Improving Resilience through Diversity

Analyses on Shaded Coffee Systems in Sumberjaya Watershed, West Lampung, Indonesia

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There is a strong international demand for conservation of forest in tropical regions; however, at the local scale it is evident that preservation also incurs opportunity costs. The inconsistency between policies aimed at achieving nature conservation and the needs of local populations can often lead to conflict and uncertainty. Conflict between 'nature' and 'agriculture' can be resolved by two means; one is by segregating nature and agricultural land (maximizing agricultural production on a relatively small part of the land will leave as much land for nature as possible). Alternatively, by integrating nature into agricultural land through the adoption of production systems that allow sufficient agricultural production, while ensuring conservation of considerable parts of the biodiversity of the natural system (van Noordwijk et. al, 1995).

An agroforest can be seen as an example of the "integration" case, which represents a synergetic relationship between ecology and economy. Although variable in form from traditional subsistence systems with high species richness to highly regulated and high-input commercially oriented systems, to a certain degree all can function as a refuge for trees. Combining coffee with Glyricidia and Leucaena as main shading trees has become a habit of the people in Sumberjaya, on the island of Sumatra, while some farmers also maintain systems involving a wide variety of tree and understorey species which provide fruit, timber and other commodities.

The objectives of this research are to identify economically valuable trees and products from coffee multi-strata systems and, to summarize common patterns of shaded coffee systems in Sumberjaya in the West Lampung district of Sumatra in Indonesia. This is done using variables of tree species composition and density. Also, to financially and economically value the benefits of each type of shaded coffee system. Financial and economic analyses are conducted using the Policy Analysis Matrix method developed by Monke and Pearson (1989) and Net Present Value (NPV) derived parameters. Equations to measure and compare investment feasibility in perpetual tree farming, such as Land Expectation Value (LEV) and Equivalent Annual Income (EAI) are adopted to display the competitiveness of the systems. Land Expectation Value (LEV) is a net present worth calculation that reflects amount of money the buyer is willing to pay for bare land if used to grow trees (Ministry of Forestry, 1997). Equivalent Annual Income on the other hand is a simple annualized Net Present Worth of a measurable financial characteristic of a land use, in this case, profit. Hypothetical conditions of a 25 year time span were used to compare potential profits from different coffee systems. Other assumptions are specified in the appendices.

The uncertainty of Indonesia's macro economic condition caused by the economic crisis that has been taking place since the middle of 1997 has caused many problems and changes. However the weakening of Indonesian currency against US $ have brought not only negative impacts to farmers' economy at the household level but also, due to the export orientation of some products, has had some benefits. For this reason, the assessment was conducted discriminating between the periods before (calculated until 1997) and after the economic crisis (calculated until 2000).

Shaded coffee systems are land uses that develop gradually by planting coffee and other subsistence crops such as upland paddy and chili as well as shade function trees in their early stage of development (4 years). Other fruit trees which are locally exotic but regionally indigenous, forest tree species and surface vegetation such as ginger, turmeric and dwarf cardamon (*Amomum compactum)* are usually inter-planted to optimize land productivity by occupying empty spaces and thus are patchily dispersed. Three classes of medium intensity and moderate input shaded coffee systems and two high input coffee monoculture systems are considered and compared, as have been studied by Budidarsono et. al. (2001) in the same study area

Definitions used in this prior study are also being used in the present assessment; medium management intensity -moderate input is characterized by 400 Kg ha^{-1} fertilizer (mainly Urea and TSP), which are applied from the 10^{th} year and use a mean of 120 man-days per-annum labor requirement. Meanwhile, high input and management systems are characterized by more than 1,000 Kg ha^{-1} fertilizer application (in order to maintain high productivity after peak fruiting would otherwise have passed at a farm age of 14 years); by use of other chemicals, more than 200 man-days per annum labor requirements, as well as more advanced rejuvenation grafting techniques.

Site Outlook

This study was carried out in Sumberjaya in West Lampung District, Province of Lampung (104°19' – 104°34' E, 4°55' – 5°10' S; 780 – 1700 m a.s.l. The area has complex problems in its natural resource management, especially threats to the preservation forest area from population pressure. This is indicated by the high rate of deforestation accrued in Lampung as 44.2% of the total forested area was lost between 1985 and 1999. With population density over 188 people/Km^2, Lampung is the third most densely populated province outside Java after Bali and West Nusa Tenggara (Statistik Indonesia, 2000) with migration as a major factor in population dynamics.

Although there is evidence of people arriving from South Sumatra and other nearby areas, the intensive settlement history in Sumberjaya begun in the 1950's when the Government of Indonesia through the BRN (Bureau of National Reconstruction) relocated army retirees from West Java to Sumberjaya and Pulau Panggung. They were settled in Sukapura, Tanjungsari, Purajaya, Purawiwitan and Pura Laksana (Kusworo, 2000). Currently, people from Java are the largest ethnic group in Lampung (not less than

65%), followed by native Lampungese (approx. 15%), Sundanese (12%) with the remainder Semendonese and Pasemah

In the Dutch Colonial era, most of the area was declared as forest by the imposition of 51 forest registers in Lampung. Residen Besluit No. 117, dated at 19 March 1935, made the Sumberjaya area a protected forest and named it as Register 45 B Bukit Rigis, which covered a total area of 8,295 Ha. However, during the Japanese colonial era and early after Indonesian independence, some of the areas were released for different uses. Due to excessive forest conversion by many parties (local people in particular), in 1977 the local Government of Lampung imposed a decree which dis-acknowledged forest conversion permits that had been issued prior to that time (Kusworo, 2000).

Data Collection

Agro-Ecological Data

The gardens' attributes, including location, altitude, latitude, aspect and total size were recorded. Within each garden a plot of 50 x 10 meters plot was selected for construction of a profile. For the purpose of classification, except for the coffee trees, "tree" was narrowly defined as a vascular object that has more than 10 cm of stem diameter at breast height. All the characteristics of the trees, such as diameter at breast height, height, relative position in the plot and crown height and width were recorded.

Only tree species which occur in at least 42.11% of the surveyed plots are considered in this analysis.. Meanwhile the median number of trees of these selected species, per plot area were used as a measure of overall density

Socio-economic Data

Shaded coffee samples were taken purposively in two villages; Gunung Terang, which consists of Rigis Jaya, Gunung Terang Induk and Mutar Alam sub-villages, and Simpang Sari, which consists of Talang Bodong, Tepus and Simpang Sari sub-villages. Sixty respondents were interviewed for comparison of socio-economic and vegetation parameters, nineteen of these being owners of the plots surveyed for garden classification. Thirty of the respondents were from each village. Demographic characteristics of farmers were analyzed to explore which factors influence the maintenance of shaded-coffee systems.

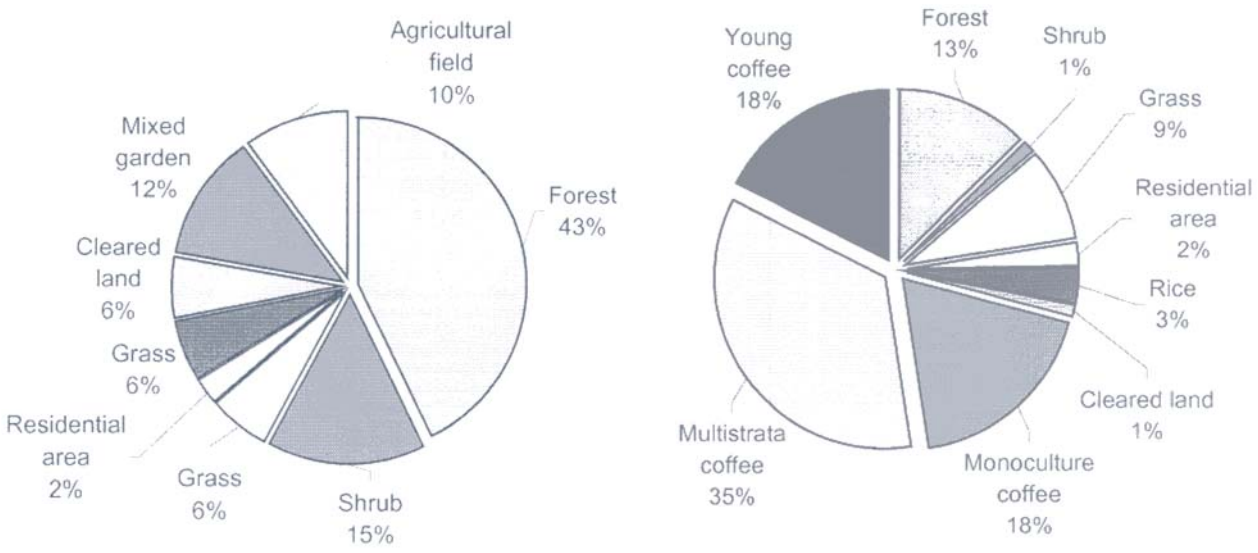
Systems Performance

Agro-ecological Performance

Shaded Coffee systems can be grouped into three classes based on the major function of the trees involved; Shade based multi-strata, Fruit based multi-strata and Timber based multi-strata. This classification facilitates economic assessment, although in the field these groups are not discrete. A Shade-Based multistrata is defined as a coffee system that mainly consists of trees whose function are

shade provision, such as *Leucaena, Glyricidia, Erythrina* spp. and *Dalbergia latifolia,* while a Fruit Based multistrata is a mixture of shade trees and indigenous and exotic fruit trees. Timber-based multi-strata is rather a mixture of systems which in El Salvador are known and classified as "rustic traditional polyculture"' and "diverse commercial polyculture" coffee (Alvarez, 1999). The timber based systems are composed of commercial species such as Mahoghany *(Swietenia mahagoni)* as well as forest tree species such as *Anisoptera, Quercus* and *Pterospermum* spp., which are mostly self-seeded.

Long term investment of land in agroforests makes time a very significant factor in evaluating their competitiveness, thus in this analysis a 25 year time span is used. Study of land use change in the surveyed area reveals that economically un-productive land uses such as forests, cleared land and shrubs have been reduced respectively by nearly 70%, 94% and 60% during the period of 1973 – 2000. Meanwhile, there has been expansion of other more economically productive land uses, multistrata coffee in particular, from 12 percent land cover by the presumed equivalent "mixed garden" to more than 35 per cent at the end of the period (Ekadinata, 2001)(Figure 1).



(a) 1973 (b) 2000

Figure. 1. Sumberjaya Land Use (Ekadinata, 2001)

Surveyed shaded coffee systems in Sumberjaya show a wide variety of species within plot, with species richness ranging from 10 to 32 species per plot. In total no less than 66 economically valuable species have been identified. Most of the trees are planted for their fruits and timber while Erythrina and Glyricidia serve mainly as shade providers to coffee and fixers of nitrogen. Some predominantly forest species have also grown opportunistically.

Regardless of some disagreement regarding relative productivity of shaded and monoculture systems, an assumption was made that short term productivity in monocultures is higher.(Budidarsono *et al*, 2001). Nevertheless, although there has not been any empirical evidence from the present study site, over the longer term, it is also likely that nutrient return by leaf fall and nitrogen fixation from leguminous shading trees has some effect of maintaining coffee productivity. A review from Steinman (1999) suggests that a 5,000 bushes per-ha density require less 100 kg N ha^{-1} annually while falling leaves from *Erythrina poeppigiana* could provide as much as 173 Kg ha^{-1} of nitrogen per year if trimmed three times in that period.

Earlier study on local carbon stocks by van Noordwijk *et. al.* (2002) revealed that the total mean biomass in shade coffee gardens between 2 and 30 years in age was 92 Mg ha^{-1} with 25% of this value derived from litter, dead trees and undergrowth. The total mean biomass in monoculture coffee between 1 and 21 years old was 44 Mg ha^{-1}, 48% of which was litter, dead trees and undergrowth. Thus, the difference between shade and sun coffee was thus close to 50 Mg ha^{-1} of biomasss, or 20 Mg ha^{-1} of aboveground carbon stock.

Economic Aspects

Returns of an agricultural system depend on physical characteristics of land, current vegetation, market access and land tenure. Sustainability can no longer be defined solely in terms of economic productivity, comparing yields of one crop type but instead as a synergetic relationship between adequate and healthy yields and environmental, cultural and social reality. Gradual development of shaded coffee systems as a result of adaptation and acculturation by local people and migrants has made these systems culturally and socially acceptable. This study also indicates that these systems could survive in different economic circumstances.

The multiple outputs inherent from an agroforest cause some difficulty in determining the total economic value of these systems. Therefore in this assessment, only tangible major products are considered, though this has an effect of somewhat undervaluing the systems.

Trees as source of timber in the surveyed area mostly serve as a "nest egg" or a saving for un-expected necessity or a family's big event. Family requirements calling for large amounts of money, such as weddings, children going to school or the building and renovation of houses are often financed from timber trees. In the 25 year period used for analysis, shade based, timber based and fruit based systems would respectively provide a predicted 21.87, 22.12 and 38.17 Cu-M of timber.

To estimate timber production, tree growth equations of some commercial trees are used. These have been developed by the Ministry of Forestry from monoculture industrial timber plantation sites in Lampung

Province. According to the equations,Lampung site suitability classes for growing *Dalbergia latifolia, Paraserianthes falcataria* and *Swietenia mahagoni* are respectively *Bonita* [1] *1, Bonita 2* and *Bonita 2.*

Growth rates of less commercial trees, which have not been empirically quantified, are assumed to follow the potential growth of secondary forest in Indonesia. The Indonesian Selective Cutting (TPI) system assumes forest increment of 1 Cu-M ha^{-1} $year^{-1}$, which is obtained from 35 core trees, saplings and poles. In spite of the coffee agroforest trees being species less commonly used commercially field experience indicates them to be faster growing, so to apply such rate (approximately 0.025 Cu-M ha^{-1} $year^{-1}$) for tree growth estimation in coffee gardens is rather conservative.

Economy is recognized as one of the most important driving factors in land use change. For example, Geist and Lambin (2001) cite demographic factors (defined as population growth and pressure) and political economy factors (market growth/commercialization, specific economic structure, urbanization and industrialization and specific economic factor) as the underlying causes of forest degradation. Thus. while many factors affect the decision to shift from subsistence oriented land use, to management with a more commercial orientation, economic motivation cannot be ignored.

In this assessment, economy, as defined by the result of Policy Matrix Analysis (PAM), IRR (Internal Rate of Return), Land Expectation Value (LEV) and Equivalent Annual Income (EAI) will be highlighted as a driving factor in land optimization. The IRR can be explained as the upper limit of resilience of systems in comparison with interest rates, being defined as the maximum interest rate allowable for a project to recover its investment and operating cost (Gittinger, 1992). The two other parameters explain the net profitability in given circumstances. A project is feasible if the IRR is higher than the current commercial interest rate.

Policy Analysis Matrices assessment compares social and private prices of products. The social price at the farm gate, before introducing the influence of distorting policies and market imperfections is considered the "ideal" price for products, while the private price is that which the farmer actually receives. Based on the 1997 situation, investment in coffee plantations is profitable for both private and social pricing though social profitability emerges as higher than private profitability. If calculations are based on the year 2000 situation, it appears that while the two monoculture systems still deliver social profit but can no longer give profit in private terms (Table 1) The shade systems remained profitable in both terms.

-> Kekurangan penjelasan untuk PAM mungkin bias masuk disini.

[1] Bonita is a terminology to describe land suitability class for individual species. The basic classification is obtained from phenotypic appearances, mainly the height of 10 tallest trees within one hectare of plantation, and tree shape. More suitable land for certain species is represented by a higher value.

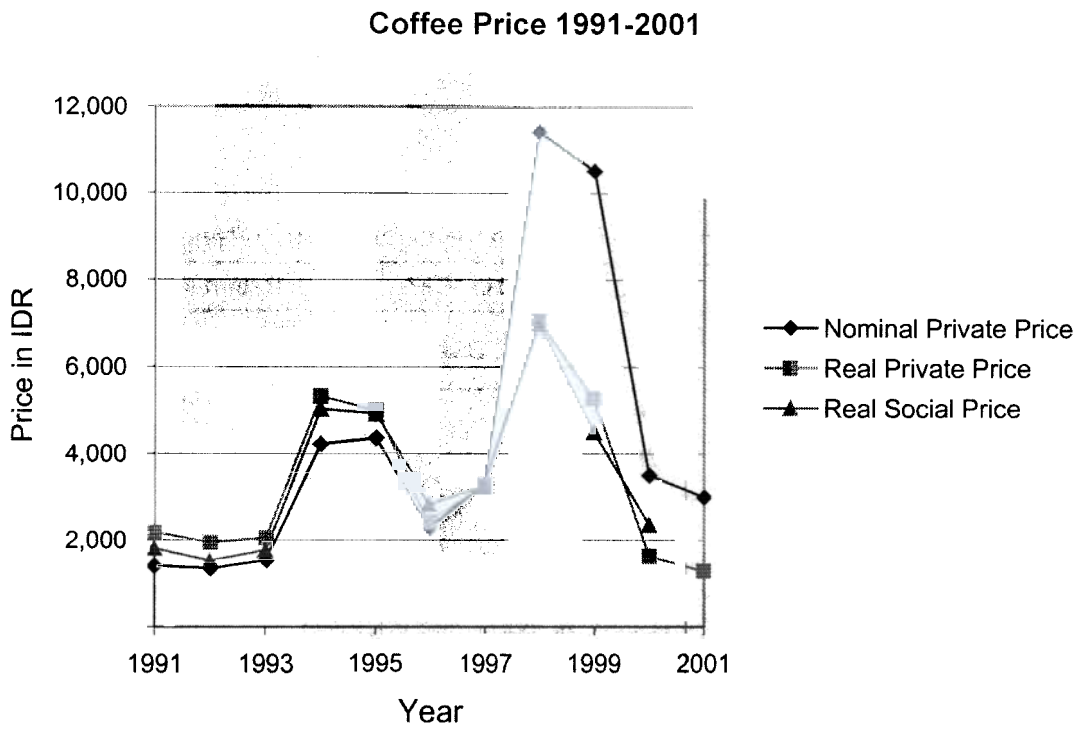
Table 1. Profitability of 1997 and 2000 Analyses of Various Coffee Systems (* 1,000 Rp)

Land-use Systems	Return to Land in 1997			Return to Land in 2000		
	Private Price	Social Price	Divergence	Private Price	Social Price	Divergence
High Input Monoculture	2,856	3,762	(906)	(1,127)	113	(1,240)
High Input Monoculture with Grafting	1,975	2,509	(535)	(1,979)	(1,047)	(931)
Shade Base	3,476	4,799	(1,323)	260	2,094	(1,834)
Shade Base with under storey	6,600	9,291	(2,690)	3,379	7,340	(3,961)
Fruit Base	7,949	13,691	(5,742)	4,415	10,430	(6,014)
Fruit Base with under storey	11,063	18,162	(7,099)	7,508	15,615	(8,107)
Timber Base	4,068	5,795	(1,727)	861	3,095	(2,234)
Timber Base with under storey	6,838	9,753	(2,915)	3,631	7,468	(3,836)

Sources : Budidarsono *et. al* (2001) and primary data

Given that conditions are as assumed, investment in fruit based multi-strata emerges as the most profitable system with the highest IRR, even in comparison with the high input monoculture coffee systems. High dependence upon one particular product, in this case coffee, has made monoculture systems very vulnerable to price fluctuation. The negative trends of real coffee prices in both local and international markets, particularly during the period of 1999-2001 have made high input monoculture coffee less profitable than the shaded coffee systems. The gravity of the economic situation for monoculture systems is demonstrated by the fall of the nominal real price of coffee to Rp. 1,629 per kilogram in the year 2000. Prior assessment of various coffee systems conducted by Budidarsono, *et. al* (2001) shows that the investment in coffee farming could no longer be sustained if the price falls below Rp. 3,500 per Kilogram.(Figure 2)

Figure 2. Coffee Price used in the analyses



Source: Statistik Indonesia and Statistik Perkebunan, (1993, 1996, 2000)

Land intensification through introduction of economically valuable under-storey vegetation such as ginger and chili requires each system to be divided into two sub-systems for profitability analysis. While few farmers are currently following this practice, the high economic value of these crops, which are able to boost income by up to 33% in shade based multistrata, has been very attractive to them.

In this case, the real prices of coffee used in both analyses (1997 and 2000) are not greatly different calculated over ten years, so profit decline has not been caused by long-term price fluctuation. Income gained from coffee in all the systems increased by 14% in NPV over the analysis period but as the labor costs are assumed to have risen by 100 %, the additional revenue still cannot afford the increment. The coffee systems are very labor-intensive; mean labor costs represented 46.1% of the total cost of management extrapolated over 25 years from the 1997 situation, or 56.1% for calculation based on the situation in 2000. Thus, profitability of the system is very sensitive to labor wage. However, if assumptions regarding macro-economic conditions in 2000 are altered, all the shaded coffee systems are able to maintain a positive contribution regardless of the effects from the rise in labor wage and other private purchased inputs, which increased by 100 % and 23% respectively (primary data.)

The current daily wage for agricultural labor is Rp. 15,000 (± 1.5 US$) and even higher for harvesting activity. This is much higher than the assumed wage levels for the years selected for the previous analyses. If these present wage conditions are inserted into the 1997 and 2000 models only fruit based

multistrata systems can remain profitable, with a daily social return to labor of Rp. 18,835 for year 2000.conditions or Rp. 16,727 based on the 1997 situation (Appendices 4-5).

The long term nature of the investment in tree farming makes it important to measure income over a period of years. Net Present Value (NPV) is usually opted as a parameter to provide this information but it solely indicates profitability of systems at the end of the investment period. To obtain more detailed information on annual income, the NPV needs to be "annualized" so it becomes Equivalent Annual Income (EAI).

The most economically feasible investment in coffee garden as indicated by the EAI, is in a fruit based coffee system, which is able to give a net return of nearly 900,000 Rupiah (equal to 100 US $) solely from the trees and coffee and 1,516,827 Rupiah (equal to nearly 170 US $) per annum if returns from the understorey crops are considered (Appendix 2). In general, average private profitability of shaded coffee systems, which increased by 8.34%, is considered sufficient for farmers to maintain effort in coffee maintenance. Monoculture systems on the other hand, incur greater losses. Apparently, the higher coffee price which increases revenue by 13% could not sufficiently cover the 23% additional costs, which originated mainly from the labor wage.

Land Expectation Value (LEV), is usually used to compare the value of bare land having had no investment made with the value of the land if used to grow trees, over a given period. In this case, the concept is adopted to compare the value of bare land after 25 years, with that subject to coffee garden investment. For calculations based on the 1997 situation all systems had a positive LEV. However, based on the situation in 2000, monoculture systems had a negative LEV, while shaded systems still had positive LEVs, although lower than in the previous scenario. Sensitivity analysis on interest rates showed that the monoculture systems' resilience to interest rate dynamics are respectively 16.7% and 13,9 % for private interest rates, while 15.2 % and 12.7% for social interest rates, based on the 2000 situation.

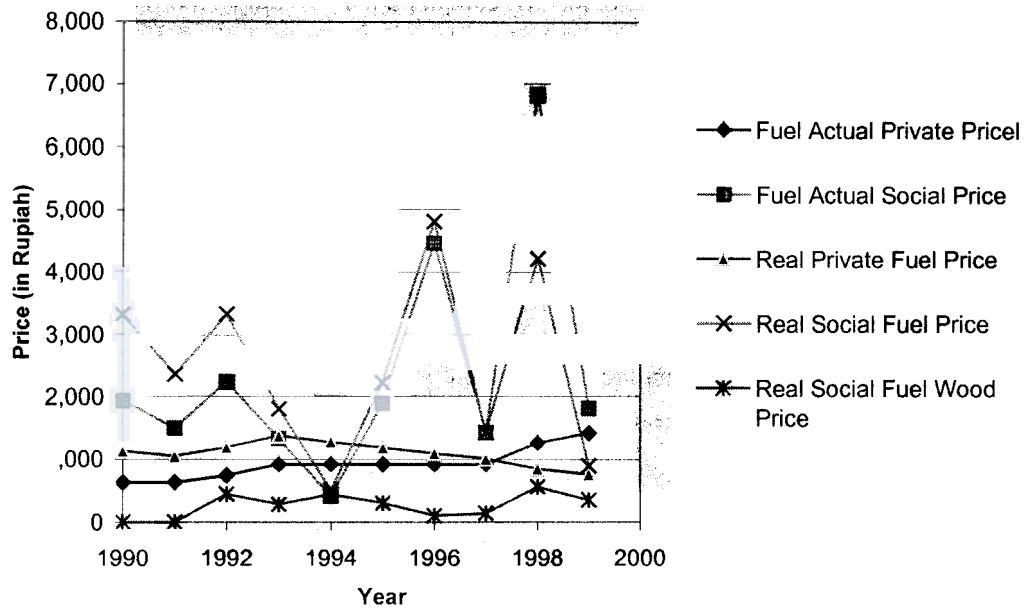
Fuel Wood Supply

Forest encroachment for agricultural land extension and illegal logging both for timber and fuel wood have also been threatening the forest surrounding the site. Fossil fuel still dominates primary energy consumption in Indonesia, amounting to more than 50% in 2000, with oil contributing to almost 60% of the total fossil fuel consumption (Ministry of Energy and Mineral Resources, 2000). However, there is disparity in consumption, with more than 70% of rural households still using fuel wood in 1997 (SUSENAS, 1997). This is largely the situation in Sumberjaya where major fuel wood extraction usually takes place when the shading trees are being pruned or thinned or taken from nearby forests.

The Government has made price discriminations for various uses of fossil fuels, but distribution mechanisms to remote areas cannot guarantee that fuel prices will be the same as in less remote areas. Also, due to inconsistency of policy in pricing, fuel prices in Indonesia have increased more than 2.5 times between 1987 and 2000, as a significant proportion of its previous subsidy has been lifted. Ref.(Figure 3)

Recently it has been floated in accordance to the Mid Oil Platts Singapore (MOPS) price by the Presidential Decree No. 45/2001.

Figure 3. Energy Price per 1,000 Megajoule



(source Statistik Indonesia, 1993, 1996, 2000)

Considering the trend of energy prices, it is rational for those who have low incomes to opt for a relatively cheaper and more abundant source of energy. Given this, fuel wood is by far the most reasonable option in the surveyed area and for this reason optimizing multistrata as source of fuel wood is important. However, fuel wood production may be under valued in this assessment due to the wide variety of tree species and un-availability of detailed information regarding fuel wood production and consumption. In this analysis, only fuel woods extracted from the shade trees of the types Erythrina, Leucaena and Glyricidia are considered.

Study in fuel wood production in West Java shows that a home garden can continuously supply 13.1 ton ha^{-1} of fuel wood per year or equivalent to 4.39 ton of oil (toe), which is sufficient to support the energy needs of a household for a year (Jensen, 1995). On the other hand, in the present 25 year assessment, fuel wood supply of shaded coffee systems varies from an oil equivalent of between 0.21 and 0.39 tons per year. These amounts are not adequate to fill the requirement of a household given conditions similar to survey results form the FAO, which state that a household would require an equivalent of 0.827 ton of oil per year.

Based on these figures, 25% of domestic fuelwood demands must then be met by the forest. Thus, if the simplifying assumption is made that all Sumberjaya inhabitants are meeting energy needs by burning

fuelwood, forests have to bare 0.149 Giga Joule or equal to 10,498 Ton of fuel wood (equal to 5,787 Ton of solid timber or 8,903 Cu-M) or not less than 445.2 hectare of forest per year

By utilizing appropriate woody perennials, local deforestation rates for energy supply can be reduced quite significantly. Surveyed plots show that average land holding size of shaded coffee is 1.315 hectares per household and which can potentially supply 0.82 - 1.52 ton of fuel wood annually. Under such conditions, pressure on forests for energy supply can be reduced by 28% and the area of forest degraded can be reduced to 316 hectare annually. However, estimates of the probable extent of forest degradation can increase greatly dependent upon efficiency rate of stoves used, if other non-subsistence domestic activities are included in the calculation or if using the lower figure of 0.535 ha for average land holding size in Sumberjaya, from *dalam Angka* (1997).

Why Practice Shaded Coffee Systems?

To analyze which factors are significant in establishment and maintenance of shaded coffee systems, farmers were asked to answer structured questionnaires. All the characteristics were then regressively tested to gauge the probability of that character affecting the number of tree species in the garden, which was taken as an indicator of multistrata gardens. Characteristics with greater than 95% probability of having a causal relationship with garden species richness are interpreted to have significant impact on shaded coffee practice (n=60).

Among the 22 characteristics gathered, Sundanese ethnicity, level of formal education and 0-15% ground slope emerged as significant, while Javanese ethnicity shows a significant negative correlation. High similarity of tree species composition of multistrata coffee plots and mixed gardens (*kebun campuran)* in West Java (the place of origin of Sundanese people), explain the causal-effect of ethnicity as these farmers already possess knowledge of mixing tree types within the garden. However, in shaded coffee, spatial arrangement of trees is more orderly in order to surmount problems of light and nutrient competition with coffee plants. In contrast, farmers of Javanese ethnicity tend not to plant many trees in their farms. This is possibly in response to relatively unfertile land and small land holding size in their previous settlements in Central and East Java.

Factors which satisfy the lower probability level of 90% for influence over number of tree species in a garden are farm origin by self-clearing, as well as farmer age. On the other hand, receipt of farm by inheritance, or a slope class of more than 40% emerged as having a negative relationship with the number of species. However, these results are best suited to hypothesis building regarding factors affecting shaded coffee practice, as they are not derived from an extensive survey. A different inquiry setting is required to extensively explore other relevant factors.

Community Forestry (HKm)

Land tenure has been the major problem in the area and has been causing disputes ever since the Dutch left Indonesia. However, social pressure in conjunction with results of research conducted by NGO's has obtained sufficient consideration by local government to shift the "common property" status of cultivated state forest into more "private property" status. 'Community Based State Forest Management', also known as 'Community Forestry' or HKM, in this context, as governed in the Minister of Forestry Act. No. 31/Kpts-II/2001 is defined as a state forest whose management is conducted by the community, in order to empower the community without disturbing forests' main functions. Despite having not yet received ratification from the Minister of Forestry, community-based management under conditions to ensure protection of state forest areas is already operational in Sumberjaya. With agreement from the community, the local government of West Lampung has given permission to manage around 400 hectares of state forest in Register 45 B Rigis Jaya as multistrata coffee systems.

In the past, various reforestation[2)] and afforestation[3)] (re-greening) programs have been conducted in the area. However, these programs which should have been fully supported and hence funded by the national Government's Reforestation Fund, have so far taken place at a low rate in comparison with the deforestation rate. During the periods of 1985-1997, 367,000 hectares of forest have disappeared from Lampung province while only slightly over 25,000 hectares were replanted through reforestation and afforestation programs (Statistik Kehutanan, 2000). This is ironic when the Reforestation Fund (and other non tax revenue from forestry), collected since 1989/1990 amounted more than 6 trillion Rupiah in 1997/1998 and is estimated to be 2.5 trillion Rupiah for 2001 alone (RAPBN, 2001). However, a 'top-down' procedure in species selection, timetable designation and also other bureaucracy have made farmers reluctant to fully participate in the programs. Current programs still involve a problem in tree tenure as the government does not allow farmers to harvest the trees that they have planted.

Through the HKM program a collaborative relationship between parties with different vested interests in forest management can be formed. Granting managerial rights over state forest land provides farmers with safer land tenure status, though not providing security equivalent to that of freehold. Hence, there is greater certainty that the land will be managed in a more conservative way, although not necessarily fulfilling all forest functions.

Environmental Services

Forest-like land use systems are to some extent able to provide services a forest would perform. Current assessments of environmental services by watershed protection (control of erosion and run off) and carbon sequestration conducted by various ICRAF scientists suggest that some of services could be sufficiently provided by various coffee multistrata systems (van Noordwijk *et al*, 2002). Nevertheless

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[2)] Reforestation is defined here as a government program involving the plantation of trees in degraded forest areas by distributing seeds and paying labor to plant them.

[3)] Afforestation is another government program to improve quality of privately owned land by giving farmers timber tree seeds to be planted in their area.

these services have yet to be recognized and appraised adequately in a manner equivalent to the biodiversity conservation services of coffee farming systems for migratory birds in South America. Transfer mechanisms of rewards for environmental benefits should be in accordance with immediate local requirements and could possibly be different from in the South American case.

To some extent, rewarding virtue in environmental management practice has been conducted by the Government since 1986 with competitions for awards of Adipura and Kalpataru. Effectiveness of these types of one-off incentives in promoting ongoing good environmental practice remains unknown.

Perhaps the possibility of safer land tenure could provide an ongoing incentive encouraging extension of multistrata systems, as a long-term compromise strategy for stewardship of forest-designated areas. In contrast with rewarding environmentally sound practices in the area, in 2000 the Local Government of Lampung issued a Provincial Decree No. 7/2000 to tax the sale of designated products harvested from state forest land. Twenty six of the thirty two products have been identified in the surveyed plots. In addition, farmers who continue to cultivate coffee in state forest areas without official agreement, are subject to "unofficial fees" extracted by the person arbitrarily "in charge".(Budidarsono *et al*, 2001). Thus the attractiveness of incentives for land stewardship in the area is enhanced by their contrast with the disincentives for environmentally damaging behavior.

Shaded coffee systems provide farmers with higher income and a cleaner environment due to the use of smaller amounts of fertilizer and chemicals than monoculture systems. They also cause less erosion and lower run off. These are not only beneficial to farmers in maintaining land quality and ensuring long-term livelihood security, but also to other stakeholders such as the hydroelectric power plant located on the downstream. Thus, there are many grounds for rewarding conservative farming practices, which more closely simulate forest functions. However, there remains a need for authorities and stakeholders to discuss both the types and mechanisms that these rewards should take.

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