Project ITTO PD 523/08 Rev. 1 (I)
Operational Strategies for the Promotion of Efficient Utilization of Rubberwood from Sustainable Sources in Indonesia

“Improving the Incentives and Capacity for the Utilization of Farmers’ Rubberwood on Replanting Areas in Jambi and South Sumatra Provinces”

(Report on the implementation of the activities pertaining to Output 2)

Executed by:
Directorate General of Forestry Enterprise Development (BUK),
The Ministry of Forestry of Indonesia

In collaboration with:
Indonesian Sawmill and Woodworking Association (ISWA)

With the assistance of:
The International Tropical Timber Organization (ITTO)

Jakarta, May 2013
Project PD 523 / 08 Rev. 1 (I):

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Serial Number : PD 523/08 Rev. 1 (I)

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List of abbreviation

BUK : Bina Usaha Kehutanan/Forestry Enterprise Development
GOI : Government of Indonesia
ISWA : Indonesian Sawmill & Woodworking Association
ITTO : International Tropical Timber Association
M³ : Cubic Meter
MOU : Memorandum of Understanding
MDF : Medium Density Fibreboard
PMT : Project Management Team
RSDP : Rubber Small-Holding Development Project
SKAU : Surat Keterangan Asal Usul/Certificate of Origin
USD : United States Dollar; 1 USD = 9,500 IDR
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Summary

The specific objective of project PD 523/08 Rev. 1 (I) was to promote the utilization of rubber wood from sustainable sources; it was planned to be achieved through delivery of five outputs one of which was “incentives for and capacity in the utilization of wood from farmers’ plantations improved.” In order to deliver this output, four activities were planned to be implemented, namely: 1) to provide reliable information on potential benefits of utilizing rubber wood owned by farmers, 2) to carry out intensive consultation with farmers regarding requirements for and impacts of rubber wood utilization on farmers’ livelihood, 3) to establish models plantation with cash-crops inter-planting for demonstration and training of farmers, 4) to train farmers on efficient techniques for replanting and harvesting of old trees, and 5) to identify feasible options for adoption by local governments to assist farmers in rubber replanting. These activities had been fully executed involving the national consultants, project beneficiaries and partners.

Under activity 1, potential benefits of utilizing rubberwood owned by farmers in terms of the revenue accruable to owners had been estimated and communicated through dialogues. In addition, the constraints to and requirements for the utilization of farmers’ rubberwood had been identified during the dialogues organized under Activity 2. Agro-forestry models for rubber replanting had been established at four sites in four districts of Jambi and South Sumatra provinces involving farmers; it was found that farmers were supportive of the model due mainly to its perceived contribution to future livelihood. Appropriate techniques for agro-forestry model development and for rubber tree harvesting had been demonstrated to 87 and 80 farmers, respectively, under Activity 4. Through the consultations with concerned authorities of four district governments under Activity 5, feasible forms of incentive that are needed by farmers for replacing old plantations were identified.

Achievement of Output 2 of the project was assessed using the indicators defined in the logical framework matrix of the project. The assessment concluded that the output has been achieved noting that the size of agro-forestry model established is slightly short of target.
1. INTRODUCTION

1.1 Background information

ITTO Project PD 523/08 Rev. 1 (I) “Operational Strategies for the Promotion of Efficient Utilization of Rubberwood from Sustainable Sources in Indonesia” was implemented by the Directorate General of Forestry Enterprise Development (BUK) of the Ministry of Forestry of Indonesia in collaboration with the Indonesian Sawmill and Woodworking Association (ISWA) based on the project agreement signed by the Government of Indonesia on 25 March 2010 and by the International Tropical Timber Organization (ITTO) on 6 April 2010. Actual project operations commenced in May 2010 and lasted for thirty-six months, which were governed by the Memorandum of Understanding (MOU) establishing the tasks and responsibilities of both BUK and ISWA; the MOU signed by the parties in February 2010.

The project was aimed at promoting the utilization of rubberwood from sustainable sources in Indonesia, i.e. the rubberwood harvested by rubber companies and farmers from their respective replanting areas. Its development objective was to contribute to lessening of wood raw material supply problem facing the national forest industry by utilizing the vast rubberwood available from sustainable sources. The expected outputs of the project were: i) interest in the utilization of rubberwood owned by big companies increased; ii) incentives for and capacity in the utilization of rubberwood from smallholding plantations improved; iii) government policy governing rubberwood resource utilization revised and enhanced; iv) investment in rubberwood utilization increased; and v) appropriate technologies are available for the utilization of rubberwood from smallholding plantations.

The total project budget was USD 907,794 comprising contributions of ITTO and Government of Indonesia (GOI) in the amounts of USD 605,094 and USD 302,700, respectively. The project funds actually disbursed to GOI by ITTO was USD 449,040 as an amount of USD 156,054 was retained and administered by ITTO for purpose of project monitoring and evaluation. The ITTO project funds were contributed by the Government of Japan, Japan Lumber Importers Association and the Government of South Korea.

This technical report presents information on Output 2 “incentives for and capacity in the utilization of rubberwood from smallholding plantations improved” covering implementation of pertinent activities, assessment of its achievement as well as practical implications of results and the output. Pertaining activities of Output 2 that had been fully implemented are:

Activity 2.1 : To provide reliable information on potential benefits of utilizing rubberwood owned by farmers

Activity 2.2 : To carry out intensive consultation with farmers regarding requirements for and impacts of rubberwood utilization on farmers’ livelihood
Activity 2.3 : To establish models plantation with cash-crops inter-planting for demonstration and training of farmers

Activity 2.4 : To train farmers on efficient techniques for replanting and harvesting of old trees

Activity 2.5 : To identify feasible options for adoption by local governments to assist farmers in replanting of rubber

1.2 Organization of the report

This report has been prepared in accordance with the existing ITTO Manual and concerns only with Output 2 and its pertinent activities. The first part of the report outlines the project elements and identities; the second part presents the methodologies applied in implementing the activities, data collection and analysis; findings are presented in Part 3 and analyzed in Part 4. Part 5 presents the conclusions drawn and recommendations made while implications of findings for practice is highlighted in Part 6 of the report.
2. APPLIED METHODOLOGIES

The second planned project output was “incentives for and capacity in the utilization of rubberwood from smallholding plantations improved”. In order to deliver this output, five activities had been identified during the project formulation stage and fully implemented, namely:

Activity 2.1 : To provide reliable information on potential benefits of utilizing rubberwood owned by farmers
Activity 2.2 : To carry out intensive consultation with farmers regarding requirements for and impacts of rubberwood utilization on farmers’ livelihood
Activity 2.3 : To establish models plantation with cash-crops inter-planting for demonstration and training of farmers (4 sites, total 20 ha)
Activity 2.4 : To train farmers on efficient techniques for replanting and harvesting of old trees (4 trainings, 80 trainees)
Activity 2.5 : To identify feasible options for adoption by local governments to assist farmers in replanting of rubber

It was hypothesized that by fully executing above mentioned activities, planned output will be fully achieved and that the output will induce changes to perception and behavior of smallholders towards replacement of old rubber plantations as well as efficient utilization of rubberwood obtained from replanting areas with appropriate assistance by concerned local governments.

It is evident from above defined activities that in order to deliver the planned output, it was necessary to provide reliable information on potential benefits of utilizing the rubberwood contained in replanting areas (Activity 2.1). Such information should reflect actual condition of rubber plantations especially as regards volume of marketable rubberwood, production costs covering felling, bucking, loading/un-loading, hauling and other cost elements as well as selling price of rubberwood at local markets. This information was then to be disseminated to rubber farmers through intensive consultations in order to motivate and encourage farmers to replace old rubber plantations and utilize rubberwood available on replanting areas. During the consultations with farmers, information on the requirements for realizing the potential benefits of rubberwood utilization and the extent to which these benefits would affect livelihood of rubber farmers were also identified and assessed (Activity 2.2). As Activities 2.1 and 2.2 are in fact complements to each other, they had been implemented in a concurrent fashion. The methodologies applied in the execution of Activities 2.1 and 2.2 are summarized below.

Source and collection of primary data:
Field surveys were carried out to collect information concerning: harvestable log volume of old rubber trees from replanting areas, logs production cost and selling price as well as estimates of potential net
revenue accruable to rubber log owners; the surveys were carried out in four project sites namely Districts of Batang Hari and Muaro Jambi in Jambi province and Districts of Ogan Ilir and Banyuasin in South Sumatra province. The information collected included:

i) Wood volume of old rubber trees
   Obtained by measuring dimension of trees occupying the sample plots purposively located in each district. One circle plot of 0.1 ha in size was located on each plantation aging twenty years or more, owned by individual farmers. The information collected from individual sample plots included history of the plantation, number of trees, volume of logs suitable for sawn timber and for other uses such as chips, Medium Density Fibreboard (MDF) or fuel wood, accessibility and distance from processing mills.

ii) Log production cost
   Components of logs production cost included felling, bucking, skidding and hauling costs as well as administrative and taxation costs. In the estimation of production cost it was assumed that logs are sold at mill gate or at stumpage.

iii) Logs selling price
   Unit selling price of rubber logs was obtained through consultation with farmers and millers alike which was then cross-checked using the information received from experienced sellers or local traders. The selling price was quoted for both sawn logs and other uses such as chip wood, MDF and fuel wood.

iv) Potential gain of farmers
   Potential gain was obtained by deducting the hectarage total production cost from total revenue from selling rubberwood, as appropriate.

v) Socio cultural data
   These data were obtained through consultation with selected rubber farmers in four districts of concern. The main purpose of this consultation was to document response and perception of farmers to the potential benefits from utilizing and selling owned rubberwood and on constraints to realize such assessed benefits as experienced by the farmers. The respondents used included: rubber farmers, rubberwood users, local government authorities at different levels responsible for or involved in rubber plantation development, and traders of rubberwood. The respondents were distributed in four districts where the project was located.

Source and collection of secondary data:

- The secondary data collected included location and size of rubber plantations in the provinces of Jambi and South Sumatra, processing mills utilizing rubberwood as raw material and condition of existing road network in each province; and

- The sources of information included the Agriculture, Forestry and Crop Estate Agencies of individual districts where the project was located.
Establishment of agro-forestry model of rubber replanting was intended to show-case to farmers on how such a model will help generate income through planting and selling of inter-planted cash-crops (Activity 2.3). This was thought as the necessary incentive for farmers to replace old rubber trees with young ones because the income generated by cash-crops can compensate the income loss by not producing latex from old rubber trees and secure income during the no-latex production period which may last for four to five years.

Under Activity 2.4 rubber farmers were trained on efficient techniques for replanting and harvesting of old rubber trees. The purposes of this activity were:

- To ensure that replanting of rubber under agro-forestry model is carried out properly and efficiently that both rubber plantations and cash-crops grow and develop well.
- To increase value added of rubberwood accruable to owning farmers; acquiring the competence to harvest owned old rubber trees will mean retaining the harvesting cost that otherwise would have been collected by a harvesting contractor.
- The techniques for harvesting demonstrated to trainees covered operation of a chainsaw, tree felling and bucking, debarking and identification of log yard sites.

Activity 2.5 was designed to assist the local governments in the identification of suitable forms of incentive for farmers to replace old plantations that are feasible and workable. Different forms of incentive were considered and discussed with local government authorities in terms of their suitability for and applicability by farmers and concerned local governments. It was conceptualized that an incentive is suitable if it serves well the interest of both recipient and provider thus acceptable to both parties; it is applicable if needed resources including procedures and mechanisms are available for implementing the incentive.

The objectives of implementing Activity 2.5 were: to identify suitable forms of incentive for farmers to replace old, unproductive plantations, and to define mechanisms and associated resources for application of the incentives by local governments. Incentives were conceptualized as having two forms: direct or indirect incentives. A direct incentive may be in cash (wage, grant, subsidy, low interest loan), in kind (food, farming facilities, veterinary, seedlings, etc.) or in technical assistance (training on needed skills, extension, etc.). Indirect incentives include government policies that favorably affect livelihood of rubber farmers, cost of production, taxes on latex and rubberwood, selling price, etc.

Indirect incentives may be categorized as variable incentives or enabling incentives. The former category may be divided into sectoral or macro-economic incentives; the latter category may take different such forms as land security, accessibility, market development, devolution of natural resource management, decentralization of decision-making, credit facilities or national security. In the context of incentive for farmers to replace their old rubber plantations, relevant information was
gathered through consultation with rubber farmers, traders and users of rubberwood as well as the authorities of concerned district governments responsible for rubber industry development.

The activities pertaining to Output 2 were fully executed in partnership with competent national consultants for the following reasons:

- The Project Management Team (PMT) did not acquire needed professionals to execute the activities;
- To properly execute individual activities, collaboration with local stakeholders especially rubber farmers was indispensable for which staying in the project sites for an extended period of time was required; and
- Highly competent national consultants were available for hire.
3. PRESENTATION OF FINDINGS

3.1 Potential benefits of replacing farmers’ old plantations and utilizing rubberwood

The salient features of small-holding rubber plantations in four districts are summarized in Table 1; the potential benefits of replacing old plantations are, to a greater extent, determined by features of the plantations to be replaced.

Table 1. Summarized of the salient features of small-holding rubber plantations

<table>
<thead>
<tr>
<th>Feature</th>
<th>Batang Hari</th>
<th>Muaro Jambi</th>
<th>Ogan Ilir</th>
<th>Banyuasin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area of plantations (ha)</td>
<td>111,527</td>
<td>54,787</td>
<td>29,251</td>
<td>88,875</td>
</tr>
<tr>
<td>• Young trees</td>
<td>21,162</td>
<td>14,244</td>
<td>9,495</td>
<td>26,449</td>
</tr>
<tr>
<td>• Productive</td>
<td>75,040</td>
<td>31,427</td>
<td>18,032</td>
<td>53,680</td>
</tr>
<tr>
<td>• Damaged/non-productive</td>
<td>15,325</td>
<td>9,116</td>
<td>1,263</td>
<td>8,696</td>
</tr>
<tr>
<td>Number of owning households</td>
<td>38,613</td>
<td>15,156</td>
<td>28,179</td>
<td>37,500</td>
</tr>
<tr>
<td>Average size of plantation (ha)</td>
<td>2.89</td>
<td>3.61</td>
<td>1.04</td>
<td>2.37</td>
</tr>
<tr>
<td>Planting materials used</td>
<td>Seed</td>
<td>Seed</td>
<td>Seed</td>
<td>Seed</td>
</tr>
<tr>
<td></td>
<td>Wildings</td>
<td>Wildings</td>
<td>Wildings</td>
<td>Wildings</td>
</tr>
<tr>
<td></td>
<td>Partly clone</td>
<td>Partly clone</td>
<td>Partly clone</td>
<td>Partly clone</td>
</tr>
<tr>
<td>Original spacing</td>
<td>Irregular,</td>
<td>Partly irregular,</td>
<td>Partly irregular,</td>
<td>Partly irregular,</td>
</tr>
<tr>
<td></td>
<td>moderate density</td>
<td>moderate density</td>
<td>moderate density</td>
<td>moderate density</td>
</tr>
<tr>
<td></td>
<td>Partly regular,</td>
<td>Partly regular,</td>
<td>Partly regular,</td>
<td>Partly regular,</td>
</tr>
<tr>
<td></td>
<td>high density</td>
<td>high density</td>
<td>high density</td>
<td>high density</td>
</tr>
<tr>
<td>Maintenance inputs</td>
<td>Poor</td>
<td>Partly poor</td>
<td>Partly poor</td>
<td>Partly poor</td>
</tr>
<tr>
<td></td>
<td>Partly sufficient</td>
<td>Partly sufficient</td>
<td>Partly sufficient</td>
<td>Partly sufficient</td>
</tr>
<tr>
<td>Latex tapping techniques</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Tapping intensity</td>
<td>Tree trunks, branches</td>
<td>Tree trunks, branches</td>
<td>Tree trunks, branches</td>
<td>Tree trunks, branches</td>
</tr>
<tr>
<td>Damaged bole by tapping (%)</td>
<td>60-90</td>
<td>50</td>
<td>30-70</td>
<td>20-30</td>
</tr>
<tr>
<td>Current # of tree per ha</td>
<td>160</td>
<td>290</td>
<td>270</td>
<td>400</td>
</tr>
<tr>
<td>Average wood volume (m$^3$/ha)</td>
<td>30.05</td>
<td>50.78</td>
<td>64.39</td>
<td>85.73</td>
</tr>
<tr>
<td>Purity of plantations</td>
<td>Mixed with tree species, shrubs Even/uneven-aged</td>
<td>Mixed with tree species, shrubs Even/uneven-aged</td>
<td>Mixed with tree species, shrubs Even/uneven-aged</td>
<td>Mixed with tree species, shrubs Even/uneven-aged</td>
</tr>
<tr>
<td>Accessibility for trucking</td>
<td>Non-graveled road, very low intensity Only a few sites</td>
<td>Non-graveled road, very low intensity Only a few sites</td>
<td>Non-graveled road, very low intensity Only a few sites</td>
<td>Non-graveled road, very low intensity Only a few sites</td>
</tr>
<tr>
<td>Average hauling distance to processing mills (km)</td>
<td>65-135</td>
<td>39-223</td>
<td>1-68</td>
<td>78-228</td>
</tr>
</tbody>
</table>

The estimates of potential net revenue are presented in Table 2; potential net revenue was smallest in Batang Hari district at USD 218.45/ha and largest in Ogan Ilir district at USD 1,194.44/ha. The figures on revenue are closely related to the attributes of old plantations as presented in Table 1, particularly with wood volume and hauling distance.
Table 2. Estimates of potential net revenue accruable to owners of rubber plantations

<table>
<thead>
<tr>
<th>Elements</th>
<th>Batang Hari</th>
<th>Muaro Jambi</th>
<th>Ogan Ilir</th>
<th>Banyuasin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total wood volume/ha</td>
<td>30.05</td>
<td>50.78</td>
<td>64.39</td>
<td>85.73</td>
</tr>
<tr>
<td>• Sawn logs (m³/ha)</td>
<td>16.00</td>
<td>33.67</td>
<td>37.60</td>
<td>57.66</td>
</tr>
<tr>
<td>• Chip/fuel wood (m³/ha)</td>
<td>14.05</td>
<td>17.11</td>
<td>26.79</td>
<td>28.07</td>
</tr>
<tr>
<td>Total production cost (USD/ha)</td>
<td>510.08</td>
<td>917.86</td>
<td>478.82</td>
<td>1,651.50</td>
</tr>
<tr>
<td>Average selling price at mill gate, USD/m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sawn logs</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>• Chip/fuel wood</td>
<td>6.32</td>
<td>6.32</td>
<td>6.32</td>
<td>6.32</td>
</tr>
<tr>
<td>Total revenue, USD/ha</td>
<td>728.53</td>
<td>1,454.91</td>
<td>1,673.26</td>
<td>2,483.71</td>
</tr>
<tr>
<td>• Sawn logs</td>
<td>639.80</td>
<td>1,346.85</td>
<td>1,504.06</td>
<td>2,306.43</td>
</tr>
<tr>
<td>• Chip/fuel wood</td>
<td>88.73</td>
<td>108.06</td>
<td>169.20</td>
<td>177.28</td>
</tr>
<tr>
<td>Potential net revenue by selling at mill gate, USD/ha</td>
<td>218.45</td>
<td>537.05</td>
<td>1,194.44</td>
<td>832.21</td>
</tr>
<tr>
<td>Potential revenue at stumpage, USD/ha</td>
<td>158.06</td>
<td>267.10</td>
<td>338.69</td>
<td>450.94</td>
</tr>
</tbody>
</table>

3.2 Requirements for replacing old plantations and utilizing rubberwood owned by farmers

i) Constraints to rubberwood utilization

- Farmers are losing income up to five years by replacing their old rubber trees; in order to support subsistence living, the farmers have to find job as daily wagers at nearby rubber plantations or other agricultural activities;
- The cost of planting rubber is in the order of USD 1,438/ha, an amount not affordable to most farmers without support of local government in forms of low interest loan, subsidy, etc.;
- Revenue from selling rubberwood at stumpage was largest in Banyuasin district, i.e. USD 450.94/ha which was much smaller than the cost of rubber replanting, i.e. USD 1,438/ha. The lowest revenue at stumpage was in Batang Hari district at USD 158.06/ha as shown in Table 2. Selling at stumpage was necessitated by the poor accessibility of plantation sites brought about by poor intensity and quality of road network;
- Indeed, most plantation sites are not accessible by heavy load transport means such as truck; consequently only a few farmers have enjoyed income from selling wood noting that even
these farmers have mostly had to sell their wood at stumpage due mainly to the lack of skills and resources as well as market network;

- Farmers could obtain bank loan only by presenting certificate of ownership on the land planted with rubber; however, farmers only have a land authentication letter issued by the head of village where they reside which is not acceptable to bank as collateral;

- In land preparation, farmers normally applied slash and burn method in order to minimize planting cost; this method is now banned by the government without introducing an alternative, in-expensive method; and

- High selling price of latex is a form of disincentive for replacing old rubber trees; while latex yield of old trees is low, it serves as the primary source of income for many rubber farmers thus needs protecting, not replacing. Therefore, provision of income during the no-latex production period is truly a big challenge.

ii) Requirements for utilizing rubberwood on replanting areas

It is evident from above constraints that the basic requirements for the efficient utilization of rubberwood on replanting areas by farmers are to remove above listed constraints. These requirements are highlighted below:

- Road network development by the government is urgently needed for improving accessibility of rubber plantations; improved accessibility will increase economic value of the rubberwood harvested from replanting areas through increased unit selling price which will, in turn, generate larger revenue that will serve as an incentive for replacing old, unproductive rubber plantations;

- Easing the procedures for obtaining bank loan at low rate of interest is required for encouraging farmers to replace old, unproductive rubber plantations;

- Information on potential economic benefits of rubberwood utilization should be made available and well understood by farmers in order to motivate farmers on harvesting of old rubber trees;

- In-expensive and effective alternative method of land preparation should be developed; it is not suffice for the government just to ban the conventional, slash and burn method; and

- Farmers have to be trained on skills for utilizing owned rubberwood using simple technologies with small capital investment in view of increasing value added of rubberwood and widening of job opportunity beyond rubber business related activities.

3.3 Establishing rubber plantations using agro-forestry model

a. The agro-forestry model sites identified

The agro-forestry model was intended to be sustainable for purpose of learning and training of farmers regarding the different stages of rubber plantation development and implications of the model
to livelihood of farmers. Therefore, sites of the model must be secured in terms of land tenure. Site identification was carried out through intensive consultation with individual farmers and selected the most suitable sites. The criteria employed in site selection were: i) land is about 3.0 to 5.0 ha in extent; ii) land ownership is definite; iii) land is clean and clear of conflict; iv) easily accessible; and v) occupied by old rubber trees ready for replacement.

![Samples of old plantations ready for replacement](image)

### Table 3. Selected sites of agro-forestry model

<table>
<thead>
<tr>
<th>Province</th>
<th>District</th>
<th>Sub-District</th>
<th>Village</th>
<th>Owner</th>
<th>Size (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jambi</td>
<td>Batang Hari</td>
<td>Muara Bulian</td>
<td>Rantau Kapas Mudo</td>
<td>Mr. Arwinsyah</td>
<td>3.00</td>
</tr>
<tr>
<td>Jambi</td>
<td>Muaro Jambi</td>
<td>Sekernan</td>
<td>Bukit Baling</td>
<td>Mr. Misbah</td>
<td>3.00</td>
</tr>
<tr>
<td>South Sumatra</td>
<td>Ogan Ilir</td>
<td>Payaraman</td>
<td>Payaraman</td>
<td>Mr. Muslim</td>
<td>3.00</td>
</tr>
<tr>
<td>South Sumatra</td>
<td>Banyuasin</td>
<td>Banyuasin III</td>
<td>Petaling</td>
<td>Mr. Suhardi</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mr. Yani</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mr. Darwin</td>
<td></td>
</tr>
<tr>
<td><strong>Total all sites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>14.00</strong></td>
</tr>
</tbody>
</table>

For site accessibility reason, the total size of agro-forestry plots was only 14 ha because there were very few plantations with a size more than 3.0 ha that was easily accessible and ready for replacement.

b. Planting materials used

Rubber clone PB 260 was used as the planting material for the following reasons:

- Proved high yield of latex
- Locally available
- Farmers are familiar with
- Recommended by local crop-estates authority

The seedlings were obtained from local rubber cultivators through direct purchase of ready-to-plant seedlings. The number of seedlings needed for original planting was 556/ha; for infixing purpose, additional 100 seedlings per ha were also made available for each site.
The cash-crops inter-planted between rubber seedlings were:

- At Rantau Kapas Mudo site of Batang Hari district: green chili, long bean and sweet potato
- At Bukit Baling site of Muaro Jambi district: corn and peanut
- Payaraman site of Ogan Ilir district: pineapple
- At Petaling site of Banyuasin district: paddy, long bean, green chili and peanut

Rubber clone PB 260 used in agro-forestry model development

The cash-crops were selected based primarily on experience of farmers in growing such crops and marketability of the yields. Planting materials for the cash-crops were purchased from local suppliers in close consultation with land owners to ensure quality of the materials based on their knowledge and experience.

c. Spacing

The spacing in planting of rubber seedlings used was of 6 x 3 meters, 6 meters on north-south direction and 3 meters on west-east direction. Therefore, 556 seedlings were originally planted per hectare of land.

d. Planting of rubber and cash-crops

Prior to planting rubber seedlings, the preparatory works performed included land clearing, hole digging and fertilizing. Land clearing included cutting and removal of old rubber trees and/or shrubs. To prevent attack of white root fungae (Rigidoporus lignosus), stump and root of old rubber trees were also removed to the extent possible. When the removal was unsuccessful, stump and root were destroyed using substance, Garlon 480EC or Tordon 101.

Sizes of the holes for planting were of 40 x 40 x 40 cm; removed sub-soil and top-soil was piled up at the opposite direction of the hole in order to avoid misplacing in re-filling of the hole during planting. The original fertilizer used was NPK tablet at 250 grams per hole, evenly mixed with the soil removed from the holes.
3.4 Training of farmers on techniques for establishing plantations and harvesting of old rubber trees

- Training on appropriate techniques for rubber plantation development using agro-forestry system conducted at four sites, namely Rantau Kapas Mudo village in Batang Hari district, Bukit Baling village in Muaro Jambi district (Jambi province), Payaraman village in Ogan Ilir district and Petaling in Banyuasin district (South Sumatra province).
- The training lasted for about one week within the rubber planting period due to irregular availability of farmers; some farmers were available for a particular day but not for the other days due to their daily routine activities. The training was conducted in March 2011 at Muaro Jambi, April 2011 in Batang Hari, November 2011 in Ogan Ilir and January 2012 in Banyuasin with a total 87 participants.
- The activities on agro-forestry system demonstrated included:
  - Land clearing and preparation

![Sites for establishment of agro-forestry models, after land clearing](image-url)
- Selection of suitable clone and cash-crops
- Spacing arrangements
- Appropriate techniques for planting of rubber seedlings and cash-crops

The training on harvesting techniques was conducted after the establishment of the agro-forestry models had been completed at the sites nearby the models’. Training on harvesting techniques was combined with the training on wood preservation and were organized as follows:

- At Rantau Kapas Mudo of Batang Hari: 6-7 May 2011, 20 participants
- At Bukit Baling of Muaro Jambi: 4-5 May 2011, 20 participants
- At Payaraman of Ogan Ilir: 30 April-1 May 2012, 20 participants
- At Petaling of Banyuasin: 27-28 April 2012, 20 participants
• The total number of trainees was 80 rubber farmers whom were also the trainees of the agro-forestry development techniques.

• Each of the trainings on agro-forestry and harvesting techniques was performed in two sessions; in the first session, relevant theoretical background and experience were presented while the second session was used for practical exercise to demonstrate on how individual activities ought to be performed.

• The harvesting techniques demonstrated included: chainsaw operation, tree felling, bucking and identification of logyard site.

In addition to above trainings, the farmers were also trained on appropriate techniques for charcoal making using small-sized rubberwood and for preservation of rubberwood in order to prevent damages by blue stain and pests. The conduct and results of these trainings are elaborated in Technical Report No.5.

### 3.5 Identifying incentives for replacement of old rubber plantations

The forms of incentive that are conducive for increasing the interest of farmers in replacing old rubber plantations as listed below were indentified through consultation with rubber farmers, buyers/users of rubberwood and the local authorities responsible for development of rubber and wood industries:

i. Construction of road network to rubber plantation sites to improve accessibility which in turn will raise the economic value of latex and rubberwood owned by farmers;

ii. Dissemination of information on the economic value of rubberwood from replanting areas and its determinants in order to encourage farmers to take care of rubber trees in terms of quantity and quality;
iii. Training of farmers on simple, appropriate processing techniques to facilitate efficient 
utilization of rubberwood and creation of larger value added for farmers with small capital 
investment;
iv. Development of centers for clone production nearby plantation sites to reduce transport cost 
and mortality rate due to handling problems during loading, hauling and unloading;
v. Deregulation of rubber clone certification procedures in view of reducing total cost of planting 
materials;
vi. Training on agro-forestry development model for establishing new plantations to optimize land 
use and generate income from cash-crops to support livelihood of farmers during the no-latex 
production period;
vii. Simplification of procedures and requirements for obtaining soft loan from the local banks to be 
used by farmers for purchasing necessary inputs such as quality clones, fertilizer and seed of 
cash-crops;
viii. Simplification of wood accounting system to reduce transaction costs especially those relating 
to transport and change of custody;
ix. Provision and dissemination of information on location, extent, estimate of growing stock, 
owner of plantations and timing of replacement to facilitate development of raw material supply 
schedule by rubberwood processors; and
x. Deregulation of policies on investment, trading, taxation, etc. to encourage engagement of 
private sector in rubberwood utilization.

In addition to above incentives for farmers, there is a need to apply incentives for private sector. 
Based on the consultation with selected wood processors, clone producers and concerned 
authorities, following are incentives for private sector that have the potential to increase interest in 
rubberwood utilization:
- Simplification of accounting system to reduce transaction costs;
- Generation and dissemination of information on rubber plantations to be replaced as regards 
location, size, estimate of growing stock and accessibility condition to facilitate planning of 
wood raw material supply schedule;
- Provision of technical assistance to rubber clone producers to ensure high operational 
efficiency and product quality;
- Deregulation of rubber clone certification procedures in view of reducing total production cost of 
rubber clones; and
- Development of favorable business environment in order to attract investors in rubberwood 
processing and trading as well as in rubber clone production, certification and trading.
4. ANALYSIS OF FINDINGS

4.1 Potential benefits of rubberwood utilization for owning farmers

The main determinants of economic return to owners of rubberwood harvested from replanting areas are: volume of wood, production cost and selling price. Volume of wood is influenced by available growing stock and efficiency of harvesting. It was found that the average volume of wood available, based on the measurement of trees occupying the sample plots, varied between 30.05 m³/ha (Batang Hari district) and 85.73 m³/ha (Banyuasin district); the actual volume removed must be smaller than these averages depending on efficiency of harvesting. To illustrate on how and why growing stocks were different between the districts, conditions of the rubber plantations in Batang Hari (smallest growing stock) and Ogan Ilir (largest growing stock) districts were compared to each other in the paragraphs that follow; conditions of the plantations in the other two districts should lie between these two extremes.

Indeed, the average volume available for harvesting was determined by management history of plantations. In Batang Hari district, two types of rubber plantations were commonly found. The first type was locally called rubber jungle because rubber trees were mixedly growing with other tree species and shrubs. These plantations were established through direct seeding and planting of wildings at irregular but dense spacing; plantations grew and developed naturally, practically without any maintenance. On this type of plantation, mortality rate of trees was high that at replacement age the number of survived trees in Batang Hari district was only 80 trees/ha yielding only 14.03 m³ of wood.

Samples of the first type, uneven-aged “jungle” rubber plantations
Samples of the first type, uneven-aged “jungle” rubber plantations

The second type of plantation was somewhat mono-culture in nature, established using wildings with irregular but dense spacing. Infixing was carried out in irregular manner resulting in uneven-aged stands. Plantations received no caring inputs that they developed poorly. On this type of plantation, the number of trees at replacement age was 240 trees/ha yielding about 45.80 m$^3$ of wood. Therefore, it was not surprising to find the significantly small volume of wood available for harvesting in Batang Hari district, i.e 30.05 m$^3$/ha, the average of the two types of plantation. Note that these types of plantations were also observed in Muaro Jambi district.

Samples of the second type, even-aged rubber plantations
The attributes of rubber plantations in Banyuasin district were considerably different from those in Batang Hari district. While the first type of plantation, rubber jungle, was also found in Banyuasin district, their performance at replacement age was much better in terms of survived trees, averaging 350 trees/ha, which yielded about 85.30 m$^3$ of wood. This large number of trees was attributable to the dominant composition of rubber in the jungle, more frequent infixing of died seedlings, and larger original density of trees. The second type of plantation developed even better because it was established using clones at regular but dense spacing. In addition, the plantations had received some caring inputs including fertilization and cleaning under the assistance of RSDP (Rubber Small-Holding Development Project) project. The average number of trees that survived at replacement age on this type of plantation reached 450 trees/ha yielding about 86.20 m$^3$ of wood. It is therefore only reasonable to find the much larger volume of wood at replacement age in Banyuasin district which was estimated at 85.73 m$^3$/ha with the average number of survived trees at 400/ha. Note that the history of plantations in Ogan Ilir and Banyuasin districts was comparable to each other although with different growing stock volume brought about mainly by the variations in the original spacing and management intensity applied.

The history of rubber plantations in the project sites and estimates of rubberwood available for harvest are summarized in Table 1. By closely examining the information in Table 1, one would conclude that quality of plantations in Muaro Jambi and Ogan Ilir districts was much better than that in Batang Hari district but much poorer than that in Banyuasin district. This conclusion is understandable.
because growth and yield of trees are dependent on their origin and the treatments they received during the gestation period.

Production cost of rubberwood varied between the districts: USD 17.00/m$^3$ in Batang Hari, USD 17.00/m$^3$ in Muaro Jambi, USD 7.44/m$^3$ in Ogan Ilir and USD 19.26/m$^3$ in Banyuasin. Variation in unit cost was caused mainly by the difference in hauling cost, wood volume and wage rate in general. The average harvestable wood volume was 30.05 m$^3$/ha in Batang Hari, 50.78 m$^3$/ha in Muaro Jambi, 64.39 m$^3$/ha in Ogan Ilir and 85.73 m$^3$/ha in Banyuasin (see Table 2). The average hauling costs from plantation to mill sites were USD 10.53/m$^3$ in Batang Hari, USD 13.68/m$^3$ in Muaro Jambi, USD 3.68/m$^3$ in Ogan Ilir and USD 16.11/m$^3$ in Banyuasin districts, respectively. The average felling cost was USD 4.26/m$^3$ in Batang Hari district, USD 2.52/m$^3$ in Muaro Jambi district, USD 1.99/m$^3$ in Ogan Ilir district and USD 1.49/m$^3$ in Banyuasin district. Another cost components such as bucking, loading/unloading and other costs also varied between the districts yet at a smaller range compared to hauling and felling costs. In addition, availability of skilled laborers also affected cost of production. The average total production costs are shown in Table 2; the figures were derived based on wood volume (m$^3$/ha) and unit cost of production (USD/m$^3$). The figures in Table 2 clearly indicate that the production cost was lowest in Ogan Ilir (USD 478.82/ha) and highest in Banyuasin (USD 1,651.50/ha).

Estimates of total revenue as shown in Table 2 ranged between USD 728.53/ha in Batang Hari district and USD 2,483.71/ha in Banyuasin district. The estimates were derived using the average harvestable wood volume and average selling price of sawn logs and non-sawn wood at mill gate. The potential net revenue accruable to farmers was obtained by deducting the total production cost from total revenue. The figures in Table 2 suggest that potential net revenue was largest in Ogan Ilir district at USD 1,194.44/ha and smallest in Batang Hari district at USD 218.45/ha. Note that the potential net revenue is deliberately quoted in hectare to allow direct comparison with establishment cost of rubber plantation which is expressed per hectare.

It is worth noting that in deriving the estimates of potential net revenue as previously discussed, it was assumed that rubberwood is sold at mill gate. In reality, however, selling at mill gate was problematic as most plantation sites were not accessible due to the lack of road network for trucking. Due to lack of resources in terms of skills and financial capital, farmers did not have the capacity themselves to harvest rubberwood available at replanting areas and transport the wood to processing mills. For this reason, most farmers have actually sold their rubberwood at stumpage. Available information indicated that the average stumpage price was in the order of USD 5.26/m$^3$. Under this scenario, the potential net revenues of farmers were USD 158.06/ha in Batang Hari, USD 267.10/ha in Muaro Jambi, USD 338.69/ha in Ogan Ilir and USD 450.94/ha in Banyuasin, respectively, which were much smaller than the potential net revenue under the mill gate selling price scenario assuming the same wood volumes in the respective districts as quoted before.
The consultation held with selected farmers also indicated that:

- The average cost of establishing rubber plantations was about USD 1,438/ha comprising USD 739 of wages (51%) and USD 699 of consumables (49%); and
- The average cost of living in the four districts ranges between USD 14,000 to 17,000 per household for five years, i.e during the no-latex production period.

Above information clearly indicates that revenue from selling rubberwood either at stumpage or mill gate was smaller than the establishment cost; even the largest revenue, USD 1,194/ha in Ogan Ilir can not fully cover the cost of rubber plantation establishment. The problem is even worse if cost of living during the no-latex production period is taken into account.

4.2 Requirements for replacing old plantations and utilizing rubberwood

By replacing their old rubber plantations, the farmers will be losing income from latex during the no-latex production period of young plantations which may last between four to five years. Indeed, old plantations, especially those aging 25 years or more, yield only small quantity of latex; how small it might be, it was still an important source of income to farmers that it needs to be conserved, practically at no maintenance cost. This is particularly true during the times when selling price of latex is at peak. During the 2011-2012 period for instance, price of latex reached USD 3-4/kg; during this period, it was truly useless to talk with farmers about plantation replacement program as they would protect every single tree for latex production.

The average cost of establishing rubber plantation was about USD 1,438/ha in 2012. Indeed, this is a huge amount of investment for most farmers. Even for a typical rubber farmer in Ogan Ilir district, with the highest net revenue from selling rubberwood at USD 1,194/ha, this level of investment is not affordable. In fact, net revenue could reduce to only USD 158/ha if rubberwood is sold at stumpage like that in Batang Hari district making establishment cost is even farther beyond the reach.

For most of the households consulted, latex is the primary source of income to support livelihood; therefore, latex must be produced at all times. In this light, rubber farmers have applied different replacement strategies as follows:

i) Seedlings are inter-planted between old rubber trees; when the seedlings start yielding latex, the old trees are removed. Applicability of this strategy is influenced by density of the old trees; the fewer the old trees in number, the more applicable the strategy is;

ii) One parcel of old plantation is divided into two or three units and each unit is replaced sequentially that no-latex production period is not experienced by the farmers. This strategy is applicable when the parcel is sizeable, preferably no less than three hectares in size;
Old plantations at different, separate sites, are replaced by site one after another that latex is continuously produced at all times. This strategy is normally adopted by farmers owning big plantation areas; and

Old rubber trees occupying a parcel of land are entirely and simultaneously removed and the land is planted with new seedlings. Under this strategy, owning farmers will experience no-latex production period. In order to support living, members of households would strive to do any jobs relating to rubber trees or farming activities for daily wages. This strategy is also applicable to farmers owning alternative source of livelihood.

Selling rubberwood at mill gate for higher unit price than at stumpage is not possible for most farmers for a number of reasons:

- Most plantation sites are not accessible for trucking because road is simply not available or existing road is not passable especially during rainy days
- Even if trucking is possible, most farmers do not acquire the skills needed for harvesting, bucking and skidding that selling at stumpage is the only choice available for farmers
- Selling wood at stumpage is not always feasible even at low price because buyers, either traders or processors, are not willing to invest in roading that buying at mill gate or at easily accessible log yards is most preferable.

In order to maximize economic value of rubberwood harvested from replanting areas, it is indispensable to build road network passing through sites of farmers' plantations; and road building is certainly the responsibility of the governments, not the rubber farmers nor the wood buyers.

To appropriately establish rubber plantation, investment in the amount of USD 1,438/ha is required; an amount not affordable to most farmers. Smaller fraction of this investment might be covered by the income received from selling of wood. The balance will have to be covered with bank loan. However, obtaining bank loan is extremely difficult for most farmers due to the requirements and procedures set by the banks. Another option is for the government to provide subsidy in different such forms as provision of seedlings free of charge or at reduced price, partial or full support of fertilizer, etc. These kinds of support have been widely practiced in the neighboring countries for many years now and successfully encouraged farmers to replace old rubber plantations. Indeed, it is most preferable for farmers to invest only the money received from selling owned rubberwood and their labor in plantations; the balance is expected to be covered by subsidy and bank loan at low rate of interest.

To minimize cost of establishment, farmers had been using slash and burn method for land preparation. This method has been banned by the government in recent years and aggravated the problems facing farmers. Banning the method without providing a solution with comparable advantages is indeed not a wise decision. The government will have to introduce an alternative method that encourages farmers to replace old plantations.
The information on potential benefits of replacing old rubber trees and selling harvested wood in the form of monetary income has been communicated with farmers of selected villages in the four districts. The figures on potential net revenue of farmers in the respective districts as shown in Table 2 have been discussed with the farmers. While the farmers did appreciate the potential net revenue, they were skeptical of its realization due primarily to the rooted problem of accessibility and inability of most farmers to provide the necessary inputs to realize the income. The farmers consulted underlined the fact that only a few farmers have enjoyed income from selling rubberwood either at stumpage or at mill gate, i.e. only those farmers owning plantations along or nearby the existing road network. Therefore, only a few farmers have the strong interest in replacing old rubber plantations because these farmers can sell wood at reasonable price and the proceeds can cover significant portion of plantation establishment cost.

Most of the farmers consulted were less interested in replacing their old rubber plantations for simple reasons: rubberwood can not be sold at reasonable price due to the absence of transportation means and cost of replanting is unaffordable. Therefore, prerequisites to replacing old rubber plantations are availability of infrastructure for hauling out the wood harvested from replacement areas and resources for replanting. Government policy must focus on solving these rooted problems because of their detrimental impacts on the economic value of rubberwood and uncertain sustainability of productive rubber plantations which surely affect livelihood condition of local communities.

4.3 The advantages of establishing rubber plantations using agro-forestry model

Security of livelihood during the no-latex production period of young rubber trees has to be carefully assessed by a farmer to make decision on replacing old rubber plantations. Most of the farmers consulted indicated anxiety on security of livelihood during the absence of income from latex selling. Knowing that establishing plantation under agro-forestry system will generate income stream through selling of cash-crops inter-planted between rubber plants, farmers enthusiastically supported demonstration of the system. This enthusiasm was evident from the number of farmers offering their lands as the site for demonstration. However, only those lands that met the criteria set by the project were finally chosen as the agro-forestry model sites.

Another indication of the farmers' support on agro-forestry demonstration was the number of farmers taking part in the demonstration. The project did not have any problem in recruiting 87 farmers as the trainees; the target was 80 trainees. The trainees should be able to replicate the design and techniques demonstrated at the four sites at smaller parcels of land but in a more flexible fashion. The main features of the agro-forestry plots at the four sites by end of the project are summarized in Table 4.

Table 4. Main features of the agro-forestry models by end of the project (April 2013)
<table>
<thead>
<tr>
<th>Elements</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual date of planting</td>
<td>Batang Hari</td>
</tr>
<tr>
<td>Rubber clone planted</td>
<td>PB 260</td>
</tr>
<tr>
<td>Size of plots (ha)</td>
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<tr>
<td>Original density, trees/ha</td>
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</tr>
<tr>
<td>Seedling mortality rate, %&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>20</td>
</tr>
<tr>
<td>Average diameter of trees, cm</td>
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<tr>
<td>Range of height, cm</td>
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</tr>
<tr>
<td>Median height, cm</td>
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</tr>
<tr>
<td>Overall health condition</td>
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<tr>
<td>Total yield of crops, kg</td>
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<tr>
<td>Green chili</td>
<td>420</td>
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<tr>
<td>Paddy</td>
<td>-</td>
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<tr>
<td>Pineapple, fruit</td>
<td>-</td>
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<td>Peanut</td>
<td>-</td>
</tr>
<tr>
<td>Long bean</td>
<td>300</td>
</tr>
<tr>
<td>Total gross income from cash-crops, USD/ha</td>
<td>631</td>
</tr>
<tr>
<td>Yearly gross income, USD</td>
<td>316</td>
</tr>
</tbody>
</table>

<sup>1)</sup> Died seedlings were completely replaced with new ones

The figures in Table 4 indicate that the rubber plantations in Batang Hari and Muaro Jambi districts grew somewhat better than those in Ogan Ilir and Banyuasin districts using diameter size and tree height as the criteria. This difference in growth is very likely attributable to the cash-crops inter-planting and age of the plantation. In Ogan Ilir for instance, pineapple is planted too close to rubber trees that the pineapples and rubber trees are competing for nutrient. Likewise, paddy in Banyuasin was planted without any distance from the rubber trees that intense competition for nutrient is taking place for an extended period of time. In addition, planting of clones in Batang Hari and Muaro Jambi districts was carried out around six months earlier than that in Ogan Ilir and Banyuasin districts.

In Batang Hari and Muaro Jambi districts, cash-crops growing is less intensive that that in Ogan Ilir and Banyuasin districts. In Muaro Jambi for instance, no cash-crop was grown between rubber trees. Indeed corn and peanut were initially planted but was then discontinued because the farmer could not afford to fight pests, primarily pigs that damaged nearly all the plants. In Batang Hari district, planting of cash-crops was performed properly by providing ample distance between the crops and rubber trees that competition for nutrient was minimized.
Two years old rubber trees on agro-forestry sites in Batang Hari and Muaro Jambi districts

Eighteen months old rubber trees on agro-forestry sites in Ogan Ilir and Banyuasin districts

Eighteen months old rubber trees on agro-forestry sites in Ogan Ilir and Banyuasin districts
The income of farmers from planted cash-crops was less satisfactory. For instance, the total gross income was USD 631 in Batang Hari, nil in Muaro Jambi, USD 2,526 in Ogan Ilir and USD 2,361 in Banyuasin. On yearly basis, the largest income from cash-crops was generated by the farmer in Banyuasin at USD 1,889 followed by farmer in Ogan Ilir at USD 1,783; the lowest income was in Batang Hari at USD 316 as shown in Table 4. It was also found that farmers in South Sumatra in general were more familiar with agro-forestry system compared to their counterparts in Jambi; this fact explained why cash-crops inter-planting in Jambi were not performed satisfactorily.

Three determinants of income from cash-crops are primarily crop species, survival of crops and interest of the farmers involved. Pineapple appears to provide largest income but growing of this crop is not popular in the districts other than Ogan Ilir for reasons of inferior local knowledge and less suitable soil characteristics. Another potential species are paddy and peanut, which are suitable only for dry land like that in Banyuasin district.

Survival of the crops planted is very much determined by maintenance intensity and pest attack incidence, as farmers are mostly skillful on planting and caring techniques. Fencing is one the means for minimizing pest attack but not all farmers have the capacity to doing this like that occurred in Muaro Jambi district. Another important determinant of income from cash-crops is the degree of interest of the farmers involved. Farmers owning small size of land are normally more interested in using land space more productively compared to those owning several parcels of land or those who have another source of income. That is to say that there is still much homework to do in the future; i.e. to raise interest of farmers of different land ownership in increasing land productivity by properly growing suitable cash-crops between young rubber trees focusing in Jambi areas.

4.4 Improved technical skills of farmers on harvesting and planting

The elements of training on agro-forestry model covered the model designing, selection of rubber clones and cash-crops species, actual planting of rubber seedlings and cash-crops and procedures as well as techniques for fertilizing and infixing. Demonstration of infixing could not be undertaken as the activity is to take place only at around 3-4 weeks after planting. However, farmers would not be facing any difficulty to perform infixing and fertilizing because the procedure and technique are the same as those that were demonstrated during the original planting exercise. According to the farmers consulted, the rates of infixing were about 20% in Batang Hari, 10% in Muaro Jambi, 15% in Ogan Ilir and 20% in Banyuasin, respectively.

Training on agro-forestry was conducted during the rubber planting seasons; i.e. April 2011 in Batang Hari district, March 2011 in Muaro Jambi district, November 2011 in Ogan Ilir district and January 2012 in Banyuasin district. The training covered land preparation, hole digging, fertilizing and
planting of seedlings. Where, when and how to inter-plant cash-crops between rubber seedlings were also demonstrated to the trainees; there were 87 farmers took part in the agro-forestry training.

Training on agro-forestry model would now enable farmers to replicate the model on their own lands. The training shed hope that replanting of rubber under agro-forestry model, would generate income stream for farmers through sales of cash-crops thus support livelihood during the no-latex production period. Indeed, spacing of rubber must not be too dense to allow inter-planting. Fewer numbers of rubber trees does not mean smaller quantity of latex production because the trees would be growing more vigorously and developing faster thus producing larger quantity of latex. Cost of maintenance would be minimized because it is to be shared with the cash-crops nurturing. In fact, debris of cash-crops after harvesting would serve as fertilizer that positively affects growth of rubber trees.

The number of trainees on harvesting techniques was 80 farmers in four districts; they were the same trainees as those with the agro-forestry model demonstration. The first element of the training was on familiarization with chainsaw elements and its operation. The trainees were shown the right tension of chain, sharpness of chain blade; clutch functioning, oil and fuel filters, spark-plug, and other parts. The trainees are now familiar with chainsaw operation and open the opportunity to be hired by loggers and rubber plantation developers though very few of them had ever in the past operated a chainsaw on their own.

The other element of training was on locating log yard. Log yards in the cutting block should be located nearing concentration of growing stock in order to ease skidding task by minimizing skidding distance. On tree felling, trainees were shown the techniques for making felling cut to direct falling (takik rebah) and reciprocal cut (takik balas) in order to minimize damages to timber and also prevent accident from happening. Also demonstrated were cleaning of branches and twigs and bucking.

The advantages of training on harvesting techniques are:
- To retain larger value added for farmers; if farmers are able to perform felling and bucking, they might be able to save around USD 2.38/m$^3$ of value added that would otherwise be accruing to buyers;
- To broaden job opportunity; having the capacity to operate chainsaw, farmers may have the opportunity to work with nearby logging companies or land clearing related activities; and
- To show case the fact that farmers are also receptive to applying simple advanced technologies.

Sortiments are the outcome of bucking whose length is dictated by buyers at between 70 to 200 cm. In order to preserve the sortiments produced, wood preservation using simple method and locally available, in-expensive materials was also demonstrated to trainees which is reported under Activity 5.4.
4.5 Identifying incentives for farmers to replace old rubber plantations

The different forms of incentive are depicted in Figure 2 while the difference between variable incentive and enabling incentives are illustrated in Table 5.

![Figure 2: Different categories and types of incentive](image)

<table>
<thead>
<tr>
<th>Variable incentives</th>
<th>Enabling incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sectoral</td>
<td>Macro-economic</td>
</tr>
<tr>
<td>Prices of inputs and outputs</td>
<td>Exchange rate</td>
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<td>Taxes</td>
<td>Taxes</td>
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<td>Subsidy</td>
<td>Interest rate</td>
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<td>Tariff</td>
<td>Monetary and fiscal policies</td>
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On the basis of expected output, like money income and degree of control exercised, incentives may be grouped into four classes, namely welfare based incentives, weak incentives, empowerment based incentives and strong incentives as illustrated in Figure 3. The grouping of incentives as shown in Figures 2 and 3 has been employed in the analysis of incentives that follows.
• Construction of road network for purpose of improving accessibility of farmers' plantation sites is probably one of the most critical incentives for farmers to replace old, unproductive plantations. Improved accessibility will surely increase price of rubberwood either at stumpage or mill gate due to eased transportation and reduced hauling cost to processing mills. This incentive will not only benefit the farmers but also buyers of rubberwood. In fact, the incentive will favorably affect local and regional economies thus has the potential to create job opportunities, increase income and welfare of the society in general; that is to say that construction of road network is a strong, enabling incentive that contributes to empowering local and regional economies.

• Information on the potential economic value of rubberwood is available. This information, however, has to be adequately communicated with farmers. How quality affects price for instance is not well understood by farmers leading to unintended but extreme damages to tree boles due to improper conduct of tapping in their attempt to force maximum latex production. Improper tapping has seriously damaged boles, reduced quality of logs and resulted in low recovery of processing; consequently, rubber logs have been priced very low by buyers, depending on the degree of damages. Damaged boles may reach 60% of bole surface leaving only smaller part of bole that can be sold as sawn logs at reasonably high price. In fact, maximizing tapping surface does not mean maximum latex quantity because there is a limit to latex production due to the work of several biological factors. Understanding on determinants of rubberwood price is therefore a strong motivating incentive for farmers to take care of rubber trees and apply proper tapping techniques.
• Training on appropriate wood processing techniques is another form of incentive that has far reaching implications. Trained farmers on chainsaw operation for instance will widen job opportunity; acquired skills on charcoal production techniques will allow for development of small-scale business at village level. Obviously, training on processing techniques is a form of welfare-based incentive as the skills learned are in fact an income generating tool.

• Development of clone centers close to concentration of rubber plantation sites is another form of incentive that benefits both farmers and clone producers. The centers so located will reduce average price of clone due to less expensive transport cost. Shorter transport distance will also reduce mortality rate due to stressful seedlings. All in all, the centers will benefit farmers through reduced price and profit producers through stronger demand for seedling. This undertaking is a form of indirect, motivating incentive.

• Deregulation of rubber clone certification as regards place, requirements and involvement of authorities will facilitate an efficient certification process thus reduce cost of clone at farmer level. This deregulation is a form of sectoral, variable incentives as it deals with lowering price of clone, inputs to plantation; the incentive benefits both clone producers and farmers.

• Training on agro-forestry model is a welfare-based incentive with direct and indirect gains. The direct gain is in the form of income from selling the cash-crops; indirect gain is in the form of
rubber trees that produce latex at later stage. In addition, the training will encourage farmers to replace old, unproductive rubber trees with young ones that yield latex at greater quantity for a long period of time.

- Simplification of procedures and requirements for obtaining soft loan from local banks is a form of enabling incentive with welfare content. Availability of soft loan will enable farmers to establish new plantations that will generate income stream for many years since the fifth year.

- Deregulation of wood accounting system is a form of incentive for farmers and traders of rubberwood through reduced transaction cost. The existing requirement for certificate of origin (SKAU) in rubberwood trading has been in many instances mis-used by local authorities especially village administrators, heightened transaction cost and discouraged efficient utilization of rubberwood. Such a deregulation is a strong enabling incentive that benefits owners and processors of rubberwood alike.

- Provision of reliable information on replacement of old plantations in terms of location, size and timing is a form of direct incentive for wood processors to using rubberwood; it is also an indirect, motivating incentive for farmers to replace their old trees through increased demand for rubberwood.

- Deregulation of policies on investment in rubberwood processing and trading of wood products is an incentive for private sector to involve in rubberwood utilization that also benefits farmers through increased demand for rubberwood.

Other forms of incentive that may positively affect interest of private sector in rubber planting business and in rubberwood processing and trading are highlighted below:

i) Simplification of wood accounting system to reduce transaction costs. The costs are reduced because of less paper work, more simple procedures and fewer administrative requirements. This is a strong enabling incentive that benefits both owners and processors of rubberwood;

ii) Generation and dissemination of information on old plantations to be replaced would help wood processors develop a realistic rubberwood supply schedule. Knowing the exact site of replacement, its size as well as harvestable wood volume and accessibility will allow estimation of rubberwood price at mill gate. This is a strong, enabling, empowerment-based incentive that benefits the local economy as a whole;

iii) Provision of technical assistance to clone producers will help ensure quality of clone that meets the standards required by supervising authority. In addition, trained producers would be able to perform production process in an efficient manner thus lowers production cost. This is an empowerment-based incentive that benefits both producers and buyers of rubber clone;

iv) Deregulation of clone certification producers that includes moving the place from provincial to district level closer to farmers and reducing the number of authorities involved in the
process to only one authority will surely reduce the certification cost thus clone price. This is a sectoral variable incentive; and

v) Development of favorable business environment through implementation of appropriate policies will surely attract private sector to get involved in rubberwood business especially in the processing of logs and trading of processed products. This is a macro-economic, variable incentive that benefits the regional and national economies.

4.6 Achievement of the output

Achievement of Output 2 was assessed in light of the indicators defined in the logical framework matrix of the project document as shown in Table 6. Overall, it can be stated that Output 2 has been achieved. Indeed, the total size of agro-forestry models established was only 14 ha, smaller than the target of 20 ha. This reduced size was dictated by local conditions; it was difficult to locate old rubber plantations at the size of 5.0 ha or larger that were ready for replacement and easily accessible for purpose of effective monitoring and conduct of training as initially planned to doing.

Table 6. Pre-defined indicators of output vs actual achievement

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Achievement</th>
<th>Remark</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Feasibility of utilizing farmers’ rubberwood in 4 districts collaboratively assessed with owning farmers in years 1 &amp; 2</td>
<td>• Feasibility of utilizing farmers’ rubberwood assessed in collaboration with farmers&lt;br&gt;• Harvestable volume of wood from old plantations estimated using purposive sampling method</td>
<td>Fully achieved</td>
</tr>
<tr>
<td>2.</td>
<td>Needed incentives for replacing old rubber plantations by farmers identified in 4 districts in years 1 &amp; 2</td>
<td>• Selected farmers at 12 villages of four districts interviewed regarding needed incentives for replacement of old rubber plantations&lt;br&gt;• Intensive consultation with the same farmers conducted to obtain information on constraints to and requirements for replanting</td>
<td>Fully achieved</td>
</tr>
<tr>
<td>3.</td>
<td>Models of rubber replanting with agro-forestry system established at 4 sites totaling 20 ha</td>
<td>Agro-forestry models established at 4 sites totaling 14 ha in size</td>
<td>Nearly achieved</td>
</tr>
<tr>
<td>4.</td>
<td>At least 80 farmers trained on techniques for harvesting of old trees and agro-forestry system, respectively, in 4 districts in years 1 &amp; 2</td>
<td>• Training on harvesting skills conducted at 4 sites with 80 participants&lt;br&gt;• Training on agro-forestry techniques conducted at 4 sites with 87 participants</td>
<td>Fully achieved</td>
</tr>
</tbody>
</table>
5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

i) Potential benefits of an old rubber plantation to be replaced are strongly influenced by features of the plantation especially as regards volume of harvestable timber and hauling distance to mill gate:
   - Potential net revenue varied between USD 218/ha in Batang Hari district and USD 1,194/ha in Ogan Ilir district under the mill gate delivery scenario; and
   - Potential net revenue is much smaller by selling at stumpage, ranged from USD 158/ha in Batang Hari district to USD 451/ha in Banyuasin district.

ii) The average establishment cost of rubber plantation was estimated at USD 1,438/ha; the potential revenue from selling rubberwood could not cover the establishment cost that external assistance has to be sought for by farmers.

iii) The farmers consulted were skeptical of the likelihood for realizing the potential revenues for two main reasons: i) selling rubberwood either at mill gate or at stumpage is enjoyed only by a few farmers as most plantation sites are not accessible due to poor road network in terms of quality and intensity, and ii) mill gate price is dictated by buyers due primarily to the lack of farmers’ resource for harvesting operations.

iv) The main constraints to replacing old rubber plantations faced by farmers were:
   - Establishment cost of rubber plantation is too large to be shouldered by farmers alone without external assistance as revenue from selling rubberwood covers only a small fraction of the establishment cost;
   - Replacing old rubber trees meaning losing income from latex for four to five years and livelihood is jeopardized during this no-latex production period;
   - Selling price of rubberwood is very low due mainly to poor accessibility and poor wood quality; harvestable wood on plantations that have no access for trucking is practically not marketable thus generates no income to owning farmers;
   - Obtaining soft loan to support replanting is problematic because farmers only have letter of land authentication issued by village administration that is not acceptable as loan collateral by local banks; and
   - Slash and burn method normally used by farmers in the past to ease land preparation is now banned by the government without introducing any inexpensive, comparably effective alternative method.

v) The basic requirements for replacement of old rubber plantations by farmers were removal of existing constraints namely provision of assistance in the forms of subsidy, soft loan, etc., generation of income stream during the no-latex production period, development of road network to plantation sites, simplification of procedures and requirements for obtaining soft loan, and
development of applicable, inexpensive land clearing method in place of the already banned slash-burn method.

vi) Knowing that envisioned agro-forestry model is an income generating means, farmers at all project sites were enthusiastic with model development that locating lands for demonstration was actually not a problem. Constrained by the project resource, agro-forestry model was successfully established in collaboration with land owners and farmer trainees. The agro-forestry model, totaling 14 ha in extent, was successfully established at four sites although at slightly smaller total area than the target of 20 ha.

vii) The training on agro-forestry techniques, attended by 87 farmers, demonstrated the designing of agro-forestry model, land preparation, spacing and hole digging, fertilization, and planting techniques. The training took a longer duration than originally planned due mainly to availability of farmers to attend the demonstration.

viii) Training on harvesting techniques was successfully accomplished with 80 participants, mostly were the farmers who took part in the agro-forestry training. The trainees were taught on how to operate a chainsaw, do properly the felling and bucking, and identify log yard sites. After the training, the farmers should now be able to do jobs relating to land clearing and logging.

ix) Among the main forms of direct and indirect incentive identified in close consultation with farmers, wood processors and concerned authorities were:

• Development of road network to plantation sites with poor accessibility in order to increase the economic value of rubberwood that proceeds from selling wood can cover larger proportion of establishment cost;

• Reduced price of rubber clone through deregulation of clone certification procedures and through technical training of clone producers to ensure production of quality clone in a cost efficient manner;

• Simplification of the requirements and procedures for obtaining soft loan from local banks to support establishment of plantations by farmers;

• Continuation of training on agro-forestry techniques to increase land productivity and generate intermediate income stream during the no-latex production period; and

• Provision of incentive for wood processors to increase involvement in rubberwood utilization through effective dissemination of information on old plantations to be replaced, simplification of wood accounting system and deregulation of procedures for investment in rubberwood utilization.
5.2 Recommendations

Findings of the project indicated that utilization of rubberwood by farmers from replanting areas is indeed limited due primarily to the lack of interest in replacing old rubber plantations caused by different forces. The project had introduced only limited forms of incentive that should have contributed to raising interest of farmers in replacing old plantations and in utilizing rubberwood from replanting areas. In order to preserve the already created interest under the project and consistently strengthen it, following are recommendations made by the project based on its findings.

i. Many rubber plantation sites are not accessible due to poor and limited road network causing very low economic value of rubberwood; concerned local governments have to allocate resources for road construction to induce participation of market in rubberwood utilization. This is the form of incentive that rubber farmers need most of all.

ii. Replacing old trees means loss of income from latex selling for 4-5 years to most farmers. To secure income during this no-latex selling period, application of agro-forestry system in replanting initiated under the project needs to be fortified and expanded to other localities.

iii. As farmers were found supportive of the agro-forestry system, training on its application needs to be strengthened and expanded focusing more on proper cash-crops inter-planting to ensure high quantity and quality of yields thus income of farmers.

iv. Rubber clone is one of the essential inputs to establishing rubber plantation yet costly for farmers to buy. Concerned authorities should strive to make price of clone affordable to farmers by deregulating the clone certification process and providing technical assistance to clone producers.

v. Concerned authorities should seriously facilitate dissemination of reliable information on replacement of old plantations as such information will attract the attention of wood industry to utilize rubberwood from replanting areas.

vi. The provincial and local governments need to provide incentive for farmers in the forms of subsidy, soft loan, etc.; such incentives will certainly raise the interest of farmers in replacing old plantations because the establishment cost of plantation is too heavy for them to shoulder alone.

vii. Training on harvesting techniques needs to be continued and expanded; trained farmers will be able to expand job opportunity beyond the latex production related activities especially during the no-latex selling period.

viii. The governments need to provide attractive incentives for wood processors in order to strengthen their interest in rubberwood utilization by implementing appropriate policies in view of creating favorable business environment, e.g. simplification of wood accounting system and procedures for investment.
6. IMPLICATIONS FOR PRACTICE

Following are among the important practical implications of the project findings:

i. The rate of utilization of rubberwood on replanting areas is strongly affected by accessibility of plantation sites. As road construction is indeed costly yet essential for rubberwood utilization and regional economic development in the long-run, government at different levels have to allocate sufficient resources for construction of road network focusing on the areas where rubber plantations are concentrated.

ii. Various authorities at different levels of government are involved in one way or another in road construction undertaking; to support decision making and resource allocation, it is best to have a high level, powerful law such as a presidential decree or instruction to be used as the legal basis by all concerned authorities in taking concrete action.

iii. The different forms of incentive identified under the project need follow-up actions for which relevant district government policies need to be formulated and implemented.

iv. The farmers were found enthusiastic with the agro-forestry model introduced under the project that wider application of the system is socially and technically feasible; a sound training program on the expansion of agro-forestry techniques needs to be develop and implemented by concerned authorities.

v. Application of agro-forestry system, especially in the context of rubber plantation development, is limited in Jambi region; the information on the potential benefits of the system for livelihood of farmers during the no-latex selling period needs to be intensively disseminated by concerned local government authorities.

vi. Damaged of rubber tree boles due primarily to improper latex tapping techniques has resulted in low price of rubberwood; a sound training program on latex tapping needs to be developed and widely implemented by the authorities of crop-estates at the district level.
Selected references


ITTO Pre-project PPD 80/03 Rev. 2 (I). 2005: Promoting the utilization of rubberwood from sustainable sources in Indonesia. Completion Report, prepared by PHJ Nainggolan, Published by ITTO and ISWA, Jakarta.


