Tools for accurate prediction, and methodological advances for stakeholder consultations and negotiation are required, while acknowledging the differences in resources and information, wealth, political power, and social status (van Noordwijk et al. 2002).

In order to identify the determinants of the adoption of multistrata coffee, this study applied the familiar probit regression procedure. A recent study on the determinants factors of agroforestry adoption (Pattanayak et al. 2003), classified the determinant factors into five categories: preference, resource endowments,

market incentives, biophysical factors and risk/uncertainty. The explanatory variables in this study's regression included age of head and schooling of head, walking time from house to field, number of male family workers, number of female family workers, dependency ratio (the ratio of dependent members to the total numbers of household members), slope, tenure and plot located in protected forest dummy. Means of explanatory variables are shown in Table 6.

A result of the probit analysis for adopting multistrata coffee is presented in Table 7. A value of 1 indicates the adoption of multistrata coffee and 0 is for non-adoption. The Goodness of Fit test shows that the overall model fits reasonably well as indicated by a Chi-square value of 67.7 with a probability value of over 0.998.

As expected, tenure has a positive influence and is statistically significant. The result supports this

study's arguments that more secure land tenure is likely to encourage farmers to adopt a multistrata coffee system. A significant influence on the probability of adoption is available male manpower in the household, in that the higher the available male manpower, the greater the chances of adoption of the multistrata system. The result was not unexpected as establishment of a multistrata system requires much labour and strength.

The steepness of plot (slope variable in Table 7) was also significant in the probability of the adoption of a multistrata system. The steeper the coffee farm, the higher is its likelihood to be a multistrata system. Similar results of slope on agroforestry adoption were also reported by Pattanayak and Mercer (1998). The remaining tested variables (household head's age and education, distance of coffee plot from house, female manpower in the house) were shown to be statistically insignificant in influencing the adoption of a multistrata system by the households.

A reward mechanism

Secure land rights are an option for rewarding farmers to be more responsible in managing forest resources and providing environmental services (Gan et al. 1998). Lessons from South Asia (India, Nepal) and Africa (Gambia, Tanzania) indicate that absence of secure tenure for forests and other natural resources creates a 'discouraging' environment for community involvement in their management (Warner 2000). In India tenure on forest land still remains the most contentious issue and lack of tenurial security for the forest managing communities is a major cause for lack of success in community-based forest management (Nayak 2002). Secure long-term access with policies that recognize these local rights and provide the landholders with legal and regulatory support can be an attractive incentive for communities to adopt conservation practices.

In case of Trimulyo in Lampung, 86% of farmers stated that they would accept any joint management of forest resources inside protected forest areas only if the government provided them with official usufruct rights to their cultivated land inside the protection forest land. The government would retain the land ownership. The majority of farmers admitted that the state actually owned the land inside protected area. To

obtain the user rights inside the state forest land, farmers had three prerequisites:

1. establishment of multistrata tree system to maintain forest functions;
2. adopt conservation techniques in coffee cultivation; and
3. protection of remaining natural forests in the area.

All respondents agreed to adopt the multistrata tree system, but preferred to have coffee as an integral component. Farmers also realised the importance of conservation techniques in farming and some farmers were already practicing techniques such as ridging, use of sediment pits and strip weeding to minimise soil erosion from slopes. Scientific investigation indicated conservation techniques could reduce soil erosion by 50% in these fragile systems (Agus et.al. 2002).

Farmers in Sumberjaya realize the importance of conservation techniques and the role of multistrata system. Nearly 95% of recent migrants agreed to use conservation techniques although only 77% of previous migrants accepted it. Again, 94% of the respondents agreed that conservation of remaining natural forest should be necessary to obtain land rights in the area. This indicates a high probability of a successful community forestry program and an effective collaborative forest management.

Policy implications

Trimulyo exemplifies many other places in Indonesia where forest cover in protection forests has become degraded. Lessons from this study can be extrapolated to sites with a similar setting. The first and foremost lesson is that a policy aimed for improving sustainable land management and the environment in forest zones cannot rely on an authoritarian approach. Past experience has shown that when farmers were forcefully evicted, efforts at forest protection were not successful. On the contrary, when there was no government intervention, and consequently farmers felt that they had more secure land rights, rehabilitation of degraded land inside state forest land took place. A partnership approach in protection and sustainable management of forest land involving local communities and other stakeholders is probably the best bet.

Secure land tenure is a key determinant in improving sustainable land management. This study indicates that the main incentive for local communities to better manage land is secure land rights that would enable farmers to carry out more sustainable and protective activities. Even where forests are degraded, local communities, with secure tenure rights can rehabilitate unproductive lands into more productive and sustainable systems. The Indonesian government's Community Forestry policy (*HKM*) may be an effective vehicle in providing more secure land rights to local communities and to sustainably manage forest land in many places.

As our study showed, it is most often the poor and those with less access to resources who have to depend more on the state owned land for their livelihood simply because they have no other alternatives. It is these poor and powerless people whose voices are rarely heard in policy formulations and negotiations. It is also a fact that it is the same group who can make a difference, who can destroy, rehabilitate and sustainably manage forest land. Forest protection and ecosystem conservation can only take place if these poor people are compensated for their efforts. Mechanisms to reward the poor for the environment services that they provide need to be developed and promoted. As we have seen in the Trimulyo case, land tenure can be an attractive incentive (or reward) for farmers to get engaged in sustainable management of protected forest land. The government also benefits from reduced social conflict and reduced expenses for forest protection.

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