DEFORESTATION AND FARMERS' CAPITAL ACCUMULATION: A CASE STUDY IN THE KERINCI – SEBLAT NATIONAL PARK, INDONESIA[1]

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Conventional wisdom says that farmers clear a forest because of their poverty. This paper shows a case in Indonesia where deforestation depends on the capital accumulation behavior of richer farmers and holders of capital. Poverty is a deterrent to deforestation because the poorest farmers have inadequate capital to finance forest clearing and other associated costs. Analysis on financial and economic returns of deforestation shows that forest clearing and the subsequent agriculture produce high financial returns and more-than-sufficient liquidity for farmer to finance the next round of forest clearing. The 1997/98 economic crisis that hit Indonesia appears to provide favourable financial and economic conditions for increased deforestation.

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INTRODUCTION

It is often assumed that farmers clear a forest because of their poverty. While this argument may be valid for certain cases, e.g. in the case of shifting cultivation and fuelwood collection in Zaire (Barbier et al., 1991), the author's fieldwork indicates that such an argument is but one subset of a larger set of deforestation mechanisms. The fieldwork reveals another subset of these mechanisms, where deforestation can be linked to the capital accumulation behavior of farmers.

This paper begins with a discussion on questionnaire development and the types of data collected. The process of farm land establishment and the property rights arrangement associated with deforested lands are then discussed. Finally, results from farmer interviews are presented. In this case the author analyses issues such as the modes of capital accumulation, who make the decision to clear a forest, and why are farmers financially capable of accumulating capital to clear a forest.

An important note should be made here. Deforestation in the study area involves intertemporal decision making under stochastic environmental conditions. The primary data collected how-ever are cross-sectional in nature, even though they cover a period of several months prior to the author's interview with farmers. Thus, an econometric analysis on these data would not shed any lights into farmers' intertemporal behavior. For this reason the author undertakes no cross-sectional econometric analysis here. Instead, financial and economic analysis on the data are performed, assuming that the parameters involved (e.g. future prices) are known with certainty. In other words, a deterministic environment is assumed.

DATA COLLECTION

For primary data collection, the micro-level approach widely used in agricultural and rural studies is adopted. Given the fact that individual decision making in rural developing countries is usually made at the household level (Fleming and Hardaker, 1993), the household is used as the level of aggregation. For organizational purpose, the questionnaire is grouped into four modules. Module I contains questions on household identity and endowment, including descriptions of the nucleus family and the education level of the head of the household. Module II concerns the household's

deforestation records, including its history of land ownership. This module also includes questions about how a deforestation decision is made. Module III is about the household's income and production records, while Module IV about consumption records.

Primary data were collected from interviews with a randomly-selected sample of 115 farmers, 55 from the upper Kerinci region and 60 from the lower region. Secondary data such as price and trading volume were collected from farmers' transaction records kept by a major village trader in the upper region. The records contain information on actual selling price received by each farmer, number of delivery times, the quantity of output sold per delivery, purchase of farm inputs and the amount of each farmer's outstanding loan for the period of October 1994 – July 1995. Unfortunately, no such data are available for the lower region.

Cinnamon yield was estimated by an actual measurement of yield for cinnamon trees of 4, 5, 6, 8, 10, 12 and 15 years of age[2]. This experiment was undertaken as a solution to the difficulties facing the author in obtaining cinnamon yield data from farmer interview. Farmers can normally recall the amount of money they received from cinnamon sales. But virtually all of them had no idea about the "true" yield of their cinnamon plantation. This is because cinnamon harvesting involves a processing procedure whose scale, technicalities and cash capital requirements make it impractical for farmers to do it by themselves[3]. As a consequence, farmers would rather sell their cinnamon on the basis of a monetary offer made by traders than harvest the plantation by themselves. Thus, cinnamon barks are sold on the basis of traders' valuation, not based on actual bark weight.

Estimates for each age group were obtained by taking 2 to 5 samples of trees. In this experiment, the author collected data on tree girth[4], tree height, and the weight of wet

[2] For logistic and accessibility reasons, the author was only able to conduct this experiment in the lower region. Here the author was assisted by five anak ladangs who worked as harvesting labourers, one professional wet bark scraper, and a village trader. Four professional cinnamon valuers were also hired with the purpose of examining discrepancies between actual harvests and valuers' estimates.

[3] This procedure includes trees felling, wet barks peeling, bark scrapping and cleaning, drying, sorting, packaging and delivery from ladangs to traders' collection centers. Not only is the procedure time consuming, it also requires a relatively large amount of advance cash capital to pay for harvesting wages. A spacious drying space is also required.

[4] The girth was measured at the height of 50 centimeters above the ground and 50 centimeters below the first branch from the top.

and dry barks. The weight of dry barks were measured for each bark quality, i.e. KA, KB and KC[5].

Throughout the fieldwork, a series of visit to *ladangs* at the forest frontier were undertaken. In the upper region, these *ladangs* are located about 1800 to 2000 meters above sea level and can only be reached by walking for about 1 to 3 hours from the villages. In the lower region, the *ladangs* are located at about 600 to 800 meters above sea level. It normally takes about 15 minutes to an hour on motorbike or 1 to 4 hours on foot to reach the *ladangs*.

LADANGS AND FARMERS AT THE FOREST FRONTIER

Farming System and Social Status

In the upper region of Kerinci, the most common farming system found in *ladangs* is multicropping involving cinnamon (*Cinnamon Burmanni*) and annual crops. Cinnamon represents a long-term investment for the farmers while annual crops provide the short term, regular production. Cinnamon trees are generally planted in rows about 4 meters apart, and spaced about 1-2 meters apart along each row. Potato is the most popular type of annual crop planted, with a relatively small amount of scallion and maize. This system of multicropping is practiced until cinnamon trees reach an age of about 6 years. Afterwards, the system will become a monoculture of cinnamon, with a negligible amount of annual crops or bananas grown on the edge.

Farmers in the lower region of Kerinci also adopt a similar multicropping system for their *ladangs*. But the most popular secondary crops here are coffee and chili, with a small amount of maize.

On the basis of their social status, farmers can be grouped into: (a) *anak ladang* (tenants/operators), (b) *anak ladang*/landowner, (c) landowner, and (d) *induk semang* (landowner and capital provider). *Anak ladangs* are operators of a *ladang*. They are usually landless, young persons (i.e. below 30 years of age) and have limited household capital. With the exception of a few unsuccessful farmers, after several years of working as an *anak ladang* older farmers are usually capable of accumulating

[5] The quality KA is the highest one, while KC is the lowest.

enough capital to own a *ladang*. They can do it by way of purchasing an existing *ladang* and/or clearing a nearby forest. At this stage the farmers become landowners. They may opt to operate all of the *ladang*(s) if they have adequate family labour, or to let new *anak ladangs* operate some of the *ladang*(s). Thus, the farmers become *anak ladangs* and landowners at the same time. Alternatively, they may opt to let new *anak ladangs* operate all of the *ladang*(s), thus becoming purely landowners. *Induk semangs* are on the highest rung of the social ladder. They are usually wealthy landowners and cash capital providers who often hold a respected position in the village, e.g. as head of the village.

Establishment of a *Ladang* and Property Right Arrangement

According to the Indonesian constitution, forests within the Indonesian jurisdiction belong to the state. In practice, however, traditional tribes consider forests as free communal assets. Those who clear a forest are entitled to claim ownership to the cleared land. Such is also the case in rural Kerinci.

After clearing a forest the claimant usually leaves the land idle for about 1 to 12 months to let the fallen trees dry out. During this "drying period" regrowth of *Imperata cylindrica* or *alang-alang* occurs and covers the land. The length of the drying period, however, depends not only on rainfall intensity but also on the availability of potential *anak ladangs*. This is because the claimant (owner) is often not endowed with sufficient family labour to cultivate all the land. Thus, the land is not utilized until an *anak ladang* asks for a contract to sharecrop the land.

Depending on the owner's judgment, the sharecropping contract can be set for a period of as short as one year to about 12-15 years. The contracts usually take on the following forms[6]:

1. The 1:1 system. This is the most popular system in Kerinci, both in the upper and lower regions. Under this system, the owner is to provide cinnamon seedlings, but not a living allowance for *anak ladang* nor cash for the purchase of farm inputs. The system entitles *anak ladangs* to keep income from their annual crops, while income from cinnamon is divided equally. If however *anak ladangs* have

[6] The contract is not necessarily a written one. In most cases, farmers only have a verbal but traditionally enforceable contract.

inadequate cash to support themselves and/or to bear the costs of annual crops, they can borrow cash from an *induk semang*. Normally no interest payment is imposed on the borrowing, but *anak ladangs* are obliged to sell their outputs to the *induk semang*. Loan repayment is directly deducted from the value of output upon delivery.

2. The 1:2 system. Under this system, in the first three years of the contract the owner supplies *anak ladang* with about 50 kg rice per month. Income from secondary crops is divided equally, while that from cinnamon is distributed as follows: one-third for *anak ladang* and two-third for the owner. In the upper region, farmers rarely adopt this system because it is financially less attractive for *anak ladang*. The average size of *ladang* operated is 0.24 hectare, with an average potato yield of 9,603 kg/hectare/season. Given that potato prices are usually comparable to or higher than those of rice, it is very uneconomical to trade off half of potato production (i.e. 1152.4 kg) and one-sixth of cinnamon output for 200 kg of rice[7]. In the lower region, however, the system is more commonly adopted especially in the case of multicropping between cinnamon and coffee. As coffee trees only come into production after two-and-a-half or three years, *anak ladangs* usually need their landowners' assistance to partially support their livelihood during the first three years of the contract. This leads to the adoption of the system.

After a contract is agreed by both parties, the land is cleared of regrowth. Land owners usually hire *anak ladang*(s) to do this job. Once land clearing is completed, *anak ladangs* may start cultivating the land with both cinnamon and the secondary crops.

For the first 6 years of the contract, *anak ladangs* rely mostly on income from secondary crops to support themselves. Between year 4 and 6 about half of the total number of cinnamon trees are cut down to thin the crop. This practice provides additional income for *anak ladang*. Some *anak ladangs* may also earn income from working as casual labourers, both in the agricultural and non-agricultural sectors.

After six years, due to shading, no annual crops can be grown in the *ladang.* Subject to owner's approval, *anak ladangs* may harvest some of the cinnamon trees to allow enough space to grow annual crops. However, owners usually opt not to harvest a 6-

[7] If the 1:1 system is adopted, *the anak ladang* would have received one-half of cinnamon income. By adopting the 1:2 system, *the anak ladang* would only be entitled to one-third of the income, hence a foregone earning of one-sixth of the income.

year old plantation because it produces bark of low quality. If such is the case, *anak ladangs* need to have another contract to operate another *ladang.*

As for landowners, they usually receive no income from the land until cinnamon trees are felled for thinning or harvest. In the case of multicropping between cinnamon and coffee, however, landowners receive income from coffee production from the third to the eight years.

CHARACTERISTICS OF THE RESPONDENTS

Based on their social status, approximately a half of the respondents are grouped as *anak ladang* (Table 1). Landowners and *induk semang* al-together account for around one-fifth of the respondents, while the *anak ladang*/landowner group for less than one-third.

As expected, landownership increases with increased social status. *Induk semang* has the highest level of landownership (i.e. 8.5 hectare on (average), followed by landowners and *anak ladang*/landowners (Table 1). The picture for the lower region is however not so straightforward as the *anak ladang*/landowner group shows a slightly higher landownership than the landowner group. This might relate to the fact that the lower region's *anak ladang*/landowners have a much higher family workforce than the other groups (Table 2). Thus, they tend to operate their *ladangs* by themselves, and as a result, are categorized as *anak ladang*/landowner.

Table 1 also shows that while virtually all *anak ladang*s are landless, there are one or two individuals that "own" lands. These individuals in fact only have "pseudo ownership" rights over "their" lands., because the lands still legally belong to their parents. They are given rights to operate the lands without any sharecropping contract, but are not allowed to sell the lands. Because these individuals also enter a contract as an *anak ladang* with other landowners, they are grouped as *anak ladang* in this paper.

In term of their age, older generation of farmers tend to have a higher social status than the younger ones (Table 2). As can be seen from Table 2, farmers tend to move to a

higher social status as they grow older. This is because the accumulation of capital during their time as *anak ladang* enables younger farmers to own lands at their thirties. The age difference between landowner and *induk semang*, however, should not matter much because at this stage the level of wealth is no longer dependent on how long the farmers have been working in a *ladang*.

Other characteristics of the respondents are presented in Table 2. These include length of formal education, family size and the number of workforce within the household. In general it can be said that the respondent have a relatively low level of formal education and small size of (nucleus) family and household workforce.

Table 1

Distribution of Respondents According to Their Land Ownership Status

	Number of Respondent		Average Size of Land Owned (hectare)	
	N	**%**	**Dry Land**	**Rice Field**
A. Upper Region				
Anak Ladang	31	56	0.01	0.00
Anak Ladang/Landowner	12	22	3.38	0.00
Landowner	5	9	7.96	0.04
Induk Semang	7	13	10.50	0.42
Total	55	100	2.80	0.06
B. Lower Region				
Anak Ladang	27	45	0.02	0.02
Anak Ladang/Landowner	24	40	3.95	0.04
Landowner	5	8	3.73	0.13
Induk Semang	4	7	5.01	1.00
Total	60	100	2.23	0.10
C. Overall				
Anak Ladang	58	50	0.01	0.01
Anak Ladang/Landowner	36	31	3.76	0.03
Landowner	10	9	5.84	0.08
Induk Semang	11	10	8.50	0.63
Total	115	100	2.50	0.08

CAPITAL ACCUMULATION AND DEFORESTATION BEHAVIOR

The Modes of Capital Accumulation

During the fieldwork, three different modes of capital accumulation that lead to deforestation were observed. The first two relate to the accumulation of land capital by successful *anak ladangs and* landowners, while the third to the accumulation of capital in the form of cinnamon plantations. To illustrate the first two modes, land ownership history of farmers H, N, P and R is presented.

Landowner H of the upper Kerinci region is an *induk semang* and a potato trader. He began clearing an area of 2 hectares in 1971, but then gradually added another 11 hectares over a period of 23 years (1972-1994). Initially he financed his forest clearing from a financial surplus generated from his trading activity, but in the 1980s and 1990s his cinnamon plantation provided adequate surplus to clear other forests.

Landowners N and P are from the lower and upper region, respectively. They have the same history of forest clearing in the sense that both began as an *anak ladang*. After accumulating adequate capital from cinnamon plantation, landowner N cleared 0.45 hectare of forest[8] in 1978, and slowly increased his land ownership by clearing another 1.2 hectares between 1987 and 1992. Landowner P has a more rapid land accumulation process, in which he cleared 1.6 hectare in 1984 and added another 4.6 hectares between 1990 to 1994.

Landowner R of the lower Kerinci region has a slightly different history of forest clearing. Coming from a relatively wealthy family, he began with a family gift of 0.45 hectare in 1985. He also receives a cash transfer from his parents to purchase 1.26 hectare of mature *ladang* in 1987. After accumulating adequate capital on his own, he cleared 1.125 hectare of forest in 1993.

[8] This represents the smallest size of forest cleared by the respondents in a one round of forest clearing.

Table 2

Selected Characteristics of the Respondents

	Upper Region	Lower Region	Overall
Average age of the head of household (years)			
Anak Ladang	23.4	26.5	24.8
Anak Ladang/Landowner	33.6	38.5	36.9
Landowner	48.2	52.0	50.1
Induk Semang	45.4	45.0	45.3
Total	30.7	34.7	32.8
Average length of formal education (years)			
Anak Ladang	7.4	8.0	7.7
Anak Ladang/Landowner	9.0	5.3	6.6
Landowner	3.0	6.0	4.5
Induk Semang	8.0	6.0	7.3
Total	7.4	6.6	7.0
Average family size a)			
Anak Ladang	2.6	2.7	2.6
Anak Ladang/Landowner	2.5	3.8	3.4
Landowner	4.8	3.0	3.9
Induk Semang	4.0	4.6	4.2
Total	3.0	3.3	3.1
Average number of workforce within household b)			
Anak Ladang	2.2	2.2	2.2
Anak Ladang/Landowner	2.0	2.8	2.6
Landowner	2.0	2.0	2.0
Induk Semang	2.0	2.0	2.0
Total	2.1	2.4	2.3

Notes: a) Defined as the number of (nucleus) household members
b) Defined as the number of household members within the working age group (i.e. 15-64 years old). School children are excluded

These stories indicate that forest clearing and the subsequent agriculture have the capacity to generate capital to finance another rounds of forest clearing. This is the first mode of capital accumulation observed. Using this mode an *anak ladang* is able to move to a higher social status as a landowner or an *anak ladang*/landowner.

The second mode of capital accumulation is the use of financial surpluses from other sectors, e.g. the trading sector, to finance forest clearing. There are a number of reasons for this phenomenon. Firstly, the social values held in the region result in greater land ownership giving a higher social status. This value motivates farmers to keep increasing their land ownership. It also explains why farmer R still needs to clear a forest even though he already owns lands from family transfers. Secondly, farmers are attracted by the high financial returns obtained from forest clearing and the subsequent agriculture. Such high returns are in stark contrast to the limited availability of other financially attractive investment at the village level. Thirdly, farmers feel more of ease with the technical details of forest clearing and the subsequent agriculture than those of other investments.

By clearing a forest, farmers acquire a parcel of land which enables them to invest their time and cash-capital in cinnamon plantation. It takes 4 years before the investment starts producing a financial return, but farmers normally opt not to harvest the plantation until it reaches the age of 12 years. Thus, cinnamon serves as a "long-term maturity bond" which will be liquidated after 12 years. The choice of liquidation time depends not only on the prevailing prices of cinnamon bark and the age of the plantation, but also on whether the farmer is in need of immediate cash for large expenses. The most cited reasons for liquidation are for expenses of land purchase, children's education (e.g. college entry costs), pilgrimage to Mecca and building of a house.

Who Makes the Decision to Clear a Forest?

The author's fieldwork indicates that instead of being a cause of deforestation, poverty (or more precisely lack of adequate capital) precludes poor farmers from clearing a forest. Young and poor *anak ladangs* have in fact very limited role in the decision making that leads to forest clearing. The reason is that, firstly, unless they have

adequate family labourers to clear a forest, *anak ladangs* cannot afford the minimum capital required for forest clearing and *ladang* establishment. In the upper region in 1995, to clear a hectare of forest costs about Rp 300,000, while the subsequent land clearing adds another Rp 450,000[9]. In the lower region, the cost of forest clearing and *ladang* establishment is even higher, that is, Rp 900,000 per hectare. These costs are far beyond the financial capacity of an *anak ladang.* Secondly, even if they have adequate capital to finance forest clearing, *anak ladangs* cannot gain adequate cash to support themselves during the idle period between forest clearing and annual crop harvests. This period can normally take more than a year.

For these reasons, the decision to clear a forest rests mostly with *induk semangs*, land owners and more established (and older) *anak ladangs.* They are most likely to have adequate capital to finance forest clearing and to support themselves during the idle-period. As Table 3 shows, while all land owners and *induk semangs* had in the past cleared a forest, only a tiny 2 per cent of *anak ladang* did so on a family grant. The fact that 86 percent of farmers in the *anak ladang*/landowner group had in the past cleared a forest indicates that while as a young farmer an *anak ladang* is precluded from deforestation, in the later years, after accumulating adequate capital he or she is likely to clear a forest.

Table 3 also shows that the average size of forest cleared tends to increase with higher social status. In the upper region, while on average *anak ladang*/landowner had only cleared 1.27 hectare of forest, landowners and *induk semangs* cleared 5.93 and 8.41 hectares, respectively. In the lower region, however, the picture is not as straightforward as it is in the upper region. The *anak ladang*/landowner group here cleared a slightly larger forest areas than did the landowner group.

The role of poverty as a deterrent to deforestation can also be seen from farmers' view about the most important factors affecting deforestation decision (Table 4). "Adequate cash capital" was overwhelmingly chosen by farmers who in the past had cleared a forest as the most important factor in their deforestation decision. In the lower region all of these farmers gave the first rank to this factor, while in the upper region 79 per cent of the farmers did so. The rest of 21 per cent considered "adequate family labour"

[9] The exchange rate was US$ 1.00 = Rp 2,100 at the time.

as the most important factor, but all of them put “adequate cash capital” as the second most important. As poverty usually leads to lack of cash capital, one can easily see

Table 3

Proportion of Farmers Who in the Past Cleared a Forest and the Average Size of Forest Cleared (... - 1995)

Group of Farmers	N	Proportion of Farmers that Cleared a Forest	Average Size of Forest Cleared (hectare)	Average Size of Dry Land Owned (hectare)	Land Owned from Other Means (hectare)
	a)	b)	c)	d)	e)
A. Upper Region					
Anak Ladang	31	3%	0.01	0.01	0.00
Anak Ladang/Landowner	12	83%	1.27	3.38	2.11
Landowner	5	100%	5.93	7.96	2.03
Induk Semang	7	100%	8.41	10.50	2.09
Total	55	42%	1.89	2.80	0.91
B. Lower Region					
Anak Ladang	27	0%	0.00	0.02	0.02
Anak Ladang/Landowner	24	88%	2.67	3.95	1.28
Landowner	5	100%	2.33	3.73	1.40
Induk Semang	4	100%	3.38	5.01	1.63
Total	60	50%	1.49	2.23	0.74
C. Overall					
Anak Ladang	58	2%	0.01	0.01	0.01
Anak Ladang/Landowner	36	86%	2.20	3.76	1.55
Landowner	10	100%	4.13	5.84	1.72
Induk Semang	11	100%	6.58	8.50	1.92
Total	115	46%	1.68	2.50	0.82

Notes: a) N = number of respondents

b) It represents the number of respondents in each group of farmers who cleared a forest at least once during his/her lifetime, divided by the total number of respondents in each group

c) The average size of forest cleared by each group of farmers

d) See Table 1

e) These include bequest and land purchase

why poverty is a deterrent to deforestation. More importantly, these figures also underline the importance of capital accumulation in deforestation decision. This is because, it is capital accumulation that provide farmers with adequate cash to meet forest clearing costs.

Table 4 also reveals the fact that farmers' expectation of achieving a higher social status does affect their decision to clear a forest. About 40 per cent of the farmers rank this as the second most important factor in their deforestation decision. This figure confirms previous result about the link between social status, both expected and realized, and deforestation.

Another interesting result from Table 4 is the seemingly irrelevant role of cinnamon and secondary crop prices in farmers' deforestation decision. Output prices may not be a part of the information set farmers used when making a deforestation decision. Thus, farmers did not rate them as an important factor. But given the crucial role of the "adequate cash capital" factor, and the fact that output prices affect farmers' stock of cash, it can then be inferred that output prices have an indirect influence on farmers' decision to clear a forest.

Table 4 also shows that a number of farmers did to some extend consider other job and investment alternatives before making a deforestation decision. These alternative investments include *inter alia* rural saving accounts and transport service business. While this factor is far less important than the "adequate cash capital" factor, it clearly shows that farmers did make a considered decision when clearing a forest.

FINANCIAL RETURNS FROM DEFORESTATION

Results from the Cinnamon Harvesting Experiment

In this experiment, common harvesting practices were followed. After the trees were felled and barks were peeled, the gross weight of the wet barks, termed henceforth as the "gross weight", was measured. Dirt, fungi and rough bark surfaces were then scraped out by a professional scraper, resulting in the net weight of wet barks, termed as the "net weight". It is this net weight that a valuer estimates during sales negotiation between farmers and cinnamon traders.

Table 4
The Most Important Factors in Determining Deforestation Decision According to Farmers Who in the Past Cleared a Forest a)

Factors	Proportion of Respondents Who Ranked the Factors as being		
	Rank #1	Rank #2	Rank #3
A. Upper Region (N=24)			
Adequate cash capital	79%	21%	0%
Adequate family labour	21%	25%	21%
High cinnamon price	0%	0%	0%
High prices of secondary crops	0%	0%	0%
No alternative job	0%	0%	0%
Expecting higher land price	0%	0%	0%
Higher social status	0%	42%	58%
No alternative investment	0%	13%	21%
B. Lower Region (N=33)			
Adequate cash capital	100%	0%	0%
Adequate family labour	0%	45%	12%
High cinnamon price	0%	0%	0%
High prices of secondary crops	0%	0%	0%
No alternative job	0%	12%	61%
Expecting higher land price	0%	0%	0%
Higher social status	0%	39%	21%
No alternative investment	0%	3%	6%
C. Overall (N=57)			
Adequate cash capital	91%	9%	0%
Adequate family labour	9%	37%	16%
High cinnamon price	0%	0%	0%
High prices of secondary crops	0%	0%	0%
No alternative job	0%	7%	35%
Expecting higher land price	0%	0%	0%
Higher social status	0%	40%	37%
No alternative investment	0%	7%	12%

Notes: a) Farmers categorized as anak ladang/landowner are included

The barks were then dried under the sun until they reach a given standard of dryness. Traders usually mention a water content of 12 per cent or less as the standard. In practice however no scientific measurement of dryness is actually undertaken. Instead, traders use their experience to "sense" if the barks are dry enough. Because the aim of this experiment is to obtain yield estimates on the basis of harvesting and post-harvesting practices normally adopted in the region, the author asked a trader to determine if the barks have reached the standard dryness usually used. After drying is completed, a new measure of yield is obtained, termed here as the "dry weight".

Detailed results of the experiment are presented in Table 1 of Appendix. The results are then averaged according to tree ages and are presented in Table 5. From this table we can see that significant increases in bark weights occur between the eight and the twelfth years. The increases apply for both the agronomical yield, as measured by gross weight, and the "processed" yield, as measured by net and dry weights. It means that this period represents the largest growth in cinnamon output.

Figure 1 provides a better description of the growth of cinnamon yield. More importantly, it shows that the agronomical growth of cinnamon bark tends to follow a logistic functional form, with the growth significantly slowing down from year 12 onward. In other words, there is a tendency that after year 12 the growth begins to enter a plateau, even though the yield still increases.

The growth of net and dry weights also seems to follow a logistic form, but with a less apparent plateau. This shape suggests that wastes during scraping, drying and sorting have caused the "processed" yield curves to somehow deviate from its agronomical one. The assessment is confirmed by Figure 2 which shows irregularities in the ratios between net and gross weights, and between dry and net weights.

A similar result emerges if the variable year is replaced by pole volume (Figure 3). In this case, pole volume is computed by the following formula:

Table 5

Estimated Cinnamon Growth and Production a)

Age (Years)	Height (cm)	Lower Girth (cm)	Upper Girth (cm)	Gross Weight of Wet Bark (kg) b)	Net Weight of Wet Bark (kg) c)	Net Weight of Dry Bark (kg) d)	Ratio of Net to Gross Weight	Ratio of Dry to Net Weight	Pole Volume e) (cu.m.)
4	540	26.2	18.9	2.3	1.7	0.623	0.738	0.354	0.040
5	564	32.3	19.1	3.4	2.7	1.193	0.817	0.434	0.054
6	712	34.0	25.3	4.1	3.3	1.196	0.801	0.371	0.091
7	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
8	864	44.3	26.0	8.9	7.4	2.990	0.830	0.407	0.156
9	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
10	893	54.5	43.8	29.2	22.8	12.345	0.780	0.552	0.314
11	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
12	954	57.9	46.5	36.0	28.3	14.770	0.787	0.524	0.379
13	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
14	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
15	969	63.4	53.0	38.6	33.6	18.395	0.869	0.549	0.478

Sources: Computed from the cinnamon harvesting data (Table 1 of Appendix B)

Notes: a) These figures are the average of data reported in Table 1 of Appendix B

b) Weight of wet barks before dirts, outer surfaces, fungi etc are scrapped out

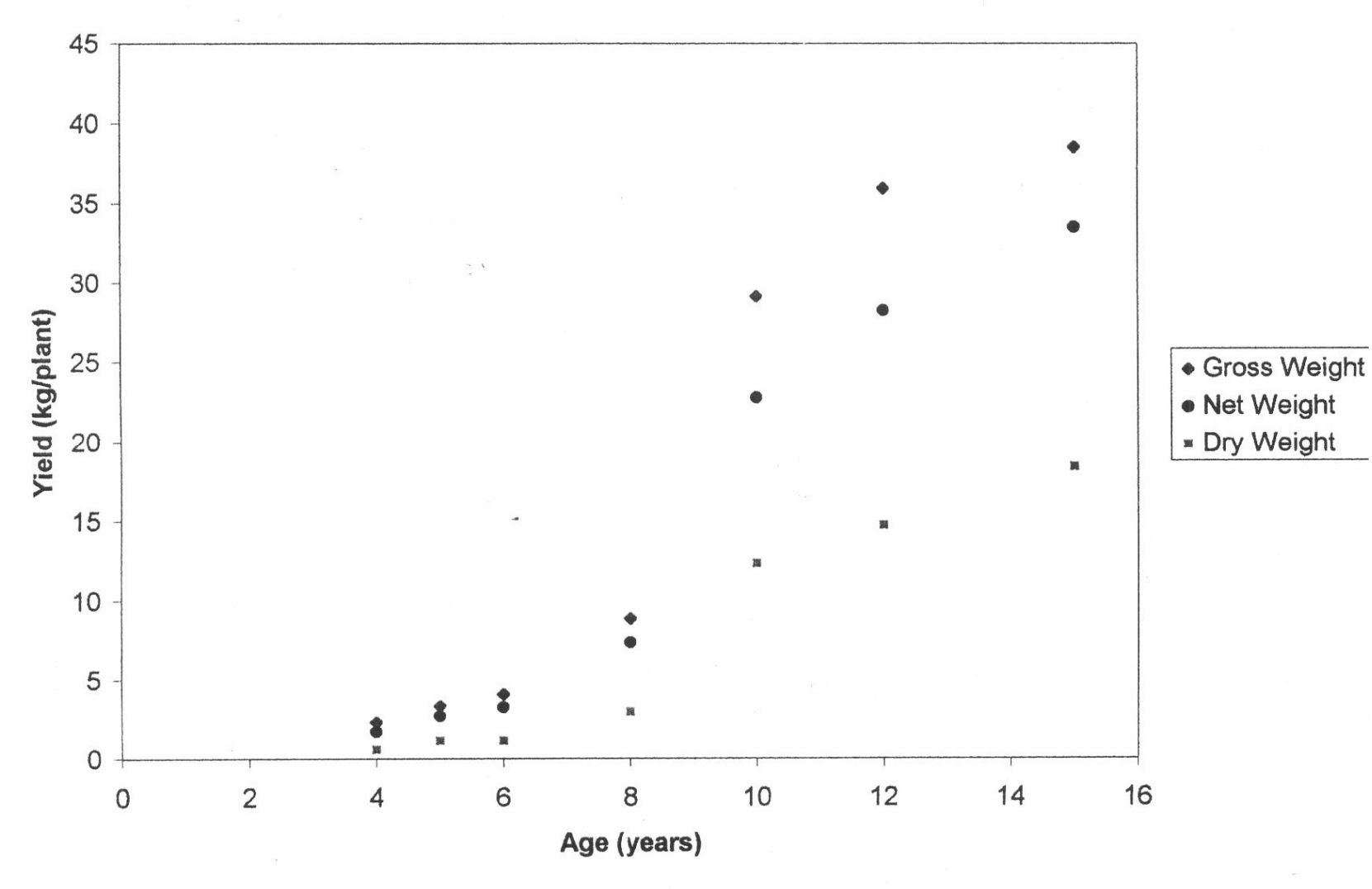
c) Weight of wet barks after scrapping

d) Weight after an 8 sunny days of drying. The water content is estimated at less than 12 per cent

e) See text for the formula used to compute pole volume

f) N.A. = not available

Figure 1. Cinnamon Yield According to Age of Tree (kg/plant)



$$V = \frac{(g_1 + g_u)^2 h}{16\pi}$$

Where V is pole volume, g_1 and g_u are lower and upper girth, respectively, and h is tree height. It can be seen from Figure 3 that the three measures of yield also have a logistic functional relation with pole volume.

These measures of yield are however not the actual levels of yield on which farmers get paid. As discussed before, farmers enter into a sales transaction with cinnamon traders based on yield estimates made by valuers. Because the valuers works on the traders' staff, one can reasonably expect their estimates to be biased towards the traders' benefit. Our experiment with four valuers supports this assertion. As shown in Table 2 of Appendix, on average their estimates underrate the net weight by about 17 per cent. For this reason, in our financial analysis we estimate farmers' cinnamon revenue on the basis of yield estimates agreed on during a sales transaction. In the lower region, these yield estimates are assumed to be 17 per cent lower than the actual net weight. In the upper region, cinnamon yield is assumed to be 27.7 and 22.1 per cent lower than the lower region yield, for cinnamon trees aged "less than 10 years" and "10 years and over", respectively[10]. The results are presented in Table 6.

[10] These assumption are made based on our interview with farmers. In general, it is a common knowledge in Kerinci that cinnamon trees in the lower region tend to have a higher yield than those in the upper region.

Figure 2. Ratios of Net to Gross Weight and Dry to Net Weight

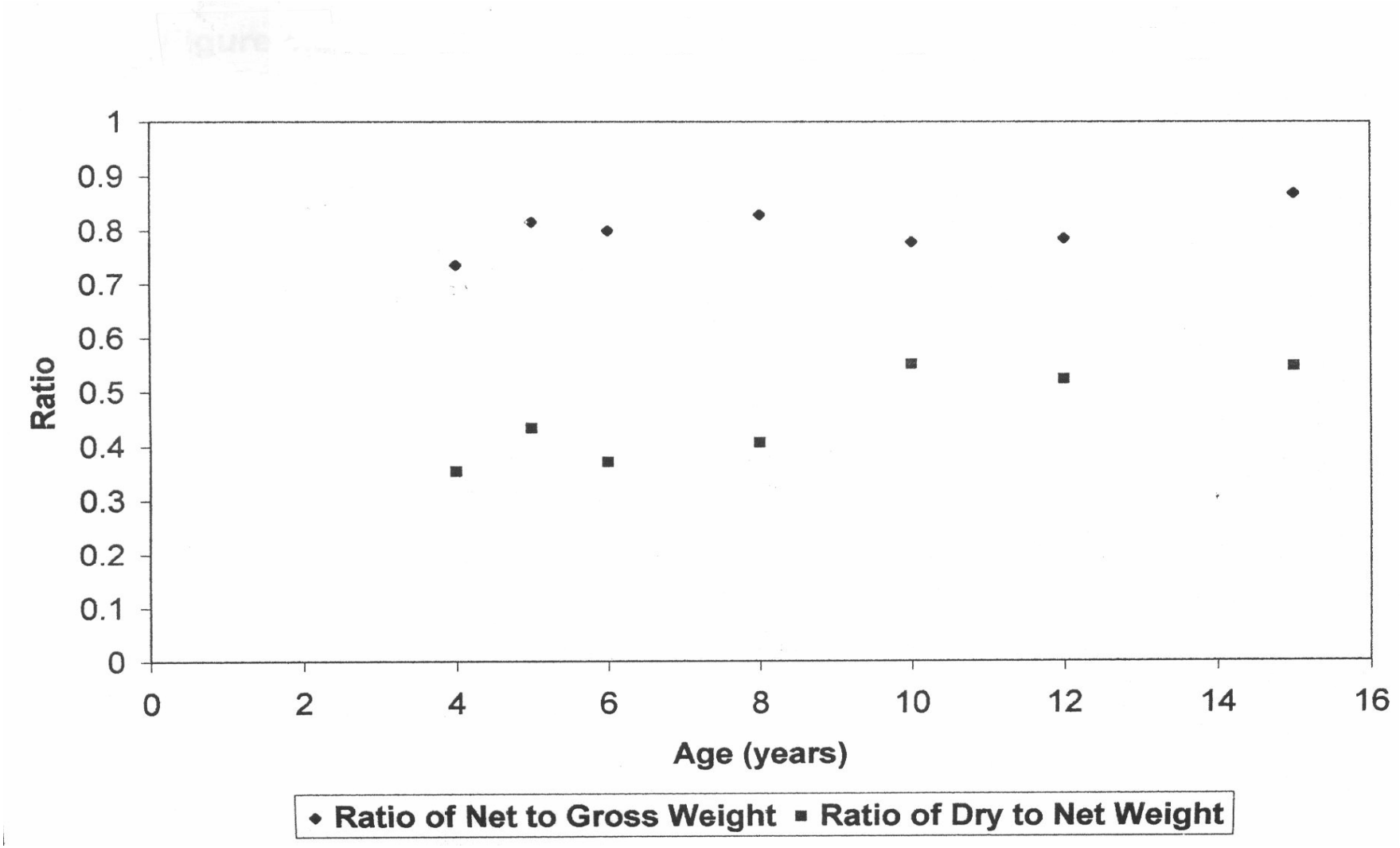


Figure 3. Relationship Between Pole Volume and Yield

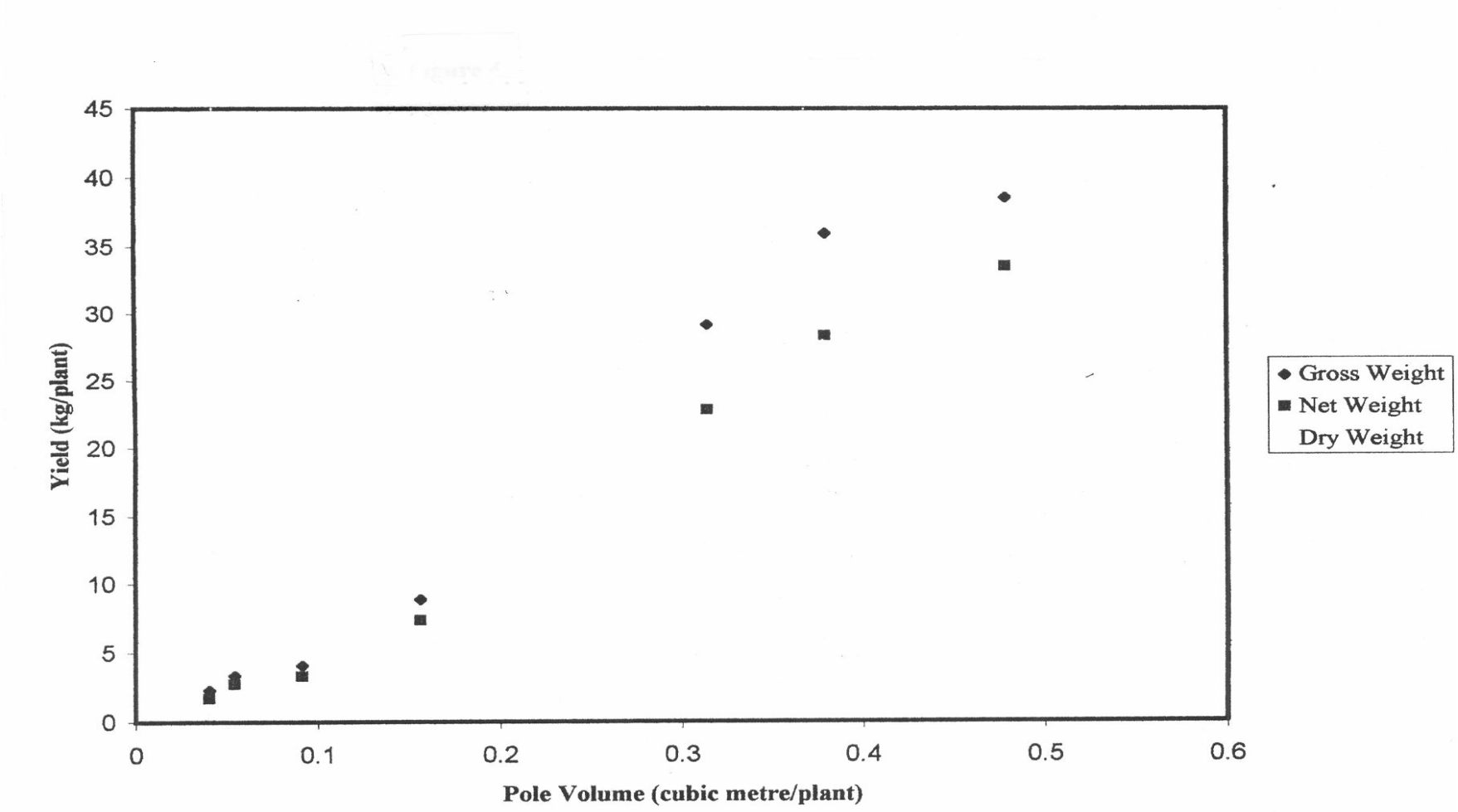


Table 6

Estimated Cinnamon Yield in Kerinci (kg wet bark/plant)

Age (Years)	Actual Yield a)	Lower Region Estimates b)	Upper Region Estimates c)
4	1.73	1.4	1.0
5	2.74	2.3	1.7
6	3.3	2.8	2.0
7	N.A.	N.A.	N.A.
8	7.4	6.2	4.5
9	N.A.	N.A.	N.A.
10	22.8	19.0	14.8
11	N.A.	N.A.	N.A.
12	28.3	23.6	18.4
13	N.A.	N.A.	N.A.
14	N.A.	N.A.	N.A.
15	33.55	28.0	21.8

Sources: Computed from Table 5 and Table 2 of Appendix B

Notes: a) Actual yield according to the cinnamon harvesting experiment. See Table 5.

b) Estimated by substracting the 17 per cent discrepancies made by valuers (Table 2 of Appendix B) from the actual yield. This is the Level of yield at which farmers are actually paid by cinnamon traders

c) For cinnamon aged less than 10 years, yield in the upper region is about 72.3 per cent of that in the lower region. For trees aged 10 years and over, the figure is 77.9 per cent. See text for further discussion

Net Returns from Deforestation

Table 7 to 9 present estimated returns from forest clearing and the subsequent agriculture. In this paper, multicropping between cinnamon and the three most popular secondary crops, i.e. potato, coffee and chili, are analysed. Detailed inputs, output and prices data are summarized in Appendices 3 to 17. It should be emphasized here that these data represent the average of data obtained from farmer interview. For brevity, however, details of these data are not discussed again. Instead, the author outlines below some important features of the data and the key assumptions used.

Firstly, it is assumed for simplicity that the agriculture commences on the following year after forest clearing is completed. Thus, if forest clearing occurs at year 0, the agriculture is then assumed to begin at year 1. This assumption is made because a cleared land would not normally be cultivated for about 9 to 11 months after forest clearing. It relates to the fact that the average lengths of the drying period in the upper and lower region are 9.6 and 7.9 months, respectively, while land clearing takes another 4 weeks on average.

Secondly, Tables 3, 8 and 13 of Appendix show that no fertilizers, pesticides and insecticides are used in cinnamon plantation. While it might seem unusual from the viewpoint of modern agriculture, this practice is very common in both the upper and lower Kerinci region. None of the farmers interviewed have ever used these modern inputs for their cinnamon plantation. Such low input production is also another reason why farmers are attracted to cinnamon planting.

Thirdly, following the most common practice in the studied area, the author assumes that cinnamon is harvested in year 12, termed henceforth as the 12-year cycle. Later a simulation is performed to see how financial returns to farmers change if cinnamon is harvested in year 10 and 15. the 10-year cycle is chosen because the largest annual yield increment occurs between year 8 and 10. the 15-year cycle is chosen to reflect what happens to the financial returns after cinnamon yield enters the “plateau” stage (See Figure 1).

Fourthly, coffee is planted under an eight year cycle with production assumed to begin in the second half of year 3. In Kerinci, coffee can be harvested throughout the year, with annual peaks reached quarterly. In year 3, however, the plantation usually has no

annual peaks. Coffee production then increases and reaches a maximum in years 6 to 7. Due to increased shading, in year 8 coffee production is assumed to decline by a half[11]. The production ceases completely in year 9 as the plantation becomes a monoculture of cinnamon.

Fifthly, the annual crops (i.e. potato and chili) are cultivated from year 1 to 6. In the upper region farmers plant potato twice a year, while in the lower region chili is planted once a year. Chili production starts from the fourth or fifth month and lasts until the end of the planting year. Because of shading, both potato and chili productions end in year 7.

Sixthly, the distribution of income and farming costs between landowners and *anak ladangs* is estimated on the basis of the sharecropping contract applied. Consequently, if the 1:2 system is applied the landowners costs will include not only farming costs, but also staple food allowance for *anak ladang*. The food allowance is only given during the first three years of the contract.

Finally, in addition to financial analysis, a simple economic analysis is also undertaken. In this case the economic value of land is set at the prevailing market price, while that of family labourers at market wages. Note that for coffee and chili harvests the wage is lower than the normal wage. A real discount rate of 16 per cent is assumed[12].

In general the results presented in Tables 7 to 9 explain why farmers are able to accumulate adequate surplus to finance the next rounds of forest clearing. First let us have a look at the 4th and 5th columns of the tables. These columns show returns from a hectare of *ladang* if the distribution of income and costs between land owner and *anak ladang* is not taken into account. In financial terms, forest clearing and the subsequent agriculture are shown to produce high net present values (NPVs). In the case of multicropping between cinnamon and potato, for example, the NPV is Rp 14.6 million/hectare[13] over 13 years (Table 7). However, if land price is set at the prevailing market price of Rp 4.63 million/hectare and family labourers are paid wages at the

[11] As the author was unable to obtain more precise data about this decline, the estimate is made based on farmers' suggestion.
[12] Wibowo (1993) argues that the "best guess" for the social opportunity cost of capital in Indonesia is in the order of 24 per cent. Given the annual rate of inflation of about 8 per cent prior to the Indonesian economic crisis, a social discount rate of 16 per cent (in real terms) is assumed.
[13] Equals to US$ 6,970/hectare at then exchange rate of US$ 1.00 = Rp 2,100

current wage rate, the NPV declines sharply to Rp 5.8 million/hectare. This is the economic return of forest clearing followed by multicropping between cinnamon and potato. Despite such a decline, the economic IRR remains very high at 54.0%. These figures indicate that forest clearing and the subsequent agriculture is capable of producing very high financial and economic returns for both land owner and the *anak ladang*.

Multicropping between cinnamon and other secondary crops (i.e. coffee and chili) also produce high financial returns for farmers (Table 8 and 9). The financial IRR of cinnamon and coffee multicropping, for example, is estimated to be 43.9 per cent. However, due to the intensive use of family labourers in coffee maintenance, harvesting and post-harvesting, this multicropping has s very low economic IRR, that is, only 10.7 per cent. In the case of cinnamon and chili multicropping, the economic IRR is higher, that is, 28.0 per cent.

A clearer picture emerges if the financial returns to land owners and *anak ladangs* are computed separately. In the case of cinnamon and potato multicropping, for example, without getting involved directly in the plantation a landowner receives a financial return (IRR) of 24.5% or an NPV Rp 846,191/hectare (Table 7). More importantly, the landowner receives a lump sum of Rp 9.2 million/hectare at year 12, which in today's value is equal to Rp 1.3 million/hectare.

The other multicropping also exhibits similar results. In the case of cinnamon and coffee multicropping, despite its low economic return, agriculture still gives a financial IRR of 18.2 per cent to landowners, with an even higher lump sum of Rp 13.8 million/hectare in year 12 (Table 8). Multicropping between cinnamon and chili also produces high financial returns and lump sum to landowners (Table 9). All these results indicate that 13 years after the first forest clearing, if the landowner wishes to add his/her land ownership, he or she will have sufficient cash to finance another round of forest clearing.

Table 7
Estimated Net Returns from Forest Clearing Followed by a Multicropping
of Cinnamon and Potato (Rp/hectare), Upper Kerinci Region, Indonesia a)

Year	Financial Returns to		Total Net Returns	
	Land Owner	Anak Ladang	Financial	Economic
0	-750,000	0	-750,000	-4,630,000
1	-205,400	4,049,285	3,843,885	2,828,391
2	0	4,049,285	4,049,285	2,478,298
3	0	4,049,285	4,049,285	2,478,298
4	155,787	4,205,072	4,360,859	2,773,872
5	246,438	4,295,722	4,542,160	2,955,173
6	396,221	2,420,864	2,817,085	1,925,173
7	0	0	0	-104,000
8	0	0	0	-104,000
9	0	0	0	-104,000
10	0	0	0	-104,000
11	0	0	0	-104,000
12	9,157,229	9,157,229	18,314,458	18,150,458
NPV (16%)	846,191	13,791,549	14,637,740	6,797,435
IRR	24.5%	N.A	517.1%	54.0%

Notes: a) Under the 1:1 system of sharecropping contract
NPV = net present value, estimated at a discount rate 16 per cent
IRR = internal rate of return
N.A. = not available
Sources: Computed from Tables 5 to 7 of Appendices B

Table 8
Estimated Net Returns from Forest Clearing Followed by a Multicropping of Cinnamon and
Coffee (Rp/hectare), Lower Kerinci Region, Indonesia a)

Year	Financial Returns to		Total Net Returns	
	Land Owner	Anak Ladang	Financial	Economic
0	-900,000	0	-900,000	-4,327,000
1	-1,006,622	0	-364,022	-1,357,422
2	-824,393	0	-181,793	-1,098,359
3	-810,039	45,587	-121,852	-1,089,739
4	465,181	683,298	1,148,479	10,040
5	714,037	1,194,309	1,908,346	769,906
6	914,293	1,608,548	2,522,841	1,380,401
7	268,753	1,285,778	1,554,530	504,091
8	45,864	642,889	688,753	-416,467
9	0	0	0	-112,000
10	0	0	0	-112,000
11	0	0	0	-112,000
12	13,839,994	6,919,997	20,759,991	20,587,991
NPV (16%)	846,191	13,791,549	14,637,740	6,797,435
IRR	24.5%	N.A	517.1%	54.0%

Notes: a) Under the 1:2 system of sharecropping contract
NPV = net present value, estimated at a discount rate 16 per cent
IRR = internal rate of return
N.A. = not available
Sources: Computed from Tables 10 to 12 of Appendix B

Table 9

Estimated Net Returns from Forest Clearing Followed by a Multicropping of Cinnamon and Chili (Rp/hectare), Lower Kerinci Region, Indonesia a)

Year	Financial Returns to		Total Net Returns	
	Land Owner	Anak Ladang	Financial	Economic
0	-900,000	0	-900,000	-4,327,000
1	-194,054	1,966,122	1,772,069	838,735
2	0	1,966,122	1,966,122	1,108,789
3	0	1,966,122	1,966,122	1,108,789
4	203,426	2,169,548	2,372,974	1,499,641
5	321,797	2,287,919	2,609,716	1,736,383
6	517,384	1,500,445	2,017,829	1,477,162
7	0	0	0	-112,000
8	0	0	0	-112,000
9	0	0	0	-112,000
10	0	0	0	-112,000
11	0	0	0	-112,000
12	11,092,394	11,092,394	22,184,787	22,012,787
NPV (16%)	1,102,833	7,920,453	9,023,287	3,232,305
IRR	25.4%	N.A	205.3%	28.0%

Notes: a) Under the 1:1 system of sharecropping contract

NPV = net present value, estimated at a discount rate 16 per cent

IRR = internal rate of return

N.A. = not available

Sources: Computed from Tables 15 to 17 of Appendix B

As for *anak ladang*, the picture is more interesting. From year 1 to 5 the *anak ladang* obtains an annual net income of Rp 4.0 to 4.3 million/hectare from potato farming. Because the average size of *ladang* operated by an *anak ladang* in the upper region is 0.24 ha, this means the *anak ladang* receives a monthly net income of Rp 80,986 to Rp 85,914. As can be seen from Table 10, such a level of monthly income is adequate to support an *anak ladang* family of 2-3 persons. This explains why *anak ladangs* can rely on potato farming to support themselves. More importantly, the *anak ladang* receives a lump sum of Rp 2.2 million in year 12, which explains why older *anak ladangs* are able to finance future forest clearing and become land owners.

In the lower region, the average size of *ladang* operated by an *anak ladang* is 0.69 hectare. The fact that coffee only comes to production in year 3 and that chili has only season per year seems to induce lower region's *anak ladangs* to operate a larger size of land than their upper region's counterparts. Nonetheless, at this size of land operated, lower region's *anak ladangs* can rely on secondary crops to support themselves. In year 1 of cinnamon and chili multicropping, for example, *anak ladangs* receive a monthly income of Rp 113,052, which continues to increase until year 5. Multicropping between cinnamon and coffee, however, has some exceptions. In year 3 and 4, the level of income received by *anak ladangs* is relatively small. Thus, the *anak ladangs* cannot rely solely on secondary crops to support themselves during these years. It is then unsurprising to find some *anak ladangs* working as casual labourers, either in the agricultural sector (e.g. as cinnamon or coffee harvesters) or in other sectors (e.g. as loading labourers in the market place). Despite these, at the present size of land operated lower region's *anak ladangs* receive a large lump sum in year 12. These lump sum amount to Rp 4.8 and 7.6 million for the cinnamon – coffee and cinnamon – chili multicropping, respectively. As in the upper region, these lump sums enable lower region's *anak ladangs* to finance the next rounds of forest clearing.

One possible explanation why forest clearing and the subsequent agriculture produce such high returns is that forest lands are virtually an "open-access resource" and are significantly undervalued. In the upper region, for example, farmers are able to clear a forest and to claim ownership over the land underneath by investing Rp 750,000/hectare, much less than the prevailing market price of a *ladang*. Had forest lands been valued properly, forest clearing could have been made financially less attractive for farmers. For example, if land cost in the upper region is set at Rp

1,731,582/hectare, land owners would have received a zero financial NPV at a discounting rate of 16%. It would significantly reduce the incentive for deforestation because land owners are the major decision makers in this process[14].

A Simulation of Financial and Economic Returns

Table 11 presents a simulation of financial and economic returns for farmers if cinnamon is harvested in year 10 and 15. The results show that for all types of multicropping the 10-year cycle would give farmers the highest financial returns. In the case of multicropping between cinnamon and chili, for example, the cycle produces an NPV of Rp 9.3 million, much higher than those produced by the 12-year and 15-year cycles (Tables 9 and 11). More-over, landowners would receive a financial IRR of 27.9 per cent by adopting the 10-year cycle, higher than what they would receive if the cinnamon is harvested in year 12 or 15.

The 10-year cycle also produces the highest economic returns for all types of multicropping. In the case of multicropping between cinnamon and potato, for example, the economic IRRs are 55.2, 54.0 and 53.0 per cent for the 10-year, 12-year and 15-year cycles, respectively. The 10-year and 12-year cycles might appear to produce the same economic IRR for multicropping between cinnamon and coffee. But still, the NPV for the former is higher than that of the later. Thus, for this multicropping the 10-year cycle remains economically superior than 12-year cycle.

These results present policy makers with a dilemma as to which planting cycle is more favourable for forest conservation. On the one hand, the 10-year cycle might reduce farmers' need to clear another forest because the existing land can be replanted again after 10 years (instead of 12 years). On the other hand, the cycles produces the highest NPV, and consequently, the largest lump sum (in present value terms) for the farmers at the end of the cycle[15]. This means, compared to the longer cycles the 10-year cycle provides farmers with a larger accumulated capital, giving them a greater financial capacity to clear another forest. Given the extremely important role of

[14] A similar calculation can also be made for the lower region.

[15] For example, the present value of the lump sum received by an *anak ladang* from multicropping between cinnamon and potato is Rp 1.44 million under the 10-year cycle. This value is higher than the Rp 1.33 and 1.01 million lump sums (in present value terms) produced by the 12-year and 15-year cycles, respectively.

"adequate cash capital" in deforestation decision, it may be hypothesized that of these two conflicting effects the later one might be the stronger one. At the end of the day, the 10-year cycle might eventually lead to a larger deforestation. Unfortunately, the author has no adequate evidence to either confirm or reject such a hypothesis. For this reason, the hypothesis is left as an unresolved matter.

Table 10

Average Monthly Consumption of Anak Ladang a)

		Upper Region		Lower Region	
		Rp	**Share**	**Rp**	**Share**
A.	Cash Expenses				
	Staple food	33,182	37%	38,833	30%
	Other foods and beverages	22,091	25%	29,305	22%
	Sub Total				
	Other cash expenses b)	25,455	29%	45,403	35%
	Total cash expenses	80,727	91%	113,541	86%
B.	Consumption of own products				
	Staple food	6,545	7%	6,909	5%
	Other foods and beverages	1,530	2%	11,046	8%
	Total	8,075	9%	17,955	14%
C.	Total monthly consumption	88,803	100%	131,496	100%

Notes: a) Unusual big expenses such as wedding and purchase of a house or a motorcycle are not included

b) They include expenses for clothing, non-work related transports, kerosene, cigarettes, sanitary needs etc.

ECONOMIC CRISIS AND DEFORESTATION

While virtually all of the Asian emerging economies suffer from the monetary and economic crisis that started in July 1997, Indonesia is probably one of the hardest-hit casualties. Compared to the other IMF patients (i.e. South Korea and Thailand), Indonesia exhibits the largest economic contraction, currency depreciation and inflation (Wibowo, 1998). The problems are worsened by prolonged political uncertainty and the breakdown of law and order in some parts of the country. Despite the expectation that the June 1999 general election could lead to a solution to Indonesia's political instability, the prospect that no clear winner will emerge from the election gives another source of instability. For this reason, Wibowo (1998) argues that compared to the relatively brighter outlook for South korea and Thailand, There is less hope for a speedy economic recovery in Indonesia.

Given this economic environment, it is then necessary to review how financial and economic returns of deforestation change under the crisis. Because currency depreciation increases the Rupiah value of exports, it can be expected that the domestic price of exported commodities (e.g. cinnamon) will increase in Rupiah terms. Similarly, price of imports (in Rupiah terms) will also tend to rise. To prevent further declines in the Rupiah's exchange rate, the government has to increase interest rates dramatically, giving inflationary pressures to the economy. The inflationary consequences of these rises in prices and interest rates result in increases in the domestic price of other goods and services, including that of non-exported commodities. With this in mind, and supported by data recently obtained from WWF's Kerinci staff[16], the following assumptions are used in this analysis.

1. Price of cinnamon wet bark is assumed to rise from Rp 1,200/kg to Rp 4,857/kg, which means an increase of 304.8 per cent. Despite the relatively large increase, this estimate is a modest one. Cinnamon price had in fact risen to over Rp 6,500/kg during the first year of the crisis. Note however that the estimate does not represent a long-run equilibrium. As price rise induces farmers to increase supply, while at the same time the Rupiah's exchange rate tends to strengthen at around Rp 8,000 to Rp 8,500 on the US dollar, the above price estimate is unlikely to prevail in the long-run. More recent 1999 data indicates that such is the case and the price has fallen back to its pre-crisis

[16] The author uses international telephone and electronic mail as means of communication in 1999.

level. For this reason, an analysis is also undertaken using the pre-crisis price of Rp 1,200/kg as a basis.

2. At the consumer level in Kerinci, coffee price has risen to around Rp 20,000/kg. Given past experience that farm gate price was usually about 35 to 40 per cent of consumer price, a farm gate price of Rp 7,000/kg dry bean is assumed.

   As potato and chili are non-exported products, their (farm gate) prices are assumed to rise less than those of cinnamon and coffee. Based on recent data, a price increase of 123.9 per cent for each quality of potato is assumed. Similarly, chili price is assumed to increase from Rp 643/kg to Rp 1,974/kg, representing a 207.0 per cent increase. Note that chili tends to exhibit a larger price rise because Kerinci and its West Sumatran neighbour are large consumers of chili.

3. Price of urea had after the crisis increased from Rp 290/kg to between Rp 1,260 and over Rp 1,300/kg. Phospate price also rose from Rp 450/kg to between Rp 1,760 and Rp 1,800/kg. For modesty we assume urea and phosphate prices to increase to Rp 1,260 and Rp 1,760/kg, respectively. Because phosphate price exhibits a lower increase, that is by 391 per cent, for simplicity we assume that prices of other farm inputs rose by 291 per cent.

4. Labour wage currently vary between Rp 7,500 to Rp 10,000/day. Again for modesty, the lower end of the range is used as the basis for our analysis. But as deforestation costs depend largely on labour wage, we also run an analysis based on a labour wage of Rp 10,000/day. For coffee and chili harvesting, the wage is assumed to vary between Rp 5,000 and Rp 7,500/day.

5. Deforestation cost and market land prices are assumed to increase according to increases in labour wages. In the upper region, for example, we assume a deforestation cost of Rp 1,406,250 and Rp 1,875,000 per hectare at a labour wage of Rp 7,500 and Rp 10,000 per day, respectively.

Table 11

A Simulation of Net Returns from Forest Clearing and the Subsequent Agricultures Assuming Different Planting Cycles

	Cinnamon-Potato Multicropping		Cinnamon-Coffee Multicropping		Cinnamon-Chili Multicropping	
	IRR	NPV (Rp/hectare)	IRR	NPV (Rp/hectare)	IRR	NPV (Rp/hectare)
A. Under the 10-year cycle						
Financial returns	N.A	14,862,488	46.9%	4,916,018	N.A	9,293,928
Economic returns	55.2%	7,051,795	10.7%	-1,981,862	30.1%	3,535,068
Financial returns for landowners	26.9%	958,565	19.5%	611,389	27.9%	1,238,154
End of cycle lump sum for landowners	N.A	1,775,014	N.A	2,527,380	N.A	2,025,628
Financial returns for anak ladangs	N.A	13,903,923	N.A	3,060,483	N.A	8,055,774
End of cycle lump sum for anak ladangs	N.A	1,775,014	N.A	1,263,690	N.A	2,025,628
B. Under the 15-year cycle						
Financial returns	N.A	13,998,311	40.8%	3,937,700	N.A	8,248,467
Economic returns	53.0%	6,127,217	9.6%	-3,025,700	25.1%	2,424,086
Financial returns for landowners	21.0%	526,477	15.8%	-40,823	21.7%	715,423
End of cycle lump sum for landowners	N.A	1,171,784	N.A	1,770,814	N.A	1,419,261
Financial returns for anak ladangs	N.A	13,471,834	N.A	2,734,377	N.A	7,533,043
End of cycle lump sum for anak ladangs	N.A	1,171,784	N.A	885,407	N.A	1,419,261

Notes: NPV = net present value, estimated at a discount rate 16 per cent
IRR = internal rate of return
N.A. = not available

Table 12 presents results of the analysis. As expected multicropping between cinnamon and coffee (both are export commodities) is the main beneficiary of the crisis. For the 12-year cycle, assuming a high cinnamon price (i.e. Rp 4,857/kg), both financial and economic returns for this multicropping are shown to increase significantly. For example, the financial IRR to landowners is doubled while the overall economic returns increase by 2.5 times.

The other multicropping also benefit from the crisis. Nonetheless, because potato is not an export commodity for Kerinci, financial returns for cinnamon and potato multicropping only rise moderately. Due to increased opportunity costs of family labour and higher economic value of land, the multicropping even gives a negative NPV at the 16 per cent discount rate. Thus in economic terms, the crisis has made deforestation less attractive if it is followed by multicropping between cinnamon and potato.

If high labour wage (i.e. Rp 10,000/day) is assumed, which also means higher deforestation cost and land price, the financial returns decline slightly. Nonetheless, the returns are still higher than they are before the crisis. For example, before the crisis, landowners receive a financial IRR of 24.5 per cent from cinnamon and potato multicropping, while after the crisis the return is 29.5 per cent (Table 12).

Under normal condition farmers would not harvest their cinnamon in year 6. To see whether the crisis has the capacity to induce farmers to do otherwise, we estimate financial and economic returns for the 6-year cycle. Surprisingly, this very short cycle still gives very high financial returns for farmers (Table 12). For example, landowners still receive a high financial IRR of 30.3, 30.5 and 28.7 per cent from multicropping between cinnamon and potato, coffee or chili, respectively. More interestingly, these returns are still higher than those of the 12-year cycle prior to the crisis (Tables 7 to 9).

All these results indicate that at a high cinnamon price, the crisis gives farmers much greater financial capacities and incentives to clear another forest. The returns are such that even the normally unfavoured 6-year cycle can still produce relatively high financial returns for farmers. Thus, we can expect some farmers to shorten their planting cycle to take advantage of the high cinnamon price. Such a decision would expedite the period required by an *anak ladangs* to have enough capital to clear a forest.

Table 12

Estimated Financial and Economic Returns from Forest Clearing and the subsequent Agricultures Given the Current Economic Crisis

		Cinnamon-Potato Multicropping		Cinnamon-Coffee Multicropping		Cinnamon-Chili Multicropping	
		IRR	NPV (Rp/hectare)	IRR	NPV (Rp/hectare)	IRR	NPV (Rp/hectare)
	High cinnamon price a)						
A.	Under the 12-year cycle, low wage level is assumed b)						
	Financial returns	60.6%	13,657,159	63.3%	24,252,106	N.A	33,156,245
	Economic returns	15.0%	-1	26.5%	11,685,488	57.3%	22,425,299
	Financial returns for landowners	32.5%	4,850,609	36.9%	10,296,288	34.0%	6,169,204
	Financial returns for anak ladangs	N.A	8,806,549	N.A	12,711,673	N.A	26,987,040
B.	Under the 12-year cycle, high wage level is assumed b)						
	Financial returns	46.5%	12,327,393	58.1%	23,767,192	N.A	31,471,498
	Economic returns	10.6%	-7,273,369	21.2%	6,833,946	37.8%	16,994,044
	Financial returns for landowners	29.5%	4,446,514	34.4%	9,811,374	30.8%	5,684,291
	Financial returns for anak ladangs	N.A	7,880,878	N.A	12,711,673	N.A	25,787,207
C.	Under the 6-year cycle, low wage level is assumed b)						
	Financial returns	74.3%	6,106,342	62.1%	11,547,723	N.A	23,814,430
	Economic returns	1.4%	-4,713,958	16.1%	37,556	59.4%	13,360,809
	Financial returns for landowners	30.3%	1,263,039	30.5%	2,994,962	28.7%	1,498,297
	Financial returns for anak ladangs	N.A	4,843,303	N.A	7,308,615	N.A	22,316
	Low cinnamon price a)						
D.	Under the 12-year cycle, low wage level is assumed b)						
	Financial returns	42.2%	3,628,123	55.3%	12,713,884	N.A	20,826,133
	Economic returns	-1.2%	-11,072,448	16.2%	147,265	50.3%	10,122,188
	Financial returns for landowners	14.9%	-163,908	25.0%	2,604,140	16.0%	4,149
	Financial returns for anak ladangs	N.A	3,792,032	N.A	8,865,599	N.A	20,821,984
E.	Under the 12-year cycle, high wage level is assumed b)						
	Financial returns	27.7%	298,358	50.2%	12,228,970	N.A	19,141,386
	Economic returns	-5.4%	-17,302,404	10.3%	-4,704,277	27.2%	4,663,933
	Financial returns for landowners	12.8%	-568,003	22.7%	2,119,226	13.7%	-480,765
	Financial returns for anak ladangs	N.A	2,866,361	N.A	8,865,599	N.A	19,622,152
F.	Under the 6-year cycle, low wage level is assumed b)						
	Financial returns	51.3%	2,045,490	49.2%	6,590,312	N.A	18,518,155
	Economic returns	-31.1%	-8,774,811	3.5%	-4,959,661	50.8%	8,064,534
	Financial returns for landowners	0.9%	-767,387	14.0%	-309,979	-0.9%	-1,149,840
	Financial returns for anak ladangs	N.A	2,812,877	N.A	5,656,145	N.A	19,667,996

Notes: a) Cinnamon price is assumed to take the value of Rp 4,857/kg wet bark for the high estimate and Rp 1,200/kg for the low estimate.

b) A high wage level of Rp 10,000/day and a low level of Rp 7,500/day are also assumed

NPV = net present value, estimated at a discount rate 16 per cent

IRR = internal rate of return

N.A. = not available

More importantly, as cinnamon and annual crops (especially chili) multicropping gives high financial returns, the pay-offs to farmers who are willing to take the risks of the cat-and-mouse game increase. Thus, the crisis offers greater inducement for risk-taking farmers to adopt the game. The farmers may also be tempted by the fact that annual crops offer relatively quicker financial returns. As a result, increased deforestation could be expected after the crisis began. Recent qualitative assessment from the WWF staff interviewed indicates that forest intrusion is on the rise in the villages studied. Worse still, there is a tendency that forest clearing has reappeared in villages usually considered to be in "non-deforestation" area.

Regardless of which wage level is used, for multicropping between cinnamon and coffee, the general picture does not change much even if a low cinnamon price (i.e. Rp 1,200/kg) is assumed. Both financial and economic returns from this multicropping are still high, even higher than the pre-crisis returns. With a high wage of Rp 10,000/kg, for example, landowners still receive a financial IRR of 22.7 per cent, somewhat higher than the pre-crisis IRR of 18.2 per cent. For multicropping between cinnamon and chili, the picture is slightly different. The multicropping still gives financial and economic returns higher than the pre-crisis ones, but with the exception of the financial IRR and NPV for landowners. For example, if a high labour wage of Rp 10,000/day is assumed, the multicropping still rewards *anak ladang* with an NPV of Rp 19.6 million, almost two-and-a-half times the pre-crisis NPV of Rp 7.9 million (Tables 9 and 12). It can then be concluded that even if cinnamon price falls back into its pre-crisis level, forest clearing and the subsequent agriculture still provides farmers with a high financial capacity to clear another forest.

This inference is however made with the exception of multicropping between cinnamon and potato. Because potato is not an export commodity, the crisis has made cinnamon and potato multicropping unattractive for landowners. Even though the overall financial returns are still relatively high, that is 42.2 and 27.7 per cent for the cases with low and high wages, respectively, the multicropping gives landowners negative NVP at the 16 per cent discount rate. The NPVs for *anak ladang* also decline to around one-fourth of their pre-crisis levels.

Table 12 also shows that if cinnamon price falls back to its pre-crisis level (i.e. Rp 1,200/kg), landowners would have much reduced incentives to harvest their cinnamon

in year 6. Financial returns to landowners under the 6-year cycle are shown to be far less than the pre-crisis ones. Because it is landowners who decide when to harvest the cinnamon, it can be concluded that at this level of price, it is unlikely that the plantation will be harvested in year 6.

CONCLUSION

While in some cases deforestation can be associated with poverty, this paper shows that deforestation can depend on the capital accumulation behavior of richer farmers and holders of capital. Poverty is a deterrent to deforestation because the poorest farmers have inadequate capital to finance forest clearing and other associated costs. The decision to clear a forest rests mostly with more established farmers such as landowners.

This phenomenon is related to the fact that forest lands are available at a fraction of their "true" economic worth. As a result, forest clearing and the subsequent agriculture are shown to be capable of producing high financial returns for farmers. More importantly, at the time of cinnamon harvest, a large cash capital is generated, enabling both poorer farmers (i.e. *anak ladangs*) and landowners to finance the next round of forest clearing. The social values held by the society, which result in greater land ownership giving a higher social status, motivate farmers to own land and to increase their land ownership.

The results also show that one cannot easily choose which planting cycle of the main crop (i.e. cinnamon) that is more favourable for forest conservation. On the one hand, a shorter cycle (i.e. 10-year one) might reduce farmers' need to clear a forest. This is because the existing land can be replanted earlier. On the other hand, this cycle also gives farmers a greater financial capacity to clear another forest.

Because the crops planted in the study area are mostly export commodities, the 1997/98 economic crisis appears to provide favourable conditions for increased deforestation. This is because the crisis gives farmers much greater financial capacities to clear another forest. The crisis also provides greater inducement to farmers to take the risks of adopting a cat-and-mouse game. In this case farmers take

a gamble on the probability of being caught by the park authority, and clear a land plot deep inside the forest.

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