Technical Report No. 5

Project ITTO PD 523/08 Rev. 1 (I)

Operational Strategies for the Promotion of Efficient Utilization of Rubberwood from Sustainable Sources in Indonesia

"Developing Appropriate Technologies for the Utilization of Farmers' Rubberwood in Jambi and South Sumatra Provinces"

(Report on the implementation of the activities pertaining to Output 5)

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 Oeganization (ITTO)

Jakarta, July 2013

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(Report on the implementation of the activities pertaining to Output **5**)

Prepared for the Project by:

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and

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Project Title	:	Operational Strategies for the Promotion of Efficient Utilization of Rubberwood from Sustainable Sources in Indonesia
Serial Number	:	**PD 523/08 Rev. 1 (I)**
Executing Agency	:	Directorate General of Forestry Enterprise Development (BUK), The Ministry of Forestry of Indonesia Manggala Wanabakti Forestry Center, Block I, Floor 5 Jl. Gatot Soebroto, Senayan, Jakarta Phone: 62-21 5730379
Collaborating Agency	:	Indonesian Sawmill & Woodworking Association (ISWA) Manggala Wanabakti Forestry Center, Block IV, Floor 8, Wing C Jl. Gatot Soebroto, Senayan, Jakarta Phone: 62-21 5746336
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Budget	:	ITTO	US$ 605,094
		Disbursed amount	US$ 449,040
		GOI/ISWA	US$ 302,700
		Total	US$ 907,794

Project Key Personnel:

- Mr. Jimmy Chandra, Project Coordinator
- Dr. Hiras P. Sidabutar, National Expert
- Ms. Diah Herlinawati, Project Secretary
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List of abbreviation

BUK	:	Forestry Products Development
CPTRD	:	Center for Processing Technologies Research and Development of FORDA
IDR	:	Indonesian Rupiah
ISO	:	International Standard Operation
ISWA	:	Indonesian Sawmill & Woodworking Association
ITTO	:	International Tropical Timber Association
FORDA	:	Forestry Research and Development Agency
MDF	:	Medium Density Fibreboard
NGO	:	Non-government Organization
PMT	:	Project Management Unit
PSC	:	Project Steering Committee
R & D	:	Research & Development
USD	:	United State Dollar

Table of contents

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 “Appropriate technologies are available for the utilization of rubber wood from smallholding plantations.” In order to deliver this output, four activities had to be implemented, namely : 1) to identify alternative technologies and select most promising alternative, 2) to procure, install and pilot test equipment and facilities for sawing, peeling, chipping and kiln-drying, 3) to publish and disseminate information on pilot-tested technologies and conduct two trainings for rubber growers, investors and local government staffs, and 4) to develop a R & D program on rubber wood resource utilization in collaboration with main stakeholders. The information generated under these activities was to be used as a motivating and convincing tool for owners of rubber plantations in the utilization of rubberwood originating from their old, unproductive plantations.These activities has been fully implemented in a collaborative manner involving the national consultants, project beneficiaries and partners. The assistance accorded by PT Jaya Cemerlang Industry greatly helped the successful execution of Activities 5.1 and 5.2.

Under activity 1, a set of multi-ripper sawing machineries were selected for purchase using pre-specified criteria developed by the consultants in close consultation with the Project Coordinator. Under Activity 2, the machineries were imported from China, installed and tested at the factory site of PT Jaya Cemerlang Industry in Tangerang. It was found that the machineries performed satisfactorily in terms of simplicity of operation and productivity. The installment and operational testing were assisted by experienced technicians of PT Jaya Cemerlang Industry. Under Activity 3, 37 representatives of rubber farmers, wood industries and government institutions from Jambi, West Java and Banten provincves were trained on the use of the machineries. In addition, farmers in Jambi and South Sumatra provinces had been trained on techniques for rubberwood preservation using simple method and inexpensive, locally available materials and tools, and on charcoal making using modified drum-kilns system. In total, 194 farmers participated in the trainings, 80 in wood preservation and 114 in charcoal making. Under Activity 4, a R & D program had been prepared and reviewed involving the main stakeholders. Revised draft R & D program will be shortly submitted to concerned research institutions to be used as inputs to the planning of their respective R & D programs on rubberwood utilization.

Judged using the modified version of indicators defined in the logical framework matrix, Output 5 of the project may be declared as fully achieved.

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" had been implemented by Directorate General of Forestry Enterprise Development (BUK) of the Ministry of Forestry of Indonesia in collaboration with the Indonesian Sawmill and Woodworking Association (ISWA) from May 2010 to April 2013. The project addressed the problems facing rubberwood utilization in Indonesia which had resulted in inefficient use of rubberwood resource and meager wood supply to the forest industries. Its specific objective was to promote the utilization of rubberwood from sustainable sources, i.e. from replacement of old, unproductive rubber plantations or from replanting areas.

The key problem addressed "very low rate of utilization of rubberwood resource" was presumed as caused by five forces, namely: i) lack of interest in the utilization of rubberwood by rubber companies, ii) lack of incentives for farmers and their capacity to utilize rubberwood they own, iii) weak government policy,iv) lack of investment in rubberwood utilization, and v) lack of appropriate technologies. Correspond to these forces, five outputs had been defined for delivery in order to realize the specific objective**:**

- Output 1 **:** Interest in the utilization of rubber wood owned by big companies increased
- Output 2 **:** Incentives for and capacity in the utilization of wood from farmers' plantations improved
- Output 3 **:** Government policy governing rubber wood resource utilization revised and enhanced
- Output 4 **:** Investment in rubber wood utilization increased
- Output 5 **:** Appropriate technologies are available for the utilization of rubber wood from smallholding plantations

1.2 Project identification

The project was built on findings of ITTO-assisted pre-project PPD 80/03 Rev. 2 (I) entitled "Promoting the utilization of rubberwood from sustainable sources in Indonesia" which are outlined below**:**

- The total area of rubber plantation in Indonesia in 2005 was around 3,37 million ha, distributed in Sumatra Island 2,38 million ha (71 %), Kalimantan Island 0,83 million Ha (25 %) and other islands 0,16 million ha (4 %).
- In terms of ownership, bulk of plantations, 2.88 million ha or 86%, were owned by smallholders or farmers and 0.49 million ha or 14% by state-owned and private big companies.
- The smallholding plantations were normally not well managed, highly fragmented with area less than 5 ha per owner, poor accessibility, low production of latex and limited replacement of old trees thus harvesting of wood. In contrast, the large scale plantations owned by big companies were well managed with high accessibility, area of individual blocks averaging well above 500 ha, with high yield of latex and well scheduled replacement of old plantations.
- The big companies commonly replace plantations at 25 years of age; applying this replacement age nation-wide, the rate of replacement or replanting would be around 134.892 ha per year, 116.000 ha by smallholders and 18,892 ha by big companies.

- Based on the measurement of 30 sample plots in Sumatra and Kalimantan, it was found that the average volume of wood biomass in Sumatra and Kalimantan was 240 m^3 and 200 m^3 per hectare, respectively. Therefore, around 30.81 million m^3 of wood biomass was harvestable per year in Indonesia of which around 13,5 million m^3 were saw logs having average diameter of 20 cm and up and the balance in the form of small sized wood.
- Out of the 13.5 million m^3 of saw logs, only 2,96 million m^3 or 22 % had been utilized so far, mostly originating from large scale plantation, for sawn wood and veneer and only a tiny amount of biomass had been used in Medium Density Fibreboard (MDF) making in Sumatra island.

The pre-project documented that the extremely low rate of rubberwood resource utilization was caused mainly by: i) lack of interest in the utilization of rubber wood owned by big companies; ii) lack of incentive and capacity in the replacement and utilization of old trees by smallholders; iii) weak government policy on rubber wood utilization; iv) lack of investment in rubber wood utilization mainly due to poor accessibility and unavailability of reliable information in terms of quantity, quality and distribution of resource; and iv) unavailability of appropriate technology for commercial utilization of rubber wood on smallholding plantations.

This report concerns only with Output 5 and its pertinent activities as listed below**:**

- Activity 5.1 **:** To identify alternative technologies and select most promising alternative
- Activity 5.2 **:** To procure, install and pilot test equipment and facilities for sawing, peeling, chipping and kiln-drying
- Activity 5.3 **:** To publish and disseminate information on pilot-tested technologies and conduct two trainings for rubber growers, investors and local government staffs
- Activity 5.4 **:** To develop a R & D program on rubber wood resource utilization in collaboration with main stakeholders

How these activities were implemented and to what extent Output 5 had been achieved are all this technical report is about.

1.3 Organization of the report

The second part of the report briefly presents the methodologies applied in implementing planned activities. Results of the activities are described in the third part and discussed in part four. The conclusions drawn and recommendations made are presented in part five while implications for practice are presented in the last part of the report. This report is organized in accordance with the ITTO Manual for project monitoring, review, reporting and evaluation, third edition, 2009.

2. APPLIED METHODOLOGIES

The methodologies applied in the execution of the activities pertaining to Output 5 are briefly described below**:**

i. Activity 5.1: To identify alternative technologies and select most promising alternative

- Selection of processing technologies was accomplished with the assistance of a national consultant, i.e. Mr. Barly of Forestry Research and Development Agency (FORDA) with the prior expressed approval of ITTO, also with the involvement of Mr. Subarudi of FORDA.
- The selection process involved literature search and peer consultation and development of selection criteria.
- The criteria employed included**:**
  - Affordability **:** refers to price of chosen equipment; it must not be too expensive for small investors to afford
  - Suitability **:** that chosen equipment must be suitable for processing of rubberwood
  - Simplicity **:** chosen equipment must be easy to operate and maintain
  - Applicability **:** chosen equipment must be applicable to specific operational environment
  - Availability **:** the machineries chosen must be available in the markets
  - Sustainability **:** operation of the machineries chosen must be sustainable because parts are readily available
  - Universality **:** the machineries chosen should be universally accepted or acknowledged; therefore, they must be produced in compliance with published standards of ISO

ii. Activity 5.2: To procure, install and pilot test equipment and facilities for sawing, peeling, chipping and kiln-drying

- The machineries chosen were procured through importation from China in accordance with existing importing procedures of the Government of Indonesia.
- Installment of the machineries was accomplished by the national consultants with the assistance of experienced practitioners.

iii. Activity 5.3: To publish and disseminate information on pilot-tested technologies and conduct two trainings for rubber growers, investors and local government staffs

- Information on the basic technological features of the chosen machineries was prepared by the national consultants based on the technical specifications published by the manufacturer.
- Two training sessions on the machinery operations were organized, targeting 40 participants representing rubber growers, investors and government staffs. Recruitment of trainees was accomplished through consultation with Forestry Agencies, association of wood industries and rubber farmer groups.

iv. Activity 5.4: To develop a R & D program on rubber wood resource utilization in collaboration with main stakeholders

- R & D program on rubberwood resource utilization was prepared in collaboration with the national consultants of FORDA.

- Draft R & D program was prepared under the project, discussed in depth with competent experts, scientists, academicians and practitioners.
- Improved R & D program is to be submitted to FORDA to be used as inputs to developing mid to long-term program on R & D of rubberwood resource utilization.

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3. PRESENTATION OF FINDINGS

3.1 Activity 5.1

Through literature search, peers consultation and employment of pre-specified selection criteria, the rubberwood processing machineries initially selected and actually purchased by the project are listed below**:**

Table 1. The rubber processing machineries purchased under the project

Model	Description	Quantity	
		Planned	Purchased
LS-1420	Round Log Multi-Rip Saws	1	1
LS-1430	Round Log Multi-Rip Saws	1	1
LS-60A	Fluctuation Multi-Gear Saws	1	1
	Log Truncation Saws	1	1
	Veneer Remove Saws	2	2
	Single Planing Machine	4	4
50	Veneer Crusher Machine	1	1
	Easy Table Saws	4	4
	156mm Spreading Machine	4	-
MTL SAWBLADE	280*40*3.0*24TWith Scraper	32	32
SPARE CHAIN	Special Chain For LS-1420	2	-
SPARE CHAIN	Special Chain For LS-1430	2	2
SPARE TRAY	Special Tray For LS-1420	2	2
SPARE TRAY	Special Tray For LS-1430	2	2
	Glue Spreader For 156mm	100	-

Due primarily to the escalating price fixed by the manufacturer, some items were not purchased or reduced in quantity. The equipment dropped were: 4 units of 156 mm spreading machine and 100 units of glue spreader while the quantity reduced was of the special chain from 4 to 2 units only.

The total price of the equipment actually purchased was initially quoted by the supplier at USD 33,148.06, CIF; the actual price paid at delivery was USD 40,073.00 or an increase by USD 6,924.94.

3.2 Activity 5.2

Supplier of the chosen machineries was Ruima Cutting Tools Co. Ltd. of Guangdong province in China. Importation of the machineries encountered no problem due mainly to the assistance of PTJaya Cemerlang Industry having years of experience in importing business.

The machineries were installed at the factory site of PT Jaya Cemerlang Industry occupying around 1,000 m^2 of concrete floor. The task was accomplished by experienced technicians of PT Jaya Cemerlang Industry, namely Mr. Ngadiono and Mr. Paryanta in close consultation with Mr. Jimmy Chandra, the Project Coordinator, and the national consultants.

It was initially planned to install the machineries at one factory of ISWA member companies in Jambi but was found not feasible thus had to be transferred to another site with the prior approval of the PSC. Operation of installed machineries entails significant costs particularly for payment of

manpower, utilities and maintenance; then, no ITTO member company in Jambi was ready to shoulder such costs. Consequently, the machineries were installed at the factory site of PT Jaya Cemerlang Industry in Tangerang, West Java mainly for reasons below**:**

i. PT Jaya Cemerlang Industry was prepared to shoulder installation, operation and maintenance costs of the machineries,

ii. The installed equipment is basically for purpose of demonstration and training whilst the host company is strategically located for the purpose, and

iii. Training participants can be mobilized from different regions of the country and reach PT Jaya Cemerlang Industry conveniently.

The operational testing of the machineries was undertaken by the aforementioned professionals whom had encountered no significant technical problems. The testing was accomplished using rubber logs obtained from nearby farmer's rubber plantation in Banten province. By using rubber logs as the testing material, suitability and applicability of the machineries were technically assessed. It was found during the testing process that suitability and applicability of the machineries were satisfactory.

3.3 Activity 5.3

The technical information on the chosen machineries was prepared by the national consultants based on the technical specifications published by the manufacturer. Such information was handed over to the trainees during the course of training sessions. Among the strengths of the multi-ripper sawing technologies introduced under the project are:

- Sawing is highly productive with the simultaneous operation of several saw blades in one round or push,
- Dimension of sawn timber can be controlled by setting up the distance between saw blades to produce desired thickness of lumber,
- Sawing operation is controlled by an intelligent computerized program that is easy to operate, and
- Sawing of curving logs can be efficiently accomplished using the fluctuation multi-gear saws controlled by a computerized program.

Rubber logs to be sawn

Logs cutting machine

Computer controlled log sawing

Multi-ripper sawing in progress

Result of multi-ripper sawing

Multi-ripper edge cutting machine

Results of multi-ripper edge cutting

Implementation of the training was fully assisted by the national consultants. Training on the use of sawing machines had been organized in two sessions. The first session was conducted on 10-11 July 2011 with 19 participants; the second session was implemented on 25-26 June 2012 with 18 participants. Therefore, a total of 37 participants representing rubber farmers, wood industries and government staffs had been trained on skills for using the sawing machineries. The implementation process of the trainings is elaborated below**:**

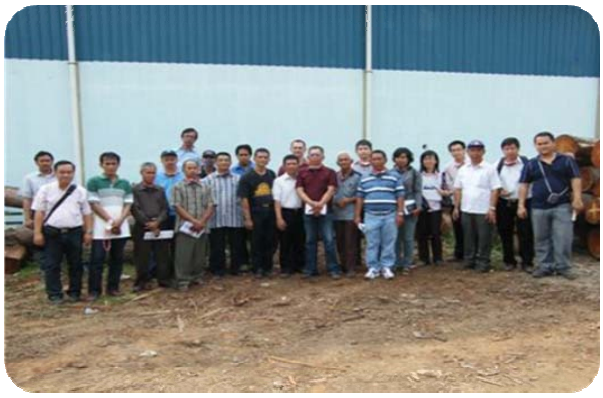
Objective of the training

- To get acquaintance with individual machines and their respective functions
- To identify performance of the machines

- To assess wood recovery and cost of sawing, and
- To evaluate outcome of the training

Training participants

- The first training session was attended by 19 participants comprising representatives of ISWA (2 persons), Jambi Provincial Forestry Agency (3 persons), forest industries (12 persons) and rubber farmers (2 persons); accidentally, all participants were originating from Jambi province.



First batch of training participants from Jambi province

- The second batch of trainees were 18 in number and comprised representatives of district government staffs (14 persons), rubber farmers (2 persons) and forest industries (2 persons); the participants originated from Banten and West Java provinces.

Second batch of training participants from Banten and West Java provinces

The subjects covered

- Supply potential of rubberwood in Indonesia on a sustainable basis, class room lecturing
- Salient features and basic characteristics of rubberwood as relate to its processing workability, class-room lecturing
- Sawing techniques, demonstration
- Protection and preservation of logs and sawn-timber, demonstration
- Seasoning and kiln-drying, observation
- Quality control, observation
- Economic implications of rubberwood processing, class room lecturing

- Marketable rubberwood processed products, class room lecturing and
- Criteria for selection of appropriate processing technologies, class room lecturing.

The training strategy pursued

- Most of the subjects were presented in class-room as specified above


Class-room lecturing on log sawing by the national consultants

- Selected subjects such as sawing techniques, seasoning & kiln-drying and quality control techniques were accomplished through demonstration of installed machineries and direct observation of wood processing by PT Jaya Cemerlang Industry.

Demonstration of sawing-related techniques

- Trainees of each session were divided into 3 groups
- Each group was given 8-10 pieces of log comprising tapered, straight and curving logs
- Each group was to measure volume of the logs
- Trainees were assisted in sawing the logs using the installed machines
- Trainees were to measure volume of sawn timber and calculate wood recovery rate
- Trainees were exposed to seasoning and kiln-drying as well as protection and preservation activities being carried out by the host company
- Quality control techniques were elucidated during the above processes.

Teaching of participants on how to measure productivity and assess wood recovery of sawing machines was among the training objectives. The trainees recorded that the production capacity of the machines was around 8 m^3 of log intake per shift. The wood recovery documented was**:**

- Straight logs to planks **:** 72.55%
- Tapered logs to planks **:** 41.80%
- Tapered logs to squares **:** 63.11%
- Truncated logs to planks **:** 32.20%

The experiments on using the chosen machineries at PT Jaya Cemerlang Industry indicated that estimated total production cost was IDR 1.25 million/m^3; at selling price of IDR 1.50 million/m^3 the operating margin was IDR 250,000/m^3. The estimate was derived under the assumptions that mill-gate price of rubber log was IDR 400,000/m^3 and plank recovery rate of 40%. The estimated level of margin was certainly attractive to investors. Considering the magnitude of required investment, however,

employment of the machineries tested is suitable only for medium-scale operators. It is worth emphasizing that the estimate of production cost derived is at best preliminary in nature. Further cost study is still needed to ensure accuracy of production cost estimate.

Aside from the sawing-related techniques as described above, the appropriate technologies that also introduced under the project were: rubberwood preservation and charcoal making techniques; following are highlights of training on the technologies.

a. Rubber wood preservation techniques

Training on wood preservation was designed for farmers in view of increasing the economic value of rubberwood they own. Fresh rubberwood, in the form of logs or sawn-timber, is known to be prone of blue stain and ambrosia beetles attacks that may significantly down grade wood quality, reduce selling price; worst is that damaged wood is of limited use or useless thus priced by buyers very low or not marketable at all. Therefore, there is an obvious need for farmers to acquire simple and in-expensive preservation technology for preventing quality down grade caused by pest and disease attacks.

The objectives of the training therefore, were**:**

- To provide information on the need to preserve quality of rubberwood by farmers
- To identify types of preservative materials suitable for rubberwood yet inexpensive and easy to apply
- To demonstrate the preservation techniques, and
- To evaluate outcomes of the activity

The training was conducted in four sessions, each with 20 farmer participants or a total of 80 trainees. The training sessions were organized at four sites, namely Rantau Kapas village in Batanghari district, Bukit Baling village in Muaro Jambi district, Petaling village in Banyuasin district and Payaraman village in Ogan Ilir district. The first two disticts are located in Jambi provinces and the latter two districts are located in South Sumatra province.

Participants of training on rubberwood preservation

Each training session was organized in two steps: the first step was for information sharing and the second one was for demonstration. During the first step, the farmers were exposed to kinds of pest and disease that are fond of attacking rubberwood, where and when the attacks may take place,

damages resulting from the attacks and their implications, and the kinds of material that are suitable for preservative purpose.

Demonstration of preservation techniques was accomplished in the following fashion**:**

Rubber logs to be preserved with simple method

- The preservative materials used in the training were detergent, cleaning or washing liquid under the commercial names of So Kiln, SOS Karbol, Cresol, Wipol and other disinfectants. These substances normally contain around 1.5% of active ingredient and are readily available at local shops. For coating of logs, the liquid was thinned: one part of detergent was diluted to two or three parts by adding clean water

Materials and tools for preservation treatment

- Logs were applied or coated at both ends with thinned liquid using paint brush or dipped into diluted substance; coating was also performed on bole surface where bark was damaged or wood was exposed to fresh air

Dipping log-end in diluted disinfectant

Coating log-end using paint brush

- The piled logs were then covered with plastic sheet to avoid rain washing

Coated logs covered with plastic sheet to prevent rain washing

- The piles were observed once every two days for three weeks to see incidence of attack by blue stain. It was found that logs were preserved between fifteen to twenty days after coating, depending on the concentration applied; the lower concentration prevented logs till fifteen days while the higher concentration prevented logs up to twenty days.

b. Charcoal making techniques

The charcoal production system introduced under the project was the one called “modified drum kiln”. The drum was an ex-lubricating oil container of 200 liters modified by making three air channels on the drum upper cover and perforated at the bottom surface. This system is ideal for small-scale production or for household application. Indeed, the system may also be commercialized by having several drums simultaneously put in operation.

Class-room lecturing on charcoal making techniques by National Consultants

Outdoor lecturing on charcoal making

The complete structure of a charcoal drum kiln

Upper-part of the drum kiln

Positioning of a drum kiln 15 cm above the earth

Piling of chopped wood inside drum kiln

Wood-burnt smoke released to atmosphere

Wood-burnt residual smoke channeled to bamboo pipe

Liquefied smoke collected in a container

Liquefied smoke kept in a plastic bottle

The objectives of the training of farmers on charcoal making using rubberwood as the raw material were to**:**

- Familiarize with the modified drum kiln, its structural components and functions
- Demonstrate techniques for charcoal making covering the kiln positioning, rubberwood chopping, piling of wood inside the drum and charcoal cooking
- Assess on outcomes of the charcoal making process

To familiarize farmers with the kiln, four samples of drum kiln were first produced and exhibited to four villages, one in each district. The exhibition was carried out in such a way with ample time to ensure deep understanding on the drum kiln elements and their functions and to facilitate replication of the kiln at later stage when farmer's need arises

Demonstration of charcoal making techniques was carried out before villagers at four villages as follows**:**

- Drum kiln positioning**:**
  - The kiln must placed at a distance from any building or properties for safety reason
  - The kiln must be positioned at a distance from the earth to allow heating by fuel wood burning

- Rubberwood chopping: small-sized logs, branches or twigs must be chopped that the length is shorter than the drum diameter to facilitate efficient piling
- Rubberwood piling: chopped wood is piled inside the drum on horizontal position up to approximately 75 percent of the drum height
- Charcoal cooking: is performed by fuel wood burning for around one hour
- The charcoal production process was completed in twenty four hours
- On average, 30 kg of charcoal and 8 liters of liquefied smoke were produced from about 100 kg of chopped rubberwood burnt inside the kiln.

The charcoal production system was introduced to help farmers utilize small-sized or wasted rubberwood; the charcoal produced may be for own use or for sale at local market. The system was well acceptable to farmers due mainly to its potential contribution to livelihood and simplicity in operation. In total, 114 rubber farmers had been trained on charcoal production techniques in four districts of concern.

3.4 Activity 5.4

A R & D program on rubberwood resource utilization has been developed under the project with the assistance of FORDA experts. The initial version of the program had undergone reviews by researchers, academes, wood industries and government officials and resulted in a final version whose contents can be summarized as follows**:**

- The first part of the program document, the “introduction” outlines the background information, purposes of developing the R & D program, expected content of the program and its scope as well
- The second part of the document, the “methodology” presents the underlying notions of the R & D program development, data collection techniques and data processing**:**
  - The R & D program developed is problem solving oriented in nature as it is built on observed main problems facing rubberwood resource utilization, namely: i) poor accessibility of farmers’ rubber plantations, ii) low recovery rate of processing, iii) weak incentive for farmers to replace old plantations, iv) poor incentive for wood industries to invest, and v) weak government policy on efficient rubberwood resource utilization.
  - The information on completed R & D works pertaining to the problems facing the utilization of rubberwood was obtained through literature search and interviews with competent individuals involved in such activities.
  - The R & D program on rubberwood utilization had been defined using a gap analysis method: at first, future need for R & D as regards the five problems previously mentioned was conceptualized; secondly, completed relevant R & D works were recorded based on existing reports and documents; thirdly, the R & D program should fill up the gap between the future need for R & D and what relevant R & D works that had been completed.
  - The R & D program has been designed as a general guide for concerned institutions in developing their R & D workplans, not a detailed listing of research works to undertake; in addition, the program is dynamic in essence that updating and modifying are possible to do to accomodate changing environment of rubberwood utilization during the course of program implementation.

- The third part of the document elaborates future R & D on rubberwood utilization under five parameters: accessibility, basic properties of rubberwood, appropriate processing technologies, economies and marketing, and policy and incentive**:**
  - Needed R & D on accessibility includes: investment requirements, economic distance for hauling of rubberwood, feasibility of mobile sawmilling, and feasibility of building processing plants close to farmers' rubber plantations
  - R & D on basic properties of rubberwood focusing on anatomical, physical, mechanical and chemical properties.
  - R & D on appropriate processing technologies centers on machine characteristics and wood recovery of processing, durability and preservative attributes, seasoning or drying properties, physical and chemical modification, and suitability of rubberwood for practical applications
  - R & D on economics and marketing focuses on cost structure of making any products, cost of preservation, cost of marketing as well as cost of plantation establishment as relates to clone, latex yield and wood production
  - R & D on policy and incentive are centered on: impact assessment of any policy on rubberwood utilization and development of an incentive system suitable for promoting the efficient utilization of rubberwood resource.

- The fourth part of the R & D program document presents information on completed R & D works under the previously mentioned parameters, namely accessibility, basic properties of rubberwood, appropriate processing technologies, economics and marketing of rubberwood as well as policy and incentive:
  - Under the accessibility parameter, no information was furnished on completed R & D works
  - Under the wood properties parameter, five publications were listed
  - Under the appropriate processing technologies, some twenty publications on relevant research works were identified
  - Under the economics and marketing parameter, sixteen publications on relevant research works were listed
  - Under the policy and incentive parameter no information on completed R & D works was provided.

- The fifth part of the R & D program document presents the gap between future need for and completed R & D, i.e. the R & D on rubberwood utilization that ought to be undertaken in the mid to long-term, under each of the parameters. A matrix is included and presents the R & D subjects, corresponding problems to be resolved and target of R & D and research works to be undertaken.

- The sixth and final part of the R & D document presents conclusions and recommendations; among the important ones are:
  - R & D on rubber plantation development is to be focused on selection of clone suitable for production of either latex, wood or both; R & D on processing technology should be based on results of R & D on wood basic properties; latex tapping techniques is one determinants of wood quality that requires studies, and; studies on the economics of any products of rubberwood are needed by forest industries.

- Different institutions are involved in R & D on rubberwood utilization; the R & D program developed under the project is strongly advisable to be used as reference in developing R & D workplans of the respective institutions.
- R & D works on rubberwood utilization undertaken by different institutions is best to be coordinated by the Center for Processing Technologies Research and Development (CPTRD) of FORDA to avoid redundancy and ensure productivity and connectivity of research works as well as efficient use of resource.

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4. ANALYSIS OF FINDINGS

4.1 Selection of appropriate processing technologies

The processing technologies selected are for processing of rubberwood by farmers or small-scale processors. The equipment chosen was for demonstration and training purposes. As has been touched upon in the previous section, the criteria employed in the selection of the technologies included affordability, suitability, simplicity, applicability, availability, sustainability and universality of the machineries.

Affordability criterion took into account ability of farmers and small-scale wood processors to invest; expensive equipment should be placed at lower priority. For reason of price affordability, Chinese made machineries had been given top priority for selection. Suitability criterion was included due mainly to the unique basic properties of rubberwood especially in terms of log size and latex content. Simplicity was thought important because intended users were not well-educated operators, but common people like rubber farmers. Applicability refers to ability of the equipment to survive the tropical environment especially the high relative humidity and air temperature and to process small diameter logs. Availability refers not only to the chosen equipment but also its parts to ensure sustainability of operation at least in the mid-term. Universality was included in the criteria to ensure that the equipment purchased is produced by an acknowledged manufacturer thus is safe to operate.

Prior to purchasing the chosen machineries, a visit was made by the Project Coordinator and National Expert to a rubberwood processor in Guangdong Province of China. The main purpose of the visit was to observe first hand how the would be chosen machineries actually performed. The selection criteria were verified, particularly those of suitability, simplicity and universality. The information gathered during the visit had convinced the Project Coordinator to purchase the multi-ripper sawing machineries for purpose of demonstration and training while replicating the technology was considered as very high due primarily to the affordable price, in the order of US $ 30-40,000 for one set of machineries depending on the variety of machine chosen. This price level was much lower than the price offered by western producing countries for a set of machineries of similar function.

Suitability and applicability of processing technologies must also be judged on ground of the products wish to making. This must be so because individual products require different technologies and in turn differentiate level of investment. Rubberwood may be used as the raw material of sawn timber, veneer, finger joints, moldings, chip wood, wood pellet and charcoal. The study by Barly and Subarudi (2011) indicated that the levels of investment for different product lines are as presented in Table 2. The figures in Table 2 clearly indicate that farmers are advisable to focus on producing sawn timber by mobile sawing, chip wood by mobile chipping, wood pellet and charcoal. The required investment for these ventures were estimated at around IDR 100.0 million , IDR 80.0 million, IDR 76.5 million and IDR 25.0 million, respectively. These levels of investment are certainly affordable to rubber farmer groups.

Table 2. Estimates of required investment for different processing technologies

No.	Types of processing	Investment (million IDR)	Appropriateness by business scale		
			Farmers	Small-scale	Medium-scale
1.	Sawmill	1,334.5	x	x	x
2.	Mobile sawing	100.0	√	x	x
3.	Veneer making	1,524.0	x	x	√
4.	Wood preservation	518.0	x	√	x

No.	Types of processing	Investment (million IDR)	Appropriateness by business scale		
			Farmers	Small-scale	Medium-scale
5.	Wood drying	1,184.0	x	x	√
6.	Finger jointing	3,134.0	x	x	√
7.	Molding	1,874.0	x	√	x
8.	Chipping	365.0	√	x	x
9.	Mobile chipping	80.0	√	x	x
10.	Pellet making	76.5	√	x	x
11.	Charcoal making	25.0	√	x	x

Notes:

X = inappropriate, √ = appropriate

The lowest level of investment found was for the processing of charcoal, wood pellet and mobile chipper in the order of US$ 25,000 – 80,000. Indeed, return to investment is highest for finger jointing and molding and lowest for charcoal, wood pellet and chip wood processing.

Concern with the generally weak capacity of farmers to invest, the Project Steering Committee (PSC) at its first meeting on 29 April 2011 had proposed to operate mobile sawmill in the utilization of farmers' rubberwood in order to minimize capital investment yet generate quite reasonable profit margin. To follow up this proposal, extensive consultations with farmers were conducted with the assistance of Komunitas Anak Kampung Non-goverment Organization (NGO). The consultations revealed that mobile sawmill operation was technically not feasible. Recall that most farmers' plantation sites were not accessible due to the absence of access road. A mobile sawmill means that sawing machines must be loaded on a truck to allow movement from one site to another. Under the limited road network, the mobile sawmill could reach only a few plantation sites. For the rest of plantations, rubber logs had to be transported to the site where the mobile sawmill was parked. The moving of logs from harvest sites to the parking spot was problematic. Back-carrying or carrying logs on shoulder for a distance was not in the interest of most farmers and laborers alike. If it was at all possible, the moving cost was quite high, costing around US$ 2-3 per piece of log with a length of 1.8 to 2.0 meter for a distance between 300 to 400 meters. The moving cost of logs could be around US$ 40 – 60/m^3. Assuming a recovery rate of mobile sawmilling at 25 percent, the cost of moving log could reach US$ 160 to 240 per cubic meter of sawn timber which is a considerable cost component.

It was concluded that operation of mobile sawmill was technically and financially not feasible. In response to this situation, the Project Management Team (PMT) had proposed to introduce technology for charcoal production during the second PSC meeting on 22 December 2011. This proposal was favorably responded by the PSC. To follow-up the endorsement of the PSC, charcoal kiln was produced in a greater number of units. Towards end of the project 28 units of charcoal kilns in total had been distributed to 12 villages in all the districts of concern. In addition, 114 farmers from 12 villages in 4 districts had participated in the training on charcoal making. Indeed the farmers were enthusiastic in receiving the charcoal kilns for at least two reasons. First, farmers had acquired the skills for operating the kiln and were able to utilize any size of rubberwood in charcoal making for own use or for sale. Secondly, the charcoal making process also produced a by- product called "liquefied smoke" which was quite useful for accelerating latex coagulation and reduce the sting smell of rubber slabs.

4.2 Transfer of appropriate processing technologies

With respect to transfer of technology, the trainings that were implemented under the project included use of stand-still sawing technology, preservation of rubberwood and production of charcoal. The training on use of multi-ripper sawing had been conducted in two sessions in Tangerang at the factory site of PT Jaya Cemerlang Industry; 37 participants representing the wood industries, rubber farmers and staffs of forestry institutions had acquired the knowledge and skills for operating the machineries. Considering the level of capital investment required for the processing machineries, in the order of US $ 30 to 40,000, the technology was quite attractive to small-scale processors which could be groups of rubber farmers or existing wood industries. In this light, promotion of the technology needs to be continued after project completion. How this training will be organized needs to be defined by BUK and ISWA in terms of responsible institution and, more importantly, sources of funding to finance the activity.

As regards program on preservation of rubber logs, the technology introduced was quite simple and in-expensive. It was found that farmers were interested in the technology and so were the wood industries. Indeed, the technology is a value adding means by preventing quality down grade of fresh logs or sawn timber for around two to three weeks. It was found that inexpensive substances available at local shops were able to preserve log quality up to three weeks depending on the concentration of the preservative substance applied. This finding was indeed encouraging for farmers. In fact, this free of damage period can be further extended by using better quality preservative materials like those listed in Table 3. Previous studies indicated that proper application of the substances listed in Table 3 could prevent blue stain up to thirty days. Application of those substances, however, is not advisable for farmers for two simple reasons: the substance is much more expensive and technically complicated to apply compared to using detergent as described earlier.

Table 3. Better quality preservative materials for rubberwood

No.	Active ingredient content	Concentration (%)	Object
1.	Metilin bis tiosianat (MBT) 100g/l	2 – 4	Blue stain
2.	MBT 109,9 g/l, tio sianometil tio benzotiazol (TCMBT) 108,7 g/l	1 – 3	Blue stain
3.	MBT 48 g/l, dialkil dimetil ammonium khlorida (DDAC),149,9 g/l; alkil dimetil ammonium khlorida (ADAC),104,9 g/l	2 – 4	Blue stain
4.	Azakonazol 200 g/l, karbendazim 131,131 g/l	1 – 2	Blue stain
5.	MBT 108 g/l	1 – 2	Blue stain
6.	MBT 100 g/l, TCMTB 100 g/l	1,5 – 2	Blue stain
7.	MBT 100 g/l, TCMTB 100 g/l	1,5 – 2	Blue stain
8.	Kalium-0-fenil fenol 422,3 g/l	2 – 4	Blue stain
9.	MBT 97 g/l	1,5 – 2	Blue stain
10.	MBT 84 g/l, 4(1 metil-1-feniletil) fenol 105 g/l, 4 khlorfenil-3iodo propagil formal 10,5 g/l	2 – 4	Blue stain

Source: Komisi Pestisida (2003) in Barly & Krisdianto (2012)

Use of the preservation technology may be of limited at present, but is expected to be increasing when harvest of old rubber trees is expanding. In anticipation of expanded harvest in future time, such technology transfer needs to be continuously organized after project completion. Institutional and funding arrangements need to be made for this purpose.

The charcoal making technology using modified drum kiln was well received by farmers as it directly affects livelihood. The fabricating cost of such kiln is quite in-expensive and must be affordable to farmers to undertake, it was around US $ 100 per unit in 2011-2012. While the fabricating cost is not so much a problem, there is a need to continue providing assistance to farmers through distribution of more kilns and training on their use in order to take advantage of the already created momentum. Again, institutional and funding arrangements need to be defined for the purposes.

4.3 R & D Program on rubberwood utilization

The R & D program developed under the project was based on a gap-analysis technique. Future R & D need was indentified correspond to five main problems facing the rubberwood utilization observed in the provinces of South Sumatra, Jambi and North Sumatra. Future R & D need was assessed qualitatively and future direction of R & D were defined; corresponding R & D works that had been undertaken to date by the different research institutions was assessed by listing the relevant publications; the gap between future R & D need and completed relevant R & D works was defined as the relevant R & D program. Such a program provides elements of R & D that ought to be carried out in the mid-to long-term. The program does not list individual R & D activities to undertake.

Appropriateness of the R & D program developed in the fashion as described above is certainly, to a greater extent, dependent on the accuracy of the scope and direction of future R & D defined. In general, the direction and scope of future R & D had been defined correspond to the prevailing problems on rubberwood utilization that were identified during the occasions of the workshops held under the project. The weakness of the R & D program might lie in the listing of the relevant completed R & D works that surely affects the gap size of R & D to be carried out. It appears that the listing was inadequate for two parameters, namely the accessibility as well as the policy and incentives. This inadequate listing might be due the limited resources, especially working time, available to the national consultants. It is therefore strongly recommended that the listing is improved prior to developing R & D work plans for accessibility as well as for policy and incentive studies in order to minimize unnecessary redundancy and overlap.

The R & D program developed under the project was meant to be used as inputs by concerned research institutions in developing their respective R & D work plans for rubberwood utilization. To avoid redundancy and overlap of activities, coordination amongst the institutions is a big challenge. It is strongly recommended that the R & D Center for Forest Products Technology of FORDA to assume coordinative function for which a coordinating mechanism needs to be developed by concerned institutions.

4.4 Achievement of Output 5

Achievement of the output was assessed using the indicators defined in the Logical Framework Matrix (LFM) presented in the project document. To be realistic, the original indicators, however, had been somewhat modified based on the progress in implementation of activities with the endorsement of the PSC during its third meeting on 16 May 2012.

- Indicator 1 : One set of equipment and facilities for sawing procured and pilot tested in Tangerang, West Java

  This indicator has been satisfied; the sawing equipment and facilities had been procured as listed in Table 1 and operationally pilot tested by the national consultants and experienced practitioners at PT Jaya Cemerlang Industry's factory site in Tangerang.

- Indicator 2 : 3 technical manuals on rubberwood processing published and disseminated by end of project

  This indicator has been fulfilled; three technical manuals had been published and disseminated; i.e. technical manuals on rubber preservation, on charcoal making and on rubberwood engineering for housing construction.

- Indicator 3 : Two training workshops on appropriate technologies with 40 participants conducted at one site in Tangerang in years 2 & 3

  The indicator has been met; two training sessions on the operation of multi-ripper sawing machineries had been completed with 37 participants, 92.50 percent of the target.

As all three defined indicators have been satisfied through the full execution of four pertinent activities, it is reasonable to conclude that Output 4 has been practically fully achieved.

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5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Following are the important conclusions drawn from the implementation of activities pertaining to Output 5**:**

i. The criteria employed in the selection of machineries purchased with project funds included price affordability, suitability for rubberwood processing, simplicity in operation, applicability to local operational environment, availability of the equipment and parts, and universality of the machineries.

ii. Overall, the sawing machineries purchased under the project satisfied the pre-specified selection criteria; the machineries, however, are less suitable for farmers to use due primarily to the relatively high price but strongly advisable for use by small to medium scale wood processors.

iii. The recovery rates experienced in using the multi-ripper sawing machines were highest for straight logs-planks (72.55%), moderate for tapered logs-planks (41.80%) and lowest for truncated logs-planks (32.20%).

iv. Using magnitude of investment and accessibility as the criteria, the technologies that are more suitable for rubber farmers are for production of wood pellet or charcoal requiring capital investment less than IDR 100 million and applicable to poor infrastructure environment.

v. In total, 37 representatives of wood industries, rubber farmers, government staffs and NGOs coming from three provinces had been trained on the operation of the multi-ripper sawing machineries

vi. A simple wood preservation techniques using locally available substances and tools had been introduced by the project in order to avoid quality down grading of fresh logs and sawn timber brought about by blue stain attack; proper application of detergent or disinfectant can protect logs of blue stain up to twenty days.

vii. A simple charcoal production system using modified drum kiln had been demonstrated to 114 farmers at twelve villages in four districts; on average, the system yielded around 30 kgs of charcoal and 8 liters of liquefied smoke per drum within 24-30 hours.

viii. A R & D program on rubberwood utilization had been developed in a participatory manner using a gap analysis technique; the program is a problem solving oriented endeavor that indicates the direction to follow as well as the elements of R & D that ought to be accomplished in the mid-term.

5.2 Recommendations

Below are the recommendations made based on the experience in implementing the pertinent activities of Output 5**:**

i. The multi-ripper sawing machineries purchased under the project performs satisfactorily in terms of wood recovery and simplicity of operation; the wood industries are strongly advisable to invest in such technologies

ii. The multi-ripper sawing technology is less applicable for rubber farmers considering the magnitude of investment required, in the order of us $ 30-40,000; farmers are strongly

recommended to enter into chip wood, sawn timber, wood pellet, charcoal business using small-sized logs and wood wastes as the raw material.

iii. To utilize rubberwood from their replanting areas, it is best for farmers to collaborate with local wood industries by acting as logs suppliers and at the same time make use of small-sized logs for wood pellet and charcoal on their own initiative.

iv. The estimates of sawing costs of multi-ripper machineries that already derived to date are preliminary in nature; further studies on the subject is strongly recommended in order to arrive at accurate figures which are useful for investment decision making by the forest industries.

v. The training on operation of multi-ripper sawing machineries involving the forest industries is strongly recommended; concerned government institutions and wood industry associations have to decide on how this training can be effectively implemented.

vi. Operation of mobile chipper and mobile sawmill by farmers is feasible on ground of required capital investment but handicapped by the absence of access roads for the equipment carrying vehicles; local governments are strongly recommended to speed up construction of access roads to clusters of rubber plantation in the context of regional/ local economic development program

vii. The training on rubberwood preservation demonstrated that inexpensive locally available preservative materials like detergents and disinfectants can prevent damage by blue stain up to twenty days; training of the kind needs to be continuously implemented as a value adding means by avoiding quality down grading of fresh rubber logs and sawn timber.

viii. Introduction of charcoal production system is strongly supported by farmers; expansion of the training to other districts and regions is strongly recommended through development and implementation of appropriate training program by concerned government institutions in collaboration with local NGOs.

ix. Despite observed weaknesses of the R & D program developed under the project, concerned R & D institutions are strongly recommended to use the document as a reference in developing their respective R & D plans for rubberwood resource utilization.

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6. IMPLICATIONS FOR PRACTICE

Among the important implications of the project findings for the promotion of rubberwood resource utilization are listed herewith**:**

i. Rubberwood growing stock of old rubber plantations owned by farmers will remain at low economic value and underutilized due primarily to poor accessibility of most plantation sites; promoting the utilization of this growing stock requires that the local and provincial governments devote serious attention to construction of access roads in the context of regional economic development.

ii. The trainings on the operation of multi-ripper sawing machineries, rubberwood preservation and charcoal making proved successful in strengthening the interest of the wood industries and rubber farmers in rubberwood resource utilization that such trainings need to be continued and expanded; to this end, concerned government authorities and wood industry associations should collaboratively strive to designing and realizing such trainings.

iii. The farmers trained on appropriate processing technologies are now capacitated to do small-scale business relating to rubberwood resource utilization; the momentum created under the project may be fading away unless it is continuously nurtured through implementation of appropriate follow-up such actions as introduction of attractive incentives in various forms and construction of access roads to the areas of growing stock concentration.

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Selected references

Barly. 2010: Identifikasi Teknologi Tepat Guna untuk Mengolah Kayu Karet Rakyat. Technical Report on Activity 5.1 of ITTO Project PD 523/08 Rev. 1 (I). Unpublised document, in Bahasa Indonesia.

Barly & Krisdianto. 2012: Petunjuk Teknis Pengawetan Kayu Karet. Technical Document of ITTO Project PD 523/08 Rev. 1 (I). Publised document, in Bahasa Indonesia.

Barly and Subarudi. 2012: Standar Prosedur Operasi Mesin Pengolah Kayu Karet Bebas Limbah (Zero Waste). Technical Report on Activity 5.2 of ITTO Project PD 523/08 Rev. 1 (I). Unpublised document, in Bahasa Indonesia.

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.

Subarudi and Barly. 2012: Pelatihan Pengenalan serta Penggunaan Mesin dan Peralatan Pengolah Kayu Karet. Technical Report on Activity 5.3 of ITTO Project PD 523/08 Rev. 1 (I). Unpublised document, in Bahasa Indonesia.

Subarudi and Barly. 2013: Draft Program Penelitian dan Pengembangan Pemanfaatan Sumberdaya Kayu Karet Jangka Menengah (Draft Mid-term R & D Program on Rubberwood Resource Utilization). Technical Report on Activity 5.4 of ITTO Project PD 523/08 Rev. 1 (I). Unpublised document, in Bahasa Indonesia.

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Project ITTO PD 523/08 Rev. 1 (I) - Technical Report No. 5