Analysis of the Economic Efficiency and Comparative Advantage of the Sumatran Smallholder Rubber Using "PAM" Method

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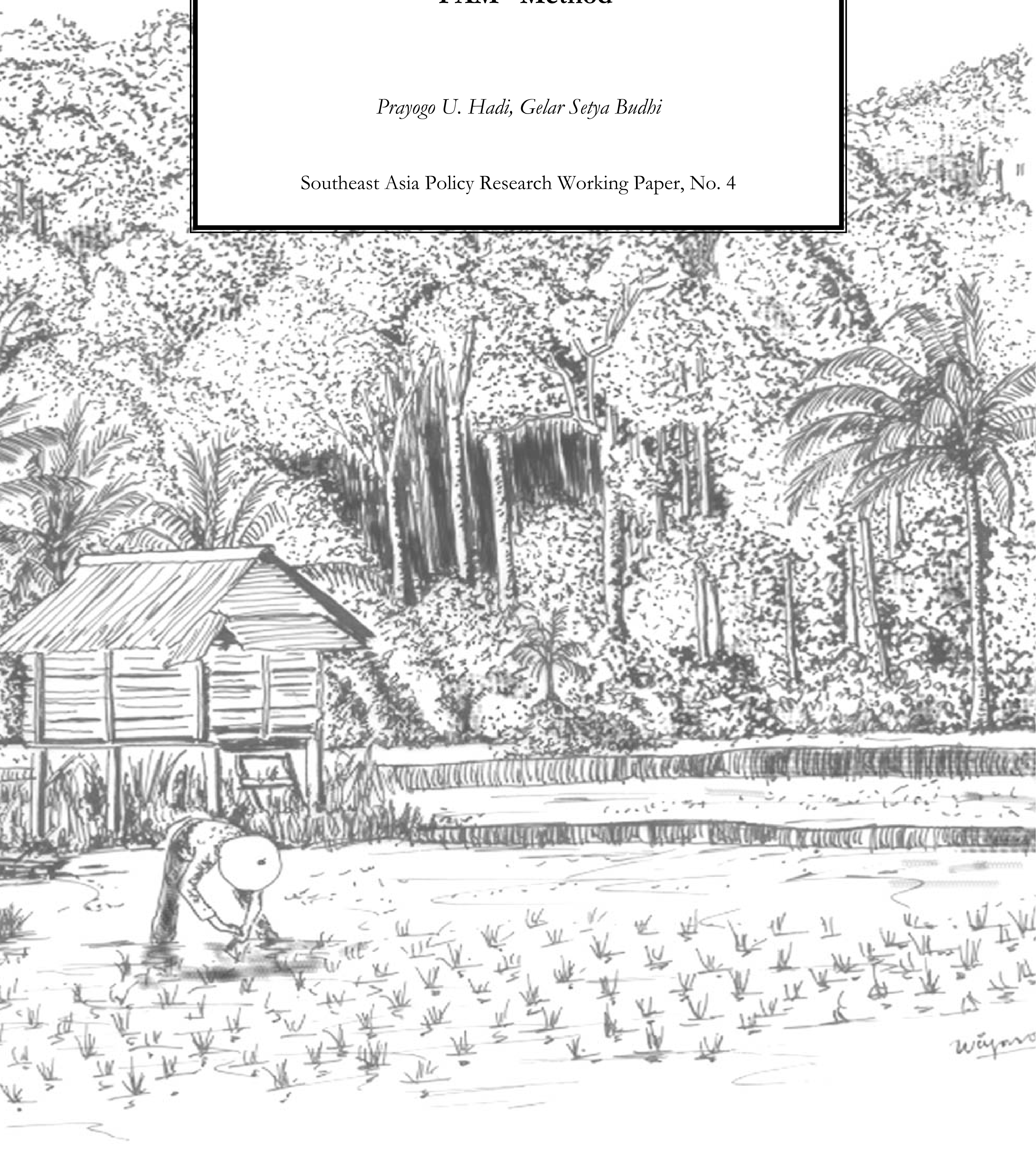

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Declaimer

Preface

Rubber has important roles in Indonesian economy. However, the use of scarce economic resources like land, labor and capital for rubber should be on efficiency basis. This report contains preliminary results of the analysis employing the methods of Policy Analysis Matrix (PAM). Field data collection was carried out in Bungo Tebo District in Jambi province for ten days on July 1997. Final report will be completed after discussion of this draft report.

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Bogor, 24 November 1997

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Director of CASER

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I Introduction

1.1. The Roles of Rubber in Indonesian Economy

Rubber plays, at least, five important roles in the Indonesian economy that pushes economic growth through positive backward as well as forward linkages. *First,* as the income source of a substantial number of rubber smallholder. Of the national rubber area of 3.50 million hectares in 1995, 2.95 million hectares (84.5 percent) constituted smallholder rubber, involving 1.47 million farm households (DGE, 1996). In some monoculture areas, rubber farm becomes the principal source of smallholders' income.

Second, as one of the promising business investment areas by large scale companies such as state-owned companies *(Perseroan Terbatas Perkebunan, PTP)*, domestic private companies *(Perkebunan Besar Swasta Nasional, PBSN),* or foreign private companies *(Perkebunan Besar swasta Asing, PBSA),* in addition to smallholders. In 1995, rubber area of PTP, PBSN and PBSA respectively accounted for 248,393 hectares, 239,850 hectares and 294,824 hectares (DGE, 1996). The total value of rubber investment during the first long term development stage (1.969-1994) was 2,153 million US dollars, 28.84 percent and 71.16 percent of which were respectively allocated for large scale companies and smallholders (PT IDU and WHAD, 1996).

Third, as an agro-industrial development corner stone. Traditionally, primary rubber produce has been the only source of raw material for rubber processing industries to produce semi-finished goods for export, such as SIR (Standard Indonesian Rubber), RSS (Ribbed Smoked Sheets), crepe, etc.

Fourth, as a foreign exchange generator. The value of rubber export increased from US$ 171.75 million in 1969 to US$ 1,964 million in 1995 (DGE, 1996). The estimated annual growth rate of this export value was 7. 10 percent. In international market, Indonesia currently constitutes the second largest rubber producer and exporter, following Thailand.

Last, as a market for urban-industrial products and services, either for family consumption such as processed foods, beverages, clothing, electronics, and other durable, or for farm cultivation's like farm tools, equipment and machinery, fertilizers, chemicals, transport services, etc.

1.2. The Problems

The Indonesian agricultural policies have been focused on the simultaneous achievement of the following three broad objectives. First, food self sufficiency for food security, especially rice. *Second,* efficient use of scarce economic resources, including natural and capital resources, for sustaining development process and strengthening global market competitiveness. *Last,* improved income distribution among income groups or regions.

It is likely, however, that the promotion of one objective conflicts with one or both of the others others. To a considerable extent, government policies often favor particular parties at the expense of the others in the use of agricultural and natural resources, in addition to factor market imperfections. In this situation, policy makers need to trade-off the gains in one objective against the losses in the other(s). For instance, efficiency losses in the substantial use of land for smallholder rubber cultivation might not be tolerated if the action could not bring about significant improvement in food (especially rice) security, income 2 distribution and market competitiveness or prevents from more efficient alternative uses of scarce land.

The essence of policy exercise is, therefore, the decision choice between these competing objectives. But, to do so is frequently difficult because of various supply constraints in the Indonesian economy, including, first, the limited availability of domestic resources such as land, water, labor and capital; *second,* the non-existence of improved production technologies; and last, the relatively high costs of all inputs.

To some extents, government policies depart from efficient conditions. The most prominent examples in the rubber case are the provision of input subsidies and imposition of tariffs on particular inputs. In addition, market failures might also exist for rubber output and particular inputs. It is also common that market exchange rates (Rupiah per US dollar) are over-valued that could weaken the competitiveness of Indonesia-made products like rubber in the global markets. If such unfavorable conditions are not removed, it is alarmed to endanger the profitability and comparative advantage of Indonesian rubber, hence the future sustainability of smallholder rubber farms, when the markets are characterized mainly by global competition. In this connection, it is necessary to measure the effects of efficient policies on the efficiency and comparative advantage of Indonesian smallholder rubber farms.

1.3. Objectives

The specific objectives of the present study maybe spelled out as follows

(1) To collect primary as well as secondary data on smallholder rubber farm.

(2) To construct a 25-year farm budget for each representative type of smallholder rubber farm using both private and social prices.

(3) To estimate the economic efficiency and comparative advantage of each representative type of smallholder rubber farm.

(4) To assess the divergences in revenues and costs under efficient condition from those under market condition for each representative type of smallholder rubber farm.

2. Methodology

2.1. Site Selection

The selected representative district for this study is Bungo Tebo which is situated in the territory of the Jambi province. The main reason for this selection is that this province constitutes the second largest rubber producing areas in Indonesia within which forest lands are currently rapidly converted into other uses such as rubber and *padi ladang* (dry land paddy) through slash and burn practices, in addition to oil palm plantation and HTI (Hutan Tanaman Industri). The Bungo Tebo district was also selected as one of the sites of ICRAF's research programmes in 1995-1996.

The selected sub-district *(kecamatan)* was Tebo Tengah. In this sub-district, two villages *(desa)* were chosen, namely Tebing Tinggi and Aburan Batang Tebo that respectively represent rubber monoculture and rubber agroforest areas.

2.2. Respondents Selection

Farmer :

Respondent of the present study consists of rubber farmers, village assemblers, wholesalers and crumb rubber factory/exporter and input (fertilizers and pesticides) retailer. For farmer respondent, in particular, there are two selected types of smallholder rubber farm, namely, rubber monoculture and rubber agroforest. The representative farms for smallholder rubber monoculture were selected from those receiving government financial assistance through *Proyek Rehabilitasi dan Peremajaan Tanaman Ekspor, PRPTE* (Project of Rehabilitation and Replanting for Export Commodities). The choice of this project is based on the duration of the project in the sense that it is the oldest rubber project in Jambi province that commenced in 1983. This can facilitate the analysis of lengthier rubber's life cycle. The representative farms for smallholder rubber agroforest, on the other hand, were selected from those without government financial assistance. Farmer respondents are not individual family but group of owner operator of 10-15 persons. Two groups were chosen for each sample village.

Trader :

The selected rubber trader consists of village assemblers and wholesaler. Local assemblers are persons who collected thick slab from local farmers and then sell it to a large wholesaler in Muara Bungo town. Two village assemblers were selected in each sample village. Wholesaler is a company that collects thick slab from local assemblers from various sub-districts and sells it to crumb-rubber factories. In the present study, a large wholesaler in Muara Bungo called PT Sinar Jambi was selected as a sample.

Crumb Rubber Factory

One crumb rubber factory called PT Jambi Waras 11 in Bungo Tebo was selected as a sample. It buys variety slabs from various wholesalers (such as PT Sinar Jambi), processes them into crumb rubber (SIR-20), and exports this processed product to other countries.

Input Retailer

A large input shop in Muara Bungo town was chosen as a sample. It sells various kinds of fertilizer, pesticide and other agricultural chemical inputs to farmers.

2.3. Method of Analysis

This analysis employs the method of "Policy Analysis Matrix" (PAM) for permanent crop for each type of representative rubber farm. The detailed PAM procedures that entirely follow those formulated by Monke and Pearson C(1995) may be presented below:

	TR	TC		Profits
		TIC	DFC	
Private	A	B	C	D
Social	E	F	G	H
Divergence	I	J	K	L

TR = total revenue (Rp)
TC = total cost (Rp)
TIC = tradable input cost (Rp)
DFC = domestic factor cost (Rp)

$A = \Sigma(Q_{Yk}.\ Q_{Yk}{}^{M})$
$B = \Sigma\ (Q_{Tli}.P_{Tli}{}^{M})$
$C = \Sigma\ (Q_{DFj}.P_{DFj}{}^{M})$
$D = A - B - C$

$E = \Sigma(Q_{Yk}.P_{Yk}{}^{S})$
$F = \Sigma\ (Q_{Tli}.P_{Tli}{}^{S})$
$G = \Sigma\ (Q_{DFj}.P_{DFj}{}^{S})$
$H = E - F - G$

$I = A - E$
$J = B - F$
$K = C - G$
$L = D – H = I - J - K$

where,

V : summation
Q_{Yk} : quantity of output *k*
P_{Yk} : price of output *k*
Q_{Tli} : quantity of tradable input *i*
P_{Tli} : price of tradable input *i*
Q_{DFj} : quantity of domestic factor *j*
P_{DFj} : price of domestic factor *j*,
k : rubber, rice, chilly
i : fertilizer (Urea, TSP, KCI)
j : seeds, other materials, labor (family and hired)
M : private
S : social.

2.4. Price Data Specification

a. *Output Price :*

Thick slab with a:,50 percent dry-rubber-content is the most type of rubber output produced by farmers. Data on the 1997 average private price of this product at the farm gate were obtained directly through interviews with the selected farmer groups and local assemblers, while the 1997 social prices of thick slab at the farm gate, were derived using equations as follows :

$$P_{FYr} = [P_{FOB.}SER - (C_m + C_f)]/drc - C_r$$

$$SER = OER(I + ER_P)$$

Where:

P_{Fyr} = social price of thick slab at the farmgate (Rp/kg)

$P_{FOB.}$ = FOB price of SIR-20 (US$/kg)

SER = social exchange rate (Rp/US$)

OER = official exchange rate (Rp/US$)

ER_p = exchange rate premium (10 %)

C_m = marketing cost from SIR-20 factory to ship (Rp/kg)

Cf = processing cost of SIR-20 (Rp/kg)

Drc = dry rubber content of thick slab (50 %)

C_r = transport cost from farm to SIR-20 factory

b. Input Price :

Farm inputs consist of : (i) tradable inputs including only fertilizers (Urea, TSP,KC1), and (ii) domestic factors including unskilled labor and capital. Tradable inputs were used by rubber monoculture only, while domestic factors were used by both rubber monoculture and rubber agroforest. Private price data on tradable inputs, particularly fertilizers, were gathered directly through interviews with a large-scale input retailer in Muara Bungo town, while data on private price of domestic factors were collected through interviews with the selected farmer groups and local leaders.

The social price of exported input like Urea is specified using similar procedures for social pricing of output, while for imported inputs such as TSP and KC1 follows the following procedures :

c. Output Data

The principal output of rubber farm is thick slab (*slab tebal*). It is the primary rubber product with approximately 50 percent dry rubber content. In addition, there were other outputs, such as dry land paddy and other annual crops as intercrops cultivated during year 1-3 of' rubber life cycle.

The salvage value of rubber wood is assumed away in this study. In fact, farmers Have never sold their rubber wood because doing so is not beneficial as a result of : (i) low rubber stand density per hectare; (ii) very small proportion of commercial rubber tree; (iii) appreciably high labor and transportation costs; and (iv) unavailability of rubber wood factory in the study sites.

3. Government Policies and Programs

3.1. Smallholder Rubber Development Project

Development of smallholder rubber through project assistance was initiated in the second Five-Year Development Plan (REPELITA II). The principal development aims had been to increase rubber productivity, farmers' income and foreign exchange.

Currently, there are five rubber development projects involving smallholders (DGE, *1996).* First, *plasma* (plasma), that is, smallholder rubber plantations established and developed by Estate or Private Companies incorporated into *Pola Perkebunan Inti Rakyat,* PIR (Nucleus Estate and Smallholder, NES). The proportion of plasma and nucleus areas had been standardized at *70* and 30 percent respectively.

Second, Proyek Rehabilitasi, Peremajaan dan Perluasan Tanaman Ekspor, PRPTE (Project of Rehabilitation and Replanting for Export Commodities). This project was financed by government using domestic public funds, commencing in *1979/1980.*

Third, Unit Pelayanan Pengembangan Berbantuan (Assisted Development Service Unit). This project has been financed by loan from foreign aids. For rubber, it included three important projects, namely Smallholder Rubber Development Project (SRDP), latter developing into Tree Crops Smallholder Development Project (TCSDP) and Tree Crops Smallholder Sector Project (TCSSP).

Fourth, partial project. In this project, which is financed by government using domestic public funds, farmers received assistance in the forms of clones, or other material inputs like fertilizers, or plant maintenance costs. Farmers have no obligation to repay this assistance because it is not a loan.

Lastly, *swadaya berbantuan* (assisted self-funded smallholder project). This project is financed by government using domestic public funds for year 0 only, for which farmers do not. have to repay. In year I and so forth, farmers receive loan from Bank/Rubber Company.

The respective area of these projects in Indonesia and Jambi in 1995 is depicted in Table 1. It is shown that smallholder rubber is of predominance, constituting total area of 2,952,684 hectares or 84.04 percent of total rubber area in Indonesia of 3,495,901 hectares. But, the total smallholder area under project was only 420,537 hectares or 14.2 percent of total smallholder area, suggesting that most smallholder rubber remains unassisted by government programs.

Table 1. The area of smallholder rubber in Indonesia and Jambi by type of project in 1995.

Type of project	Indonesia Ha	%	Jambi Ha	%
Plasma (NES)	142,057	4.06	28,115	5.52
PRPTE	49,901	1.43	17,826	3.50
UPP Berbantuan	155,244	4.44	12,462	2.45
Partial	6,712	0.19	768	0.15
Swadaya Berbantuan	66,623	1.91	8,096	1.59
Swadaya Murni*)	2,532,147	72.43	428,289	84.08
Total Smallholder	2,952,684	84.46	495,556	97.29
Company (Large scale)	543,217	15.54	13,799	2.71
Total	3,495,901	100	509,355	100

Sources: *Statistical Estate Crops of Indonesia 1995-1997Rubber* (Direktorat Jenderal Perkebunan, Jakarta, 1996).
Note **)* Pure self-funded smallholder rubber.

In Jambi province, smallholder rubber is also of predominance, constituting total area of 213,283 or 97.29 percent of total rubber area in this province of 509,355 hectares. But, the total smallholder area under project was also small, namely 67,267 hectares or 13.6 percent of total smallholder area. This also suggests that most smallholder rubber remains unassisted by government programs. By excluding plasma rubber, PRPTE becomes the major smallholder project involving rubber area of 17,826 hectares that constituted 26.7 percent of total smallholder project area in this province.

3.2. Input and Output Price Policies

Price policies cover input and output. Subsidies were provided for Urea, ZA, TSP and KCI that was initially aimed at encouraging rice production to achieve rice self sufficiency. Crops other than rice, off course, benefit this subsidy policy. Since the achievement of rice self sufficiency in 1984, however, subsidies for fertilizers have gradually decreased so as to reduce government's financial burden. In 1997, subsidy is provided only for Urea and the respective maximum retail prices (MRP) of fertilizers according to government regulation for Urea and TSP have been Rp 400 and Rp 600 per kg, while the MRP of KCI has been no longer specified (Hadi et al, 1997). In fact, the prices of Urea, TSP and KCI at the farm level were Rp 410, Rp 610 and Rp 490 per kg respectively.

Output price is not directly intervened by government. Rubber price is simultaneously determined by supply and demand equilibrium in the world market. The government policy is only aimed at preventing farmers from receiving low price of their rubber produce. It was specified that the minimum farmgate price of rubber (100 % dry rubber content) is 70-80 percent of the prevailing FOB price of SIR-20 equivalent.

3.3. Processing Policies

The development of rubber agribusiness still encounters processing problems. The tires industry as the major natural rubber consumer (72 percent) tends to move to an automatization system which definitely requires raw material with high quality consistencies and contamination free. To meet this tight requirements so as to maintain the market share of Indonesian natural rubber in the world market, the government had specified the following related policies (FPP, 1994).

First, to specify the standardized quality of rubber raw material according to the Indonesian Agricultural Standard through the Decree of Minister of Agriculture number 701/Kpts/Ap 830/10/1987 that was revised by the Decree of Minister of Agriculture number 250/Kpts/TP.830/5/1989. According to the decree, the recommended rubber raw materials are field latex, air-dried sheet, thin slab and fresh lumps.

Second, to specify Changes in Standard Indonesian Rubber Schemes (SIR)88 through the Decree of Minister of Trade number 184/14/VI/1988. The core of the decree was the need for removing low quality SIR and improve technical specification requirements of SIR with the aims of improving SIR consistencies and purities so as to meet consumer demand and improve farmers' income through quality improvement of raw material.

3.4. Macro Economic Policies

The macro economic policies which are relevant to smallholder rubber development are interest rate and exchange rate policies. The annual interest rate of loan for farmers was specified at 12 percent, but currently it has changed to 14-16 percent. It is a subsidized credit aimed at promoting smallholder rubber to involve in development project without any harmful financial burden for credit repayment.

Exchange rates have been managed by Central Bank authority using floating exchange rate system. It is obvious that the official (market) exchange rates of Rupiah per US dollar gradually increases from year to year. In July 1997, when data collection of this study was taking place, the official exchange rate was Rp 2,430 per US dollar. In most developing countries, such as Indonesia, exchange rates tend to be overvalued. According to ICRAF expert, the overvaluation rate was approximately 10 percent. Since August 1997, the evidence shows that monetary crises has been taking place, where the exchange rates goes up and down but never reached below Rp 3,400.

4. Brief Description of Production, Marketing and Proeessing Features

4.1. Production

Production activities commence with land preparation including shrub cutting *(menebas),* felling *(menebang),* sundrying, chopping, burning, and reburning *(merun).* Land clearing generally uses traditional tools like *parang* (big knife), and *beliung* (big axe),while richer farmers and project farmers use chainsaw either by purchase or rent. Both project and non-project farmers usually cleared forest land for agricultural cultivation. Not many farmers cleared their old rubber land, primarily because of their unwillingness to loose daily cash income from tapping their old rubber trees.

Dibbling and planting activities of rubber and rice then proceed following land preparation. During the first year, all farmers irrespective rubber monoculture or rubber agroforest, grow dryland rice *(padi ladang).* Weeding and wild pig trapping were also done by farmers. Husked dried rice *(gabah kering)* produce was stored as staple food stock for a couple of month and only few farmers sold husked rice for immediate cash requirement. During second and third year, farmers grew chilly as cash income source.

The principal material inputs used by farmers for pre-harvest rubber cultivation is seeds of rubber, rice and chilly. Non-project (self-funded) farmers use local rubber seeds collected from their existing rubber lands, while project farmers use clones called GT 1. Lack of information on the comparative advantages of clones, physical unavailability and cash constraints of non-project farmers have been the major reasons for not using clones (see also Yusdja et al 1980; Hadi, Manurung and Purnama 1996; Barlow 1997 cited by Grist, Menz and Amarasinghe, 1997). Project farmers, on the other hand, received seeds from the project.

Fertilizers were the other material inputs, but only project farmers used fertilizers. In the case of PRPTE farmers under study, fertilizers like Urea, TSP and KCI were used in the first year of rubber plant cycle, primarily because of inappropriate project management. Normally, fertilizers should be used from year 0 to year 5.

During the first-five years, farmers replaced damaged trees with the new ones so as to maintain reasonable population density of rubber stands. Afterwards, rubber replacement had no longer taken place. According to farmers, it is not necessary because the new plants would not be able to compete with the existing bigger and taller growing plants for soil nutrition and sunlight. Consequently, plant density continuously decreased. The principal causes of plant damage have been root diseases and heavy rain accompanied by typhoon.

Harvest (tapping) activities commenced when rubber plants reached 6 years old for clonal rubber and 9 years old for non-clonal rubber. This was preceded by tapping preparation like fixing latex cups and spout on every mature rubber plants. Other tools required for tapping activities include tapping knife, latex bucket, slab moulder and grind ston. In average, tapping days for project and non-project rubber were 216 and 195 days a year respectively. The higher tapping frequency of project rubber was probably due to the obligation of project farmers to repay their credit (principal and interest) commencing in year 6.

Small owner-operator farmers tapped their rubber by their own family members like wife or sons. Large farmers, on the other hand, hired labors adopting a share-cropping system. In the share-cropping system, land owner received one-third of the total output. Cup-lumps together with other rubber output forms were mixed in wood boxes with common size in thickness, width and length.

For project rubber (monoculture), its per hectare output (yield) increased as the rubber plants become maturer, but after reaching a peak in year 13 to 15, it then decreased (see Table 2). During a 25-year life cycle, (lie yield (slab with 50 percent dry rubber content) increased from 600 kg in year 6 to 2,000 kg in years 13-15, and then decreased to 1,300 kg in year 25. For non-project rubber (agroforest), the shape of production curve was quite different from that of rubber agroforest. That is, the yield increased from 300 kg in year 9 to 800 kg in years 12-25 (see Table 2).

Table 2. Yields of smallholder rubber monoculture and agroforest by plant age (kg slab 50% dry rubber contents)

Year	Monoculture Rubber	Rubber Agroforest
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	600	0
7	1200	0
8	1400	0
9	1800	0
10	1800	500
11	1700	700
12	1900	800
13	2000	800
14	2000	800
15	2000	800
16	1800	800
17	1800	800
18	1800	800
19	1700	800
20	1600	800
21	1500	800
22	1500	800
23	1400	800
24	1300	800
25	1300	800

4.2. Marketing

Marketing channel was very short. Farmers sold their thick slab to village assemblers only. Village assemblers usually sold slab to large scale wholesaler in Muara Bungo town (PT Sinar Jambi) and with smaller proportion to crumb rubber factory in Bungo Tebo. The wholesaler in Muara Bungo, sold slab to crumb rubber factory in Bungo Tebo (PT Jambi Waras 11) or in Jambi city. Crumb rubber factory which is also rubber exporter, then exported SIR-20 to various countries. In addition to PT Jambi Waras 11 in Bungo Tebo, there were four other crumb rubber factories/exporters, all of which are located in Jambi city.

Rubber transaction activities include price discovery and buying-selling processes. Output prices were entirely dictated by traders for two reasons. First, the market structure is always oligopsonistic competition. *Second,* farmers have a high dependence on traders because they always borrow cash money or buy consumption goods with deferred payments using rubber produce. The total value of these borrowings often exceeded the gross value of farmers' rubber produce.

To obtain rubber from farmers, rubber wholesaler in Muara Bungo town provided capital money to village assemblers who also own large rubber land or serve as local informal leaders. Crumb rubber factories usually also provided capital money to wholesalers in the rubber producing areas.

The prevailing average price of thick slab with approximately 50 percent dry-rubber-content at the farmgate in July 1997 was Rp 750 per kg. This price was equivalent with Rp 1,500 per kg slab with 100 percent dry-rubber-content. In comparison with the FOB price on the same month of Rp 2,850 per kg (i.e., US$ 1.172 x Rp 2,430/US$), the farmgate price may be said as low accounting only 52,7 percent of FOB price (i.e., [1,500/2,859] x 100%). According to DGE, it was targeted that the farmgate price would not be lower than 70-80 percent of the FOB price for equivalent rubber quality.

This low farmers' share was because village assemblers cut the weight of rubber produce they bought from farmers by 20 percent for two reasons. First, it is basically adjustment practices of assemblers so as to compensate the possible weight losses due to reduced water content of slab and decreased output quality because of the existence of non-rubber materials contained in the slab. It is noted that there was no exact measurement of dirt and water contents using tools that made no linear relationships between quality and price (see also Hendiarto and Muslim, 1995). *Second,* small farmers, generally bought basic consumption goods like rice, sugar, etc by delayed payment from consumption goods traders who are also village assemblers who bought farmers' slab. Such a payment system made the slab price lower and consumption good price higher.

However, it is worth to note that the farmgate prices would change as the FOB price change. The price of SIR-20 at FOB level may be referred in the determination of the buying price of slab at the farmgate. The FOB price was transmitted by crumb rubber factories, which were also SIR-20 exporters, to rubber (slab) wholesalers and eventually to farmers. In determining the buying price of slab, the respective marketing channels like crumb rubber factories, slab wholesalers and village slab assemblers accounted for the expenses for transportation, rubber weight loss, etc., and minimum profit gains.

With such price transmission process, the information about changes in FOB price was received first by traders, whereas farmers just accepted the price determined by traders. Farmers are often late in receiving price information when the price went up, but quicker when the price went down. This contributed to weak farmers' bargaining position.

Price changes in international market may be due to changes in supply and demand. But changes in domestic price (farmgate price) could be caused by changes in both international price in US dollar and the exchange rates of rupiah per US dollar. Even keeping FOB price unchanged, increase in exchange rates would drive the domestic price to the higher levels. It is likely that changes in FOB prices are transmitted into domestic market with a range of price in ration.

For instance, when the FOB price of SIR-20 on July was US$ 1.172 per kg and the official exchange rate was Rp 2,430 per US$, the prevailing farmgate price of rubber product with 100 percent dry rubber content was Rp 1,500 per kg and the farmers share of FOB price was estimated at approximately 52,7 percent. Other things being equal, it could be expected that changes in official exchange rate into Rp 3,400, the farmgate price would move to higher level, the change of which would be proportional with this change in exchange rate.

The transport costs from farm to crumb rubber factory were Rp 50 per kg slab for both rubber monoculture and rubber agroforest (Table 3). The marketing costs of SIR-20 from factory to ship for export (including transportation, port handling, etc) were estimated at Rp 53,482 per ton.

Table 3. Transportation cost of rubber product (slab) from farm to crumb rubber factory, 1997 (Rp/kg slab).

Transportation chain	Monoculture (Tebing Tinggi)	Agroforest (Aburan Batang Tebo)
1. F'rom farm to local assembler's house	10	10
2. From local assembler to wholesaler')	20	20
3. From wholesaler to factory2)	20	20
Total	50	50

Notes :

1) PT Sinar Jambi in Muara Bungo.
2) 2) PT Jambi Waras 11, km 50 from Muara Bungo.

4.3. Processing

At the farm level, processing activities were very simple, the output of which was thick slab with low quality. The thick slab was characterized by its high content of nonrubber materials like water, bark and gravel resulting in high output impurities, wide quality range and bad smell. This practice was aimed at increasing gross weight of output. Non-project farmers did not coagulate latex with recommended coagulant like formic acid *(asam semut)* but other materials such as battery acid, fertilizer (TSP) and *gadung* (a kind of tubers). Project farmers, on the other hand, used the recommended coagulant provided by the PRPTE project, though for the first year of harvest only. At the same time, village assemblers also argued that since farmers added non-rubber materials making the quality of slab very low, they cut the weight of rubber they bought from farmers by 20 percent. At the trader level, either village assemblers or wholesalers, no additional slab treatments were done.

Even though rubber development has been taking place for almost 30 years, farmers generally remain to produce low quality rubber and unwilling to improve processing paractices. According to farmers, these improper processing practices stemmed from the following unresolved structural problems. First, the absence of output price increase that sufficiently compensated additional costs and time spent by farmers to produce higher level of output quality (higher dry rubber content and lower impurities). In output price discovery, traders considered only quantity and not quality of output. This pricing behavior of traders also emanated from crumb rubber factory behavior that depressed the price of rubber product purchased from traders.

Hendiarto and Muslim (1995)'s study in Kapuas district (Central Kalimantan) shows that the farmgate of slab was Rp 940 per kg and to produce 1 kg smoked sheet, a 5 kg slab was required. The farmgate value of this total weight of unprocessed slab was Rp 4.700, while the farmgate price of smoked sheet was only Rp 3.000 per kg. Obviously, to produce 1 kg smoked sheet, farmers lost Rp 1.700, in addition to labor costs and time. Such a case was also true for other rubber producing areas. Yusdja et al (1980) study in Sarolangun Bangko (Jambi province) depicts that the lower the rubber quality, the lower per kg farmgate price and trader's profit margin, but the higher the total farner's return and trader profits (Table 4).

Second, crumb rubber factories was able to produce TSR (technically specified rubber). This technology used since 1969, enables to appropriately remove the non-rubber materials contained in the slabs. The blending system can mix the clean raw material with higher quality of raw material such as smoked sheets or thin slab produced by estate companies so as to produce standard export quality product as required by importing countries. This does not make low quality raw material any problems for crumb rubber factories to produce particular quality products. This rapid changes in the processing of TSR have been discouraging farmers to produce higher rubber quality.

Tabel 4. Farmer' returns and trader' profits by rubber quality in Sarolangun Bangko district (Jambi), 1979.

Bokar's Quality*	Farmers				Traders	
	Bahan (kg)	Hasil (kg)	Harga (Rp/kg)	Nilai (Rp)	Untung (Rp/kg)	Nilai (Rp)
Thin slab	20	8	220	1.760	12,96	103,68
Thick slab	20	16	180	2.880	7,83	125,28
Ojol	20	20	160	3.200	6,56	131,20

Source : Yusdja et at (1980).
Notes : * Thin slab (unsmoked sheet) is the highest quality, while ojol is the lowest one.

Third, the actual output quantity of crumb rubber factories is less than the available capacity. This is an underutilization problem that causes tight competitions in raw material procurements. This forces crumb rubber factories to collect raw material of any quality so as to meet the full capacity requirement of the factories for reducing inefficiencies.

Fourth, the quantity of output produced by farmers was small stemming from small land ownership that discouraged processing activities. In addition, the unfavorable economic condition of farmers forced them to seek daily cash incomes.

At the factory level, thick slab and other rubber raw materials are processed using automatic and more sophisticated machines. In Jambi province, there were five crumb rubber factories with total annual production capacity of 147,000 tons of SIR-20 per (Table 5).

According to the production manager of PT Jambi Waras II (the sample of crumb rubber factory in the present study), the processing steps in sequential orders include chopping, washing, pressing and grinding, air drying, cutting, electrical drying, sample testing, packing and labeling. The rubber product of this factory is only SIR-20 for export. The processing cost of SIR-20 was estimated at Rp 147,056 per ton, including variable and fixed costs

Table 5. Annual production capacity of crumb rubber factory in Jambi, 1995.

Company name	Location	Capacity (ton SIR-20)
PTJambi Waras I	Jambi city	36,000
PTJambi Waras II	Bungo Tebo	36,000
PT Remco	Jambi city	24,000
PT Batang Hari T.	Jambi city	25,000
P'I'Angkasa Raya	Jambi city	14,000
Total		147,000

Source : DGE (1996).

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5. PAM Analysis

5.1 Input and Output Quantities

Input and output quantities per hectare per year during a 25-year life cycle of rubber is presented in Appendix I for monoculture and Appendix 6 for agroforest. It can be seen that, *first,* tradable inputs including only Urea, TSP and KC1 were used by rubber monoculture in year 0 but not by rubber agroforest; *second,* rice was grown in year 0 in both cases of rubber monoculture and rubber agroforest; *third,* chilly was grown in year 0 to year 2 in rubber monoculture-but not grown in rubber agroforest; *fourth,* harvest, commenced in year 6 for rubber monoculture and year 9 for rubber agroforest, hence, working capital is incorporated accordingly; *fifth,* during a 25-year life cycle, yield (slab with 50 percent dry rubber content) for rubber monoculture increased from starting point of 600 kg in year 6 to 2,000 kg in years 13-15, and then decreased to 1,300 kg in year 25. For rubber agroforest, yield increased from the starting point of 300 kg in year 9 to 800 kg in years 12-25.

5.2 Input and Output Valuation

(1) The Private Prices

Private prices of input and output are observed (market) prices, according to respondents of the present study. Appendix 2 and Appendix 7 present data on private prices of inputs and outputs for rubber monoculture and agroforest respectively. It is noted that the prices of tradable inputs for rubber monoculture like Urea and TSP, namely Rp 410 and Rp 610 per kg respectively, were slightly higher that the maximum retail price according to government regulation, namely Rp 400 and Rp 600 per kg respectively. The additional price of Rp 10 per kg stemmed from the need for transportation costs from fertilizer seller to village.

Working capital is accounted since the first year of productive period of rubber plants, namely year 6 for rubber monoculture and year 9 for rubber agroforest. The annual private interest rate of working capital is specified at 20 percent.

(2) The Social Prices

The farmgate social prices of output, namely slab with 50 percent dry rubber content, and tradable inputs (Urea, TSP, KCI) were calculated using equation specified in Chapter 2. The results for output social price is presented in Table 6 showing that the farmgate social price of output both in the cases of rubber monoculture and rubber agroforest was
Rp 1,416,109 per ton or Rp 1,416 per kg.

The social prices data are presented in Appendix 3 and Appendix 8 respectively for rubber monoculture and rubber agroforest. It can seen that labor wage rate s were similar across activities and across farm type (monoculture or agroforest), namely Rp 5,000 per man-day (equals regional minimum wage rate regulation), and the price of chopping knife was higher in the rubber monoculture case than in the rubber agroforest case. The social interest rate of working capital is specified at 15 percent per annum

Table 6. Derivation of the farmgate social price of rubber product (slab), July 1997.

Description	Value/ton
a. FOB price of SIR-20 (US$/ton)	1,172
b. Market exchange rate (Rp/US$)	2,400
c. Exchange rate premium = 10% x b (Rp/US$)	243
d. Social exchange rate = b + c (Rp/US$)	2,673
e FOB price of SIR-20 in Rupiah/ton = a x d	3,132,756
f. Processing cost of SIR-20 (Rp/ton)')	147,056
g. Marketing cost of SIR-20 from factory to ship (Rp/ton)2)	53,482
h. FOB price of SIR-20 at factory ~ e-f-g (Rp/ton)	2,932,218
i. FOB price of slab at factory = 50% x h (Rp/ton)	1,466,109
j. Transportation cost from farm to factory (Rp/ton2)	
j1. Tebing Tinggi (rubber monoculture)	50,000
j2. Aburan Batang Tebo (rubber agroforest)	50,000
k. FOB price of slab at farmgate (Rp/ton)	
k1. Tebing Tinggi (ijl)	1,416,109
k2. Aburan Batang Tebo (i-j2)	1,416,109

Notes : 1*) See Table 3; 2) See Chapter 4.*

5.3 The Farm Budgets

The private farm budgets for a 25-year life cycle of rubber are depicted in Appendix 5 and Appendix 9 respectively for rubber monoculture and rubber agroforest, while the corresponding social budgets are presented in Appendix 5 and Appendix 10. It is seen that the values of NPV were negative in most years in the case of rubber agroforest both in tenns of private and social prices. In the case of rubber monoculture, the values of NPV for private price were also negative in most years, but positive for social prices.

5.4 Results

The PAM tables for rubber monoculture and rubber agroforest are presented in Table 7. In addition, the ratio indicators are shown in Table 8. These PAM results may be interpreted as follows.

(1) Private Profitability

The NPV of private profits of both monoculture and agroforest were substantially negative (Table 7). This means that smallholder rubber was not competitive under the existing technologies, output prices, input prices and policy transfers. According to these results, smallholder rubber would not be able to expand in the future, unless improved technologies are introduced. The cultivation of intercrops like dryland rice and chilly could mitigate farmers' losses for the first three years period of rubber life cycle, but did not mucli help increase farmers' gains from their rubber farm.

Table 7. The results of PAM analysis for rubber monoculture and rubber agroforest.

	Revenues	Costs		Profits
		Tradable Input	Domestic Factors	
Monoculture				
Private Prices	3,876,364	214,540	5,387,103	-1,725,279
Social Prices	8,511,689	246,775	6,764,913	1,500,001
Divergences	-4,635,325	-32,235	-1,377,810	-3,225,280
Agroforest				
Private Prices	1,747,146	0	3,906,513	-2,159,367
Social Prices	3,102,799	0	5,028,496	-1,925,697
Divergencies	-1,355,653	0	-1,121,983	-2,336,70I

Tabel 8. Ratio indicators of PAM analysis for rubber monoculture and rubber agroforest.

Indicators	Monoculture	Agroforest
PCR	1.4711529	2.23594
DRC	0.8185098	1.620632
NPCO	0.4554165	0.563087
NPCI	0.8693749	0
EPC	0.4430565	0.563087

From Table 8 it is seen that values of PCR (private cost ratio) for rubber monoculture and rubber agroforest were much higher than 1, especially rubber agroforest. This also suggests that the value added of the existing system could not afford its domestic factor costs.

(2) Social Profitability

The NPV of social profits of rubber agroforest was also remarkably negative, but substantially positive for rubber monoculture (Table 7). This suggests that smallholder rubber agroforest had no comparative advantage under the existing technologies and efficient policies and the system could not survive without assistance from the government. Such system wasted scarce resources by producing at social costs that exceeded the costs of importing. In contrast, smallholder rubber monoculture had the reverse situation. It had high comparative advantage under the existing technologies and efficient policies. The system could survive without assistance from the government. Accordingly, smallholder rubber monoculture could be able to compete in the world market, while smallholder rubber agroforest could not.

From Table 8 it is seen that values of DRC (domestic resource cost ratio) for rubber monoculture was less than 1, while for rubber agroforest was much higher than 1. These tell us that the value added of the existing system could afford the domestic factor costs. Producing rubber domestically was more efficient in the use of scarce resource in comparison with importing it.

(3) Policy Transfer

The value of output (revenues) transfer was negative for both rubber monoculture and rubber agroforest (Table 7) and the NPCO of these systems was 0.455 and 0.563 respectively

(Table 8). These suggest the existence of substantial output transfer from farmers to the economy. Apparently, it stemmed from two things, namely, failures in domestic market of output (as mentioned earlier) and overvalued in official exchange rates. Monoculture farmer and agroforest farmers actually respectively received only 45.5 and 56.3 percent of the efficient (FOB) price.

The value of tradable input transfer was negative for rubber monoculture and zero for rubber agroforest (Table 7) and the NPCI of these systems was 0.870 and nil respectively (Table 8). These suggest the existence of 13 percent government subsidies on tradable inputs, namely Urea, TSP and KCI, to monoculture farmers, but not to agroforest farmers. In fact, only monoculture farmers used these tradable inputs.

The EPC values of 0.443 and 0.563 respectively for rubber monoculture and rubber agroforest show that the transfers of output and tradable inputs was significant. Output transfer from farmers to the economy was much higher than the input transfer from the economy to farmers.

The net transfer was negative in both rubber monoculture and rubber agroforest, but rubber monoculture provided much higher transfer than in rubber agroforest. This was caused by the higher output quantity in rubber monoculture in comparison with that in rubber agroforest.

(4) Sensitivity Analysis

For this analysis purposes, only official exchange rates (OFR) are changed, namely from Rp 2,430 to Rp 3,400 per US dollar. Considering the transmission process of price at FOB level to farmgate level, it is assumed that the farmgate price changed proportionally with changes in OFR. It was estimated that the farrngate private price with this new exchange rates was Rp 1,050 (i.e., [3400/2430] x Rp 750). Following the similar procedures depicted in Table 6, the social price of output was estimated Rp 2,041 per kg.

The results are indicated in Table 9 and Table 10. It can be seen that with this new exchange rate, rubber agroforest remained unprofitable both in terms of private and social prices. On the other hand, rubber monoculture offered higher social profits. Output transfer by farmers and net transfer in the economy were substantial. All of these suggest that the use ol'improved technology accompanied by removement of the failures in output domestic market and distorting policies on exchange rates would bring about smallholder rubber production system more competitive in the world market.

Table 8. Sensitivity analysis of PAM of rubber monoculture and robber agroforest

	Revenues	Costs		Profits
		Tradable Input	Domestic Factors	
Monoculture				
Private Prices	4,654,965	214,540	5,387,103	-946,678
Social Prices	11,389,789	246,775	6,764,913	4,378,101
Divergences	-6,734,824	-32,235	-1,377,810	-5,324,7798
Agroforest				
Private Prices	1,966,004	0	3,906,513	-1,940,509
Social Prices	3,942,453	0	5,028,496	-1,086,043
Divergencies	-1,976,449	0	-1,121,983	-854,446

Tabel 10. Sensitivity analysis of the ratio indicators of PAM analysis for rubber monoculture and rubber agroforest.

Indicators	Monoculture	Agroforest
PCR	1.2131954	1.987032
DRC	0.6070990	1.275474
NPCO	0.4086963	0.498675
NPCI	0.8693749	0
EPC	0.3984941	0.498675

6. *Conclusion and Suggestions*

6.1. Conclusion

Smallholder rubber farm with intercroping, both monoculture and agroforest, was not competitive under the existing technologies, output prices, input prices and policy transfers. These were primarily because of two factors : (i) farmers received output price much less than the efficient price, indicating the existence of market failures of output; and (ii) overvalued official exchange rates.

Under the efficient policies, smallholder rubber agroforest remained to suffer from substantial losses, indicating that the system did not have comparative advantage in the world market, and land use was highly economically inefficient. On the other hand, smallholder rubber monoculture system was highly economically efficent.

6.2. Suggestions

For improving the economic efficiency and the comparative advantage of smallholder rubber, the present study offers the following suggestions. First, introduction of improved technology, especially clonal seeds t farmers so as to increase yield level of rubber plants. This is accompanied by extension programmes and provision of clonal seeds to farmers. *Second,* improvement in the output marketing system by provision of price information, transparent quality determination related to output farmgate price discovery, improvement of transportation facilities, etc. Third, shift from over valuation to the true values of exchange rates. Last, deeper and thorougher research on marketing and processing systems of smallholder rubber.

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