



**INTERNATIONAL TROPICAL  
TIMBER COUNCIL**

**COMMITTEE ON ECONOMIC INFORMATION  
AND MARKET INTELLIGENCE**

**COMMITTEE ON FOREST INDUSTRY**

Distr.  
GENERAL

CEM-CFI(XLII)/3  
4 September 2008

Original: ENGLISH only

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FORTY-SECOND SESSION  
3-8 November 2008  
Yokohama, Japan

**EX-POST EVALUATION REPORTS  
EXECUTIVE SUMMARIES**

[Complete reports are available from the Secretariat.]

**ITTO Project PD 10/00 Rev.2 (I,F)**  
**“Sustainable Management and Utilization of  
Sympodial Bamboos in South-China”**  
(China)

**ITTO Project PD 51/00 Rev.2 (I,M)**  
**“Improvement of Rubberwood  
Utilization and Marketing in Thailand”**  
(Thailand)

**ITTO Project PD 69/01 Rev.2 (I)**  
**“Improved and Diversified Use of  
Tropical Plantation Timber in China to Supplement  
Diminishing Supplies from Natural Forests”**  
(China)

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**ITTO Project PD 10/00 Rev. 2 (I,F)**

**Sustainable Management and Utilization of  
Sympodial Bamboos in South China**

**EX-POST EVALUATION REPORT  
[Executive Summary]**

**Prepared for the ITTO**

**by**

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&  
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## EXECUTIVE SUMMARY

### 1. BACKGROUND INFORMATION ABOUT THE PROJECT

The Project 10/00 Rev. 2 (I.F) “**Sustainable Management and Utilization of Sympodial Bamboos in South China**” was approved in the 28<sup>th</sup> Session of International Tropical Timber Council (ITTC) at Lima, Peru in 2000. The aim of the project was to develop technologies and superior planting materials for the sustainable management and effective utilization of sympodial bamboo resource in the southern region of China so as to ensure the sustainable socio-economic development of the region and the preservation of eco-system and biodiversity. The project proposal was planned to be concluded within 36 months.

The development objective of PD 10/00 Rev. 2 (I, F) was to develop the knowledge and technologies on sustainable management and improved utilization of sympodial bamboo resources, so as to contribute the socio-economic development of the rural communities, to ensure the conservation and preservation of southern-subtropical and tropical forest ecosystems and biodiversity in south China. . The specific objectives include:-

- To understand the ecological function of the bamboo stands and the biodiversity state in order to facilitate sustainable management system of sympodial bamboo.
- To promote efficient utilization of sympodial bamboo resources with the aim of promoting economic development and improving the living standard of rural poverty population.

Ultimately, the project proposal focused on the need of sympodial bamboo development, researching and putting up the sustainable management and utilizing technologies of the priority species, and launching the technical demonstration and transfer, so as to promote the economic development and the improvement of human life of the region, protect the ecological environment and biodiversity.

The Intended direct beneficiaries of the project were the farmers of the sympodial bamboo areas. The management level and benefits were to increase the surplus labour's employment by the development of the product deep-processing enterprises leading towards more income to the farmers.

The intended situation after the project completion was:-

- There will be sufficient information on the structure and function of the ecosystem.
- Recovery of the function and long-term productivity.
- Formulation of strategy of genetic resource.
- By genetic improvement, superior planting materials will be provided for the development of sympodial bamboos.
- Increase the benefits of bamboo industry through the demonstration and extension of technologies of sustainable management and high-efficient utilization.
- Promote sustainable utilization of forest resource.
- Conservation of biodiversity.

The total project budget was US\$ 696,052 which was contributed by the Government of Japan (US\$ 457,452), Government of Australia (US\$ 15,000), Government of Korea (US\$ 10,000) and Government of China (US\$ 213,600). The actual cost of the project after completion was US\$ 620,150. The implementing agency – The Research Institute of Sub-Tropical Forestry, Chinese Academy of Forestry (RISF-CAF) has got its expenditure audited and the audit report has been submitted to ITTO.

## 2. PURPOSE OF EVALUATION

Recognizing the potential value of the lessons learnt from the project, the Committee on Economic and Market Intelligence and the Committee of Forest Industry at their 38<sup>th</sup> Session in May 2006 in **Mexico** decided that the Ex-Post Evaluation of the Project PD 10/00 Rev. 2 (I, F) should be conducted to determine how well the project served its purpose and to draw up lessons and recommendations to improve the implementation of future projects.

The Ex-Post Evaluation of Project PD 10/00 Rev. 2 (I, F) was undertaken in the 2<sup>nd</sup> fortnight of June, 2008. This report presents the findings of the evaluation done approximately two (2) years after the completion of the project. The evaluation was done using the combination of personal interviews, visits to experimental areas, visit to the Pilot factory and interaction with its owner and an exhaustive review of the project documents and publications. The visits to the experimental sites and pilot factory as well as discussions with some of the direct and indirect beneficiaries of the project further enhanced the consultants' understanding of the project details and deepened the analysis/ evaluation of the project.

## 3. SCOPE OF EVALUATION

Following are the specific **Terms of Reference (ToR)** for the Ex-Post Evaluation that guided the conduct of the study:

- (i) To provide a concise diagnosis of the project so as to point out the successful and unsuccessful outcomes of the project, the reasons for successes and failures, and the contribution of the project towards the achievement of ITTO Objective 2000, and to draw lessons that can be used to improve similar projects in future.
- (ii) To assess the project's design and contribution to the achievement of their respective objectives.
- (iii) To assess the achievement of the project's outputs and specific objectives.
- (iv) To evaluate the impact and relevance of the project, detailing their impact on development and specific objectives as stated in the project documents.
- (v) To determine the effectiveness of technology transfer to target groups.
- (vi) To assess the overall post-project situation for the project, including the conditions of their intended direct or indirect beneficiaries.
- (vii) To define and assess unexpected effects and impacts, either harmful or beneficial, and present the reasons for their occurrences.
- (viii) To analyze and assess implementation efficiency, including the technical, financial and managerial aspects.
- (ix) To assess the overall sustainability of the project after completion, and include appropriate recommendations to safeguard the continuing of their positive impacts, and enhance utilization of the technologies and other results developed by the project.
- (x) Taking into account the results of the evaluation, make an overall assessment of the project's relative success or failure, to summarize the key lessons learnt; and identify any issues or problems which should be taken into account in designing and implementing similar projects in future.
- (xi) To assess the overall cost of the project with original budget provisions, and their respective linkage with the overall results.
- (xii) To prepare the evaluation report in accordance with the references for the Project Evaluation Report, as contained in the ITTO Manual for Project Monitoring, Review and Evaluation.

- (xiii) To assess the projects' contribution to the relevant ITTA objectives (1994) and relevant ITTO Action Plan.
- (xiv) To prepare one or more articles for the project, for possible publication in the ITTO Tropical Forest Update (TFU), in consultation with the editor, containing an overview of the project and summarizing the lessons learnt from the evaluation work. Appropriate photographs should be provided, if possible.

The evaluation included the detailed review of the logical framework matrix of PD 10/00 Rev. 2 (I, F). The evaluation work has been conducted in such a way as to answer the questions identified in the Ex-post Evaluation check list provided in the ITTO Manual for Project Monitoring, Review and Evaluation.

#### 4. CONCLUSIONS OF THE EVALATION

##### 4.1 Project Design and Contribution to the Achievements of the General Objectives

Proper designing of a project is key to its success. When a project is designed mainly on field activities, it is more challenging. Since bamboo is used in myriad ways from cradle to coffin, it is very significant for the socio-economic amelioration of the farmers on one hand and the ecological improvement of the soil conditions and the environment on the other hand. Rightly called as '**friend of the people**' by Chinese and '**Green Gold**' by Indians, bamboo needs more focused attention for its sustainable management and utilization. Project has been executed successfully achieving almost all outputs except for few aspects.

The design of the project appears to be quite impressive but the planning is also an integral component of the overall success of the project. The duration of the project extended by 21 months and the reasons attributed to such an inordinate delay in the completion of the project are:

- (a) Natural Disaster,
- (b) Publications of research results, and
- (c) Additional works taken by the implementing agency or given by ITTO.

Field projects need more focused attention for better research and the dissemination of good results. The project contributed successfully towards achieving the following ITTO objectives as set out in Article 1 of the International Tropical Timber Agreement (ITTA, 1994):

- (c) To contribute to the processing and sustainable development;
- (f) To promote and support research and development with a view to improve forest management and efficiency of wood utilization as well as increasing the capacity to conserve and enhance other forest value in timber producing tropical forests;
- (i) To promote increased and further processing of tropical timber from sustainable sources in producing member countries with a view to promote their industrialization and thereby increasing their employment opportunities and export earnings;
- (j) To encourage members to support and develop industrial tropical timber reforestation and forest management activities as well as rehabilitation of degraded forest land, with due regard for the interests of local communities dependent on forest resources;
- (l) To encourage members to develop National policies aimed at sustainable utilization and conservation of timber producing forests and their genetic resources and at maintaining the ecological balances in the regions concerned, in the context of tropical timber trade.

All the above indented ITTO objectives as per ITTA, 1994 (c), (f), (i), (j) and (l) were by and large achieved except the export earnings from such an industrialization and the generation of effective timber trade. Therefore, the project has successfully achieved ITTO Objectives 2000 so far as sustainable management of forests especially the bamboo forests are concerned whereas its trade and transparency are the follow up actions. The project has been implemented by having experimental sites at Cangwu, Guangning, Maoming, Nanjing and Fuyang. This helped the farmers in increasing their knowledge on management, utilization and improvement in volume production.

## 4.2 Achievement of the Project Outputs and Specific Objectives

Following are the most significant achievements of the project towards the sustainable development and utilization of sympodial bamboo resources in China. The achievements are specified output-wise below:

**4.2.1 Output No. 1:** The knowledge of the ecological functions of various sympodial bamboo stands and the biodiversity maintenance of those species.

### Achievements:-

- (i) Two technical reports for development strategy for protecting sympodial bamboo genetic resources in Southern China and the current status of the sympodial bamboo biodiversity in Southern China have been finished / completed.
- (ii) Three collection areas of sympodial bamboo genetic resources and two bamboo species garden have been established in Maoming City and Nanxiong City of Guangdong Province respectively.
- (iii) 139 sympodial bamboo species in Maoming Forestry Garden and 159 sympodial bamboo species in Nanxiong Bamboo Garden from 7 provinces in Southern China have been introduced.
- (iv) A research plot for the genetic improvement of sympodial bamboos has been established in the State Forestry Nursery in Nanjing County of Fujian Province.
- (v) Completed the analysis on genetic pattern and diversity of priority bamboo species.
- (vi) The hybridized seedlings from artificial pollination from 2001 to 2004 have been afforested in three sites after the nursery of seedling and certain fostering measure have been implemented. The progeny test is located in Nanxiong Bamboo Garden, Guangdong province. Selection of superior clones has been finished.
- (vii) Completed the study on asexual reproduction techniques of bamboo and the techniques of vegetative propagation for sympodial bamboos.
- (viii) Finished 6 (six) technical reports and five papers.

**4.2.2 Output No. 2:** Two demonstration regions for sustainable management models of priority sympodial bamboos with a total area of 2000 ha in Guangzhou city of Guangdong province and Pingxiang city of Guangxi Autonomous Region, which are useful for improving the economic situation of rural areas in South-East Asia.

### Achievements:-

- (i) Established 202 research plots for study on sustainable management techniques of sympodial bamboo and 2390 ha. high-yield demonstration stands in six bamboo species stands, which are distributed in Guangdong, Guangxi and Fujian province.
- (ii) Established total 16 surface runoff stations in Guangning, Guangdong province and Nanjing, Fujian province.
- (iii) The Runoff coefficient order of different forest type and the sediment yield have been specified in order from the highest to lowest:  
e.g.: Runoff coefficient order:  
*Dendrocalamus brandisii* > Bamboo + pine Mixed > *Pseudosasa amabilis* > *Bambusa textilis* > Natural forest.
- (iv) Seven best cultivation models for sympodial bamboos have been developed by having high yield technical studies of sympodial bamboo timber stands and high yield technical study of bamboo shoot stands.

- (v) *Bambusa textiles* stands in river bank and in mountain, *Bambusa chungii*, *Bambusa pervariabilis* and *Pseudosasa amabilis* models for bamboo timber stands and *D. brandisii* & *D. latiflorus* models for bamboo shoot stands were developed with detailed data analysis and graphs.
- (vi) Analysed the genetic variance of phenotypic traits and correlation between phenotypic traits and ecological factors.
- (vii) Cost-Benefit Analysis was also done for each demonstration area.
- (viii) Finished five technical reports.

**4.2.3 Output No. 3:** A pilot plant with improved high-value added technology for the production of ply-bamboo in Guangzhou of Guangdong province, which will benefit to the poverty alleviation of rural areas in developing tropical countries.

**Achievements:-**

- (i) Improved the technology of bamboo flooring-processing for Lida Bamboo Concrete Forming Co. Ltd. in Fuyang City, Zhejiang province.
- (ii) Finished study on preservation of bamboo culms.
- (iii) Finished three technical reports.

**4.2.4 Output No. 4:** A pilot plant for the production of tropical sympodial canned shoots in Pingxiang city of Guangxi Autonomous Region, which will give help of promoting the utilization of sympodial bamboo shoot resources in South-east Asian countries where it is usually not paid attention in this area except Thailand.

**Achievements:-**

- (i) Improved the bamboo shoots processing technology for Nanjing Yilong Foods Co. Ltd., in Nanjing County, Fujian Province.
- (ii) Developed preservation method for sympodial bamboo shoots.
- (iii) Developed new soft-packed seasoning bamboo products.
- (iv) Finished the experiments of antibiotic activities of the extractives from leaves and skins of *Phyllostachys glauca* McClure and *Indocalamus tessellates* (Munro) Keng f.
- (v) Established the Good Manufacture Practice to ensure hygienic quality-control and food security of bamboo shoot products.
- (vi) Finished three technical reports.

**4.2.5. Output No. 5:** A training and promotion program on the sustainable management and utilization of sympodial bamboos

**Achievements:-**

- (i) Finished two technical manuals on processing sympodial bamboo products and sympodial bamboo cultivation in Chinese version. They are being translated into English now.
- (ii) Compiled all sixteen technical reports into a book.
- (iii) Conducted three training courses for bamboo cultivation and ecological management at Nanjing of Fujian province in 2002 and Wuyishan city of Fujian province in 2003 respectively. More than 280 plantations were benefitted from such trainings.



- (iv) Organised two times exhibitions during Yong-an Bamboo Shoot Festival in Oct. 2002 and 2004 respectively.
- (v) The wide publicity of the projects and its results has been done by TV, newspapers, Radio and other communication media.

#### 4.3 Significant Observations:

The major achievements output-wise have been specified above but some of the important observations in the whole evaluation of the outputs, activities and their achievements are as follows:-

- (i) Good research has been done regarding genetic diversity of sympodial bamboo and good documentation of research findings / results has been done.
- (ii) No data is available for ecological study or findings in respect of natural stands, mixed stands and agro-bamboo stands i.e. a part of the activities under 1.2 could not be taken up. It is quite clear that too many activities were planned together which were too ambitious.
- (iii) Publication of papers, technical bulletins are very impressive but none of them have been published in any of the international journal or periodicals for wider utility.
- (iv) The ecological studies have been conducted very nicely and there are good establishment of sympodial bamboo stands for demonstration.
- (v) Experimental sites or demonstration areas were enlarged from targeted 2000 ha. to 2390 ha. in view of the demand from some of the provinces for the same.
- (vi) Naoxing city of Guangdong Province and Nanjing County of Fujian Province were included subsequently. Demonstration areas need to be emphasized for focused management of research plots.
- (vii) Good efforts in continuity are required for genetic biodiversity conservation of bamboos.
- (viii) The following studies were taken subsequently in addition to the project activities:-
  - (a) Economic analysis of the demonstration model of sympodial bamboo stands
  - (b) Criteria and Indicators for sustainable management of bamboo forests

Such studies could not be completed towards its logical conclusion.

- (ix) Internal Rate of Return (IRR) has not been calculated to understand the economic viability of each of the model so established / developed.
- (x) Technical papers may have more international references in discussion and analysis.
- (xi) Bamboo charcoal plant in Guangning to use bamboo processing debris to bamboo charcoal was closed as price of raw-material increased (External factor not anticipated earlier).
- (xii) The training and dissemination of research results are virtually an on-going process but the development of proper marketing network / mechanism is essential to stimulate the transfer of technology for larger benefits of stakeholders.
- (xiii) Good awareness efforts have been done and the main beneficiaries are Government, scientists, farmers and industries. More focused management or attention / message to farmers is essential especially in such cases of on-farm research.
- (xiv) There were no materials available on public relations or farmer – CAF dialogue.
- (xv) The lessons learnt in the implementation of this project can lead to better potential replication of improved project in other provinces of China.

#### 4.4 IMPACT AND RELEVANCE OF THE PROJECT

China is the largest bamboo growing country in the World. Bamboo stands cover 7 million ha. in 16 provinces of south China mainly in mountainous areas. There are more than 500 bamboo species in 39 genera in China. Moso Bamboo (*Phyllostachys heterocycla* Var. *pubescens*), a monopodial species, is the most of economic importance which covers about 3 million ha. whereas more than 290 species in 20 genera of sympodial bamboo is widely distributed in the south sub-tropical and tropical region of southern China.

In spite of having a large quantity of sympodial bamboo, only monopodial bamboos are being utilized on a large scale by the industries. The project is very much relevant in providing the research support for increasing the productivity of sympodial bamboos and understanding the control measures for reducing soil and water erosion in bamboo plantation areas. The development of techniques in demonstration areas and its dissemination under the project was indented to establish the sympodial bamboo also an important species for the development of value added items by the industries.

The relevance of the project is further clear from its activities of creating awareness and dissemination of research results for the development of sympodial bamboo value added items. A good research regarding genetic diversity of sympodial bamboo has been done. Similarly, the ecological study by having 16 run-off stations has also been accomplished successfully. The field experimental plots exhibited that the use of fertilizers increased the growth of sympodial bamboos. Some farmers are poor and therefore, they are interested in pest control and soil working only. They are not interested in fertilizers' use. Whether the use of fertilizers is economically viable or not? Does the increase in bamboo yield compensate the cost of fertilizers? Studies and economic analysis are essential in this respect.

The pilot factory i.e. Lida Bamboo Processing Co. Ltd. has started using sympodial bamboo from the last year for the production of bamboo flooring and the company is willing to go ahead with the diverse use of sympodial bamboo. Low price of sympodial bamboo in comparison to monopodial bamboo is also playing important role in this context.

Though the impact of motivating efforts of utilizing sympodial bamboos for the value added items by the industries can be seen in the Lida Bamboo Processing Co. Ltd. but a reasonable impact has yet to take place. It's a good beginning. The owner of the Lida Bamboo Processing Co. Ltd. is interested in extending the use of sympodial bamboo. He has already done survey in India and is willing to establish a factory to introduce the technology in view of cheaply available sympodial bamboos in India.

#### 4.5 EFFECTIVENESS OF TECHNOLOGY TRANSFER TO LOCAL COMMUNITIES

The experimental sites were taken on farmers' land and therefore, it was an on-farm research. The farmers witnessed the different experiments being conducted for increasing the productivity of their area through the increase in growth of bamboos. Since most of the farmers are poor, they found pest controlling and soil working more attractive than the use of fertilizers which is not so economical for them.

The transfer of technology through publication of research results, reports and technical bulletins and thereby creating awareness is excellent. But their translation into the field to the rural communities, poor people, farmers and growers has yet to take a reasonable shape / space.

The transfer of technology or concept of utilizing sympodial bamboo by pilot factory (Lida Bamboo Processing Co. Ltd) have been very impressive as the company has started utilizing 10% of its raw material as sympodial bamboo. Transfer of technology is yet to take a proper shape at wider level but it has really changed the attitude of the pilot factory owner. He is motivated to open a new factory in India by introducing the technology of sympodial bamboo, as large quantity of sympodial bamboos are available at cheaper rates in India.

The Project has been very much effective by making a good beginning but further awareness may carry forward the message of wider utilization of sympodial bamboo to the farmers, growers and industries which will also go a long way in conserving monopodial bamboos for shoots.

#### 4.6 OVER ALL POST-PROJECT SITUATION AND SUSTAINABILITY

The project concluded two years before. It has been observed that more funds have been invested by local Governments for conducting the project in their area smoothly and promote bamboo industry by using research results. Maoming and Nanxiong city Government invested to the project more than one million Yuan RMB and Fujian Forestry department gave around 200,000 Yuan RMB. It was also learnt that the Chinese Academy of Forestry has also provided some money for selection of clones of *D. latiflorus*.

This financial support and the maintenance of the facilities created are very encouraging for the sustainability of the project. It is also important to understand that the research results have been published and the necessary economically beneficial findings have to be disseminated to the farmers, growers and industries at much wider level.

Training of farmers, local leaders and necessary awareness of stakeholders are necessary to carry forward the message of good research for their benefits.

#### 4.7 UNEXPECTED EFFECTS AND IMPACTS

The project did not witness many unexpected effects and their impacts but natural disaster and publication of large number of papers, technical bulletins, technical reports delayed the completion of the project. Moreover, additional works taken by the implementing agency and some given by the ITTO also delayed the completion of the project.

Bamboo charcoal plant in Guangning County was closed as prices of raw-material increased subsequently. This is the external factor which affected the closure of Charcoal plant which was opened with full enthusiasm under the project activities. Proper assessment of bamboo charcoal industry vis-à-vis market situation and price fluctuations of raw materials could have avoided such an eventuality.

#### 4.8 IMPLEMENTATION EFFICIENCY

The project implementing agency with the Project Leader Mr. Fu Mayoi was found very much effective in its efforts. A number of publications of research results in the form of technical reports and papers are testament to their herculean efforts for the wider utility of findings of the project.

One very important aspect regarding the successful and effective implementation of the project is that an excellent cooperation exists between the Project Leader, his staff, local Governments and all stakeholders, which is key to its success.

Whatever shortfalls were observed regarding non-conducting of ecological studies in natural stands, mixed stands and agro-bamboo stands, it was perhaps the result of taking too many activities together. The implementing agency tried to introduce agricultural crops and grasses in bamboo area (10 years' old) but all agricultural crops died.

#### 4.9 STRENGTHS AND WEAKNESSES

The major strengths of the project are:

- (i) The implementing agency and the project leader have formed a very good team for conducting the field research.
- (ii) The capacity exists for conducting research and publication of research results.
- (iii) The capacity exists for conducting genetic and biodiversity research in respect of sympodial bamboos.
- (iv) For sustainability, provincial Governments and the research institute are coming forward with necessary technological and financial support.
- (v) The necessary infrastructure and field support are available for field oriented on-farm research.

- (vi) Some of the industry owners are available for making experiments in consultation with the scientists.
- (vii) Sympodial bamboo forests and plantations are available for such research and dissemination of results.
- (viii) Potential market is available for bamboo based value added items locally and within the country besides having a high potential for their exports.
- (ix) A great market potential exists for bamboo shoots.

The major weaknesses are:

- (i) The project was enlarged without assessing the over all impact.
- (ii) Some of the activities like ecological study in natural stands, mixed stands and agro-bamboo stands were planned with the similar study in plantations, which were too ambitious from the beginning itself.
- (iii) Economic and market studies and analysis were not given adequate attention for the acceptance / transfer of technology to farmers and other stakeholders.
- (iv) The proper training of farmers could not be arranged which is very much important for understanding the research on their fields for practical utility and accruing benefits.
- (v) The necessary development of bamboo shoot preservation centres together with the marketing network / mechanism is essential to translate the good research findings into practical utility.
- (vi) The transfer of technology in the areas where sympodial bamboos are available at door steps may have more meaningful and prompt impact.

## 5. LESSONS LEARNT

### 5.1 Significant development lessons learnt from project implementation

1. **Project Co-ordination:** Involving of the Provincial Governments, Scientists and other stakeholders in the implementation of the project proved quite useful as component activities could be shared with a good coordination leading towards the success of the project.
2. **Financial Planning:** The project document was not very clear on the proposed contribution of the funding from the Local Government but the project activities attracted them and they came forward for conducting the project in their area smoothly, mainly to promote bamboo industry by using research results. Maoming and Nanxiong city Government invested to the project more than one million Yuan RMB and Fujian Forestry department gave around 200, 000 Yuan RMB.
3. **Research Planning:** The 'planning' in such a field research oriented project is very important. This becomes more challenging when such a research is done on farmers' land. The involvement of the stakeholders right from the beginning of the project formulation has led to successful completion of the experiments on the farmers' field without any hindrance. This attracts more farmers for involvement in such research oriented experiments / activities for increasing the productivity of their area and thereby increasing economic gains, if visible. The proper designing of the project with active involvement of stakeholders is thus, the key to its success.

## 5.2 Operational lessons learnt during project implementation

There were also operational lessons learnt during project implementation that could be considered in efforts to improve similar project activities in future:

1. **Project organisation and management:** The organization of the project activities with the splendid coordination and effective management could yield useful results of ecological studies of 16 run-off stations and the development of 7 (seven) bamboo models and other research findings based on field experiments.  
  
Since, the project activities were spread over a number of cities and counties under different provinces, development of good co-ordination and understanding with field staff, officers / officials from the forest Bureau of concerned Provinces is very important and key to the success of the project. The interaction with farmers, industries, field staff for the successful conducting of field experiments, recording of data and the dissemination of research results for their benefit are the main components of good organization and management of the project.
2. **Project documentation:** The project documentation was kept in origin and released to the parties who were interested in the project. All the research results and findings have been well documented in the form of technical reports, papers etc. Compilation of the research results in the form of a book has also been done. The efforts made for documenting research results, their analysis and publications for creating awareness are remarkable. But only one thing which was less appreciated was that such documents must cross the limit of the country i.e. some research results and papers must be published in international journals / periodicals.
3. **Monitoring and evaluation:** Though, there was no formal monitoring and evaluation system installed but the project leader and his team having active coordination with the field staff, monitored the project leading towards successful completion of the activities under the project. Funds have been used efficiently as effectively gauging from the financial statements of the project.

## 6. RECOMMENDATIONS

Following are some of the most important lessons learnt from the implementation and outputs and from the outcomes of the project that must be carefully considered when planning and supporting similar projects in the future:

- 1) Proper designing of the project is key to its success.
- 2) Project needs to be focused for better research and it's results dissemination.
- 3) For the success of a project, good cooperation between project manager, his staff and local Governments and stakeholders is highly essential.
- 4) Project of Forestry research type requires more time and three years' duration for field research projects is very less. It must be about 5 (Five) years to visualize the reasonable impact.
- 5) New addition of studies and work subsequently after the starting of the project i.e. enlarging of project activities, need to be avoided as far as possible.
- 6) Good research findings need to be published in international journals for wider utility.
- 7) Economic and market analysis in the project activities (such as demand & supply analysis, calculation of Internal Rate of Return etc.) need more attention for the acceptance/transfer of technology to the farmers and other stakeholders.
- 8) For sustainability, the necessary arrangements of funds after the completion of the project at the local level is encouraging and essential.

- 9) On-farm research must be encouraged for more transparent transfer of research results/technology to the users on day to day basis. It is challenging too.
- 10) Multi-stakeholder input in selection of research sites with clearly spelled out selection criteria can result in excellent cooperation, support and co-ordination. This may further take into account the farmer's acceptance, budgetary constraints, local staff availability, provincial and county authority commitment to support during the time of implementation of the project and after its completion.
- 11) Opportunity exists for more practical research in the field of bamboo in continuity but emphasizing upon economic gains to farmers and expansion of industries for the purpose.
- 12) Training of farmers, local leaders and necessary awareness of stakeholders are necessary to carry forward the message of good research for their benefit in particular and expansion of bamboo stands in general.
- 13) Opportunity exists for wider potential of bamboo shoots' production with necessary marketing mechanism.
- 14) The continuity of the project by way of a new project proposal may be visualized on the sustainability of the project and especially when the project proposal executed or demonstrated the technical and financial capacity to sustain the results and undertake or follow up the responsibilities.
- 15) Where project beneficiaries are identified, it is also necessary to make clear how they would actual get the benefit. Sometimes, tangible benefits are not clearly visible to the local communities, which is not good for the project. The actual benefit accruing to the people can lead to better demonstrative effect / impact of the project.
- 16) While conducting a research project, detailed literature surveys from other countries need to be done with the focus on research, which helps in better analysis and dissemination of results. For community based project proposals, Community must be involved right from the beginning which only can lead towards a successful practical project.



**Bamboo Experimental Site at Rogou, Guangning County**



**Pilot Factory - Lida Bamboo Processing Co. Ltd.  
in Fuyang City, Zhejiang province**

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**ITTO Project PD 51/00 Rev.2 (I, M)**

**Improvement of Rubberwood Utilisation and  
Marketing in Thailand**

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Disclaimer

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## 1 Executive Summary

This paper summarises the results of the ex-post evaluation of International Tropical Timber Organisation (ITTO) project PD 51/00 Rev.2 (I, M) on *'Improving the utilisation and marketing of rubberwood in Thailand'* (the project). Nimmo-Bell & Co. Ltd – an agribusiness consulting company from New Zealand ([www.nimmo-bell.co.nz](http://www.nimmo-bell.co.nz)) – was contracted to conduct the evaluation<sup>1</sup> (hereafter referred to as Nimmo-Bell). Appendix one provides a list of acronyms used in this report.

The full ex-post evaluation report is available on request from the ITTO secretariat.

### 1.1 Background information about the project

Since the natural forest logging ban in 1989, Thailand's furniture industry – a significant exporter and employment provider – has been faced with a shortage of raw material. With an abundant source of rubberwood from Thailand's extensive rubber plantations, the furniture industry has adapted to the extent that it is almost fully reliant on rubberwood for raw material. This evolution has not been without problems, however, and over time Thailand's furniture industry has been declining in competitiveness for a wide variety of reasons.

A pre-project was implemented from 1998 – 2000 that brought together key players with an interest in rubberwood development and generated data and information about the key issues where none existed before. Yet, no one issue or group of issues stood out as being critical to address first, and the scope of work needed to address the competitiveness problems was very broad. In addition, it would take some time before a cooperative and productive relationship could be fostered between stakeholders who had hardly interacted at all prior to the pre-project. Also rubber and rubberwood are dealt with by many arms of government in Thailand, and cooperation is limited: this further hinders effective progress on rubberwood development.

The project was implemented from 2002-2006. The project strategy recognised that; "the needs for technical assistance for the development of the rubberwood sector are so extensive that a large-scale national programme would be justified. But it is first necessary to create awareness on the development potential and key issues, to establish an adequate information base, and to develop the critical mass of human resources" (project proposal, page six).

So the project outputs primarily focussed on the urgent training needs of the furniture industry. But the project had a longer term vision and was expected to:

- bring together the key stakeholders, improve understanding and build a positive environment for engagement to address rubberwood and latex development issues;
- transfer technology via (1) training the trainers; (2) developing training materials; (3) providing new technologies to local industries; and (4) improving knowledge on technical problems and sectoral issues; and
- generate a strong body of information on rubberwood to inform future work on developing the sector, including as a priority a pilot rubberwood resource assessment study.

The project was of direct relevance to ITTO objectives and priorities at the time the project was designed, as set out in the Libreville Action Plan (1998-2001). And the project remained relevant to the new ITTO strategies and priorities agreed in the Yokohama Action Plan (2002-2006). This is set out in Appendix two. The project is also consistent with ITTO's objective 2000<sup>2</sup>. Support for development of the rubberwood furniture sector allows Thailand to adapt to its reduced reliance on natural forest timber, and rebuild its position as a competitive furniture exporter.

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<sup>1</sup> Charlotte Cudby was the Consultant from Nimmo-Bell who carried out the evaluation.

<sup>2</sup> Objective 2000 is a commitment by ITTO members to move as rapidly as possible towards achieving trade of tropical timber and timber products from sustainably managed sources.

## 1.2 Evaluation purpose and scope

The Committee on Economic Information and Market Intelligence and the Committee on Forest Industry, at their Fortieth Session in May 2007, decided that an ex-post evaluation for the project should be carried out to establish how well the project served its purposes and to draw up recommendations for future action.

The primary purpose of the evaluation is to provide a concise diagnosis of the project so as to point out:

- the successful and unsuccessful outcomes;
- the reasons for successes and failures;
- the contribution of the project towards achieving ITTO's Objective 2000<sup>3</sup>; and
- lessons that can be used to improve similar projects in the future.

Appendix two sets out:

- the terms of reference for the evaluation; and
- how this evaluation report addresses each item in the terms of reference.

## 1.3 Evaluation approach

The evaluation involved:

- Consulting a range of project documents, and relevant background material and data (see Appendix three for details);
- Conducting an evaluation mission to Thailand for one week during December 2007 to interview the project team and key stakeholder groups involved in the project (see Appendix four for the mission programme);
- Cross-checking information and clarifying contextual issues, including through follow-up email communication after the mission; and
- Summarising the results of the evaluation in this report.

Project performance was assessed by:

- Analysing the project's logical framework matrix (LFM)<sup>4</sup> to assess project design and contribution of outputs to objectives - analysis of the LFM is presented in the full report and Appendix five presents the LFM at the level of the project objectives;
- Studying the project work plans and budgets, against actual schedules and spending, as well as discussing project implementation with the project team and stakeholders to judge overall operational efficiency - this is discussed in the full report; and
- Qualitatively assessing the post-project situation of target beneficiary groups using semi-structured interviews<sup>5</sup> to explore project impacts and outcomes – this is covered in detail in the full report.

While Nimmo-Bell was not able to meet with three key stakeholders (the Project Leader, the TPA and DIP), email contact was made with two of them following the evaluation mission. The evaluation mission nevertheless involved meetings with a broad enough range of stakeholders that this limitation did not significantly reduce the validity of the observations made and the quality of the evaluation.

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<sup>3</sup> Objective 2000 is a commitment by ITTO members to move as rapidly as possible towards achieving trade of tropical timber and timber products from sustainably managed sources.

<sup>4</sup> The LFM is a performance framework that captures the project strategy and sets out the project's objectives, outputs, indicators and assumptions.

<sup>5</sup> Good notes were taken of all the interviews and have been provided to ITTO to supplement this report.

## 1.4 Conclusions of the Evaluation

### ***The project strategy was sound and the outputs selected appropriate.***

Still, the project strategy was not captured well in the LFM; and so the LFM did not prove to be a good performance framework for the evaluation. The specific objectives should have been more concrete and the indicators selected at the level of objectives were not helpful measures of success. On the other hand, the outputs added during project extension reinforced the project strategy and significantly enhanced the positive impacts of the project. The project's success hinged on being able to achieve many outcomes via a single type of activity – training. In this respect the project achieved its aim.

### ***The project was implemented efficiently and effectively.***

The project was collaboratively governed and the budget well managed. That along with unexpected in-kind contributions by industry meant that significantly more activities were achieved at the level of outputs than originally envisaged. Project activities were also constantly improved based on stakeholder feedback. Many stakeholders were involved in implementing the project through from project design to completion; all with very different problems and interests. This was the most difficult part of the project to manage, yet it was achieved well. Though, staff turnover and course promotion were two areas that could have been managed better.

### ***The outputs were by and large achieved well and positive outcomes were demonstrated.***

Though some outputs were only partially accomplished, the overall impacts of the project demonstrated that positive outcomes had been achieved for the target beneficiaries of the project. Furthermore, there have since been some excellent follow-up initiatives that would not have taken place if it were not for the catalytic effect of the project. Appendix eight sets out individual course outputs and follow-up.

### ***The project had significant positive impacts on target beneficiaries.***

The circumstances of key target beneficiary groups changed for the positive as a result of the project. And despite the unexpected helpful and unhelpful influences of key external factors, the following successful and ongoing impacts were demonstrated during the evaluation mission; the project:

- Encouraged stakeholders to collaborate and build networks;
- Developed a good information base and built capacity across stakeholders on rubberwood development issues and priorities;
- Trained local trainers and developed useful and relevant course documentation;
- Spurred the industry to alter its attitudes to change and make practical improvements to operations to improve the productivity and competitiveness of the industry. However the impact on SMEs was not as great as had been hoped; and
- Highlighted the importance of stakeholder agreement on a common vision for rubberwood development to support consistent follow-up action and build longer-term commitment.

### ***Two key external influences both helped and hindered the project.***

Industry initially appeared to be unaware of their need for upgraded skills; this jeopardised the success of the project. But improved collaboration and information as a result of the project helped to change this. Secondly, rapid increases in the latex price led to shortages of rubberwood. This, combined with difficult economic conditions, led to increased interest in how to maximise value from rubberwood because of severely reduced profit margins. This also highlighted the economic importance of latex (compared to rubberwood) and that the question facing policy makers should not be how to shift the focus to wood production, but how best to optimise the production of all products from the land given fluctuating economic conditions.

### ***Overall the project was successful in contributing to its objectives.***

This evaluation showed that the project's outputs generated wide-ranging positive impacts on its target beneficiaries, which contributed positively towards the projects' specific and development objectives. Skills, knowledge and capabilities have been upgraded as a result of the project across processing

industries, trade associations, technical and vocational training institutions, and relevant government departments. The improved collaboration and information generated as a result of the project will support the further development of the sector.

***Stronger political leadership is needed to safeguard the positive impacts of the project into the future***

A third external factor - lack of clear political leadership – significantly limited the magnitude of the positive outcomes that were achieved from the project. Also, this lack of leadership is still hampering the success of various follow-up initiatives and so jeopardises the sustainability of project benefits into the future. In addition, the leadership problems lead to conflicting policies which further hinder sustainable land management more broadly. Subsequent to the project, the TFA has continued to show excellent leadership in promoting agreement by industry players on a 'roadmap'; the aim is to use the roadmap to engage with government to agree on support for priority initiatives for further rubberwood sector development. Broad agreement on the roadmap could form the basis for a national rubberwood development strategy, and secure longer-term institutional support for rubberwood development. This is an urgent priority.

***Overall, the project was a success***

In conclusion, the project has been very successful in improving the conditions of target beneficiary groups – the rubberwood furniture processing industry, training institutions and relevant government departments – and has done so in a cost effective manner.

## **1.5 Lessons learned**

There are a number of lessons that were learned from the project which should be taken into account when designing similar projects in the future:

- i. Incorporating a collaborative method of project governance and involving a wide variety of stakeholders in the design and implementation of the project resulted in positive project impacts over and above that achieved at the level of outputs.
- ii. Taking an adaptive learning approach based on feedback regularly collected during project implementation meant the project was continuously improved and ensured that project activities were targeted toward beneficiary needs even as these needs changed over time.
- iii. By generating relevant information that could be replicated and disseminated into the future, project benefits were able to be spread widely throughout stakeholder groups. Continuing to disseminate this information, and better targeting of the information to end-audience needs, will contribute to the sustainability of project impacts. More ITTO support for reporting in English could have been provided to enhance the dissemination of lessons learned to other member countries.
- iv. The specific objectives should have been more concrete. And from the outset, the outputs carefully selected and clearly defined to explicitly reflect all components of the project strategy. The indicators of success should also have been better targeted to desired outcomes, and more specific than national level data, to allow the success or not of project outcomes to be effectively measured. Some suggested improvements to the LFM are provided in section 2.4.1 on project design.
- v. Project risks should have been better identified especially the level of government support and direction and implications for the sustainability of the project considered. This would allow additional outputs to be included, e.g. a national rubberwood development strategy could have been a specific output for the end of the project. While the National Forum (Output 2.8) attempted to achieve this, this output was only included towards the end of the project at the request of the PSC and its terms of reference could have more clearly stipulated what the desired outcome for the activity was.
- vi. Promotional effort for the project activities should have been better, with longer lead times and more focussed to effectively reach the target audience (especially SME's). This would have improved participation in the project as well as awareness of the project in the rubberwood sector more broadly.

- vii. Project staff turnover is a significant risk and where it is unavoidable, efforts should be made to ensure that key knowledge is documented, key documents located and secured and important contacts passed over.
- viii. At the outset of project development, budget planning should consider adequate contingency allowances and the need to be appropriately flexible to provide for adaptive learning during the project.

## 1.6 Recommendations

The following section presents recommendations for future action that will support the sustainability of project benefits and help the further development of the rubberwood sector in Thailand.

### ***There are three overarching recommendations***

The full report presents a number of specific actions that will help to achieve these recommendations.

<b>Overarching recommendation one &amp; two</b>	
Observation:	There is a lack of clear political leadership on the role rubberwood in the context of other land use and development strategies. There is also a lack of a common vision for the sector's development in the eyes of all stakeholders.
Issue caused:	This has resulted in conflicting policies and barriers to effective cooperation between stakeholders. A common theme is the inability to secure adequate resources for further training initiatives because of competing priorities.
<b>Therefore:</b>	
<ol style="list-style-type: none"> <li>1. The government should provide stronger and more consistent political leadership for rubberwood development and address conflicting policies.</li> <li>2. Key stakeholder groups should to work towards agreement on a national rubberwood development strategy that will guide and support all future actions</li> </ol>	
<b>Overarching recommendation three</b>	
Observation:	There is still significant need in Thailand for information and training on all aspects of rubberwood. Rubberwood information dissemination responsibilities are unclear, and information transfer is ineffective. There is still room for improvement in course design and promotion. More trainers are still needed as well as better resourcing for rubberwood education.
Issue caused:	This has created barriers to widespread, effective and sustainable skills and knowledge improvement for stakeholders in the rubberwood furniture sector.
<b>Therefore:</b>	
<ol style="list-style-type: none"> <li>3. The dissemination of information on rubberwood should be improved. Extension activities should be further enhanced and expanded, including by training more trainers and providing more sustainable funding to programmes which are consistent with any agreed rubberwood development strategy (See recommendation two (above)).</li> </ol>	



***There are six specific recommendations.***

The recommendations set out below ought to be considered in the context of any agreed national rubberwood development strategy. The rationale for these recommendations is discussed in detail in the full report.

1	<ul style="list-style-type: none"> <li>• Support the creation of smallholder cooperatives for rubberwood to improve the negotiating power of farmers.</li> <li>• Review the governance arrangement for ORRAF and RRI (including the export tax and subsequent reallocation of funds) to see if the overall service provided to farmers can be improved. The aim should be to improve information and support to smallholders on maximising sustainable income streams from the land without prejudice to whether it is latex, rubberwood, inter-crops, or something else. Engagement at a high level in the Ministry of Agriculture and Cooperatives would be needed.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Establish a grading standard for rubberwood sawn timber and related products</li> <li>• Explore the need for training in this area, and potential support for that.</li> </ul>
3	<ul style="list-style-type: none"> <li>• Study the transport infrastructure, assess costs and analyse how to improve the economics of transporting rubberwood material</li> </ul>
4	<ul style="list-style-type: none"> <li>• Review the process to approve new wood processing facilities (especially for rubberwood), including how to encourage more cooperation between the RFD, DIP and industry associations when considering such approvals.</li> </ul>
5	<ul style="list-style-type: none"> <li>• Strengthen the environmental messages about rubberwood in marketing efforts.</li> <li>• Review harvesting practices and associated regulations to eliminate conflicting policies and rules. Specific guidelines could be developed that are targeted toward rubberwood, and this will prepare the ground for further developing quality standards and achieving certification - tools which can help with future marketing efforts especially in high-value markets.</li> </ul>
6	<ul style="list-style-type: none"> <li>• Analyse the net impact of land use incentive measures (especially subsidies for planting) on farmers' land use decisions and determine what the overall impact is on the economics of latex and rubberwood as a land use.</li> </ul>

## 2 Acknowledgements

The author wishes to gratefully acknowledge the warm hospitality extended during her visit to Thailand as part of the evaluation process, by Mr Worakit Soontobura (RFD; Assistant Project Leader) and Ms. Utharat Pupalboon (RFD; Project team), their RFD colleagues and the project team.

She is also grateful to those people mentioned above, and also the following people who all willingly provided information and answered questions all of which greatly assisted in the preparation of this report:

- Mr Upai Wayupat (Deputy Director General, RFD)
- Mr Visoot Somnuk (Director, Forest Management and Forest Products Research Office, RFD)
- Mr Suchat Kalayawongsa (Senior Forest Officer, RFD)
- Mr Jirawat Tangkijngamwong (Secretary General, TFA)
- Mr Suntud Sangkul (FIO)
- Assoc. Prof Boonsanong Ratanasoontragul (Associate Professor, KMIT) and KMIT colleagues
- Assoc. Prof Songklod Jarusombuti (Department Head, Wood Science and Technology, KU) and KU colleagues
- Mr Jiroge Jarirugsapituk (Director, ORRAF Rayong Province) and ORRAF colleagues
- Mr Thirachat Vichitcholchai (Director, RRI Chachoengsao) and RRI colleagues
- Representatives from the East Coast Company, Rayong Province
- Ms. Wandee Thanalertvisut (Director, Single Window e-Certification Group, DEP)
- Mr Soonthorn Suppayakorn (Managing Director, Modern Environmental Co. Ltd)
- Ms Arunwan Petsang (TPA)
- Mr Thawee Kaewmanee (DIP)

Mr Don Wijewardana and Mr Alan Reid, both members of the New Zealand Institute of Forestry; and Mr Nick Giera, Agribusiness Consultant with Nimmo-Bell; all provided useful input.

During the evaluation, many of the Thai stakeholders and government representatives involved in this project expressed thanks for the ITTO and donors for the support that made the project possible. Mr Jirawat Tangkijngamwong, Secretary General of the TFA, on behalf of his 400 members conveyed gratitude to ITTO particularly because the project promoted the kind of thinking that led to the TFA subsequently receiving the best trade association award in 2007 because of its support to industry.

Responsibility for views expressed and any errors and omissions rests with the author.

### 3 Appendices

#### 3.1 Appendix one: List of acronyms

DEP	Department of Export Promotion
DIP	Department of Industrial Promotion
EA	Executing Agency
FIO	Forest Industries Organisation
ITAP	Industrial Technology Assistance Program
ITTC	International Tropical Timber Council
ITTO	International Tropical Timber Organisation
KMIT	King Mongkut's Institute of Technology
KU	Kasetsart University Faculty of Forestry
LFM	Logical Framework Matrix
ORRAF	Office of the Rubber Replanting Aid Fund
PSC	Project Steering Committee
RFD	Royal Forest Department
RRI	Rubber Research Institute
SFM	Sustainable Forest Management
SMEs	Small and medium sized enterprises
TFA	Thai Furniture Industries Association
TIFF	Thailand International Furniture Fair
TPA	Thai Parawood Association

### 3.2 Appendix two: ITTO context

The project is of direct relevance to the following ITTO objectives as stipulated in Article 1 of the 1994 International Tropical Timber Agreement (ITTA1994)<sup>6</sup>.

(d)	to enhance the capacity of members to implement a strategy for achieving exports of tropical timber and timber products from sustainably managed sources by the year 2000
(f)	to promote and support research and development with a view to improving forest management and efficiency of wood utilisation as well as increasing the capacity to conserve and enhance other forest values in timber producing tropical forests
(i)	to promote increased and further processing of tropical timber from sustainable sources in producing member countries with a view to promoting their industrialisation and thereby increasing their employment opportunities and export earnings
(k)	to improve the marketing and distribution of tropical timber export from sustainably-managed sources
(m)	to promote the access to, and transfer of, technologies and technical cooperation to implement the objectives of this Agreement

The project was consistent with ITTO priorities at the time the project was designed as set out in the Libreville Action Plan (1998-2001), particularly:

Goal 1 Actions 3 and 6	<ul style="list-style-type: none"> <li>– Assist in the promotion and transfer of new and/or improved techniques and technologies;</li> <li>– Encourage and assist Members, as appropriate, to promote investment in timber processing industry by taking steps to:</li> <li>– Recognise the importance of a sound balance between sustainable timber production and the processing capacity of the connected industry;</li> <li>– Organise workshops/seminars on the use of new and/or improved techniques, technology and the development, testing and adoption of guidelines.</li> </ul>
Goal 2 Action 1	<ul style="list-style-type: none"> <li>– Assist with human resource development and institutional strengthening through specialist workshops and seminars and the provision of fellowships.</li> </ul>
Goal 3 Actions 2, 4, and 5	<ul style="list-style-type: none"> <li>– Facilitate and encourage the development of demonstrations, which address increased efficiency in the widest sense;</li> <li>– Assist in the promotion, transfer and adoption of new and/or improved techniques and technologies through publications and other media, workshops, seminars and fellowships;</li> <li>– Encourage and assist members, as appropriate to: develop, test and adopt regional and national guidelines that assist in the efficient conversion of raw material and help minimise waste and losses at all stages.</li> </ul>

Furthermore, the project remained consistent with new ITTO strategies and priorities agreed subsequent to project approval, as set out in the Yokohama Action Plan (2002-2006):

Key strategy 1	Accelerating progress towards the fulfillment of ITTO Objective 2000 by taking an integrated approach, balanced as appropriate, across all three areas of ITTO's work (Economic Information and Market Intelligence, Reforestation and Forest Management, and Forest Industry). This project, while approved as a forest industry project also dealt with improving information on export markets and end-user preferences and trends.
Cross-cutting actions	<ul style="list-style-type: none"> <li>(e) Assist human resource development and institutional strengthening by conducting national, regional and international training activities and the provision of fellowships.</li> <li>(h) Encourage and increase the involvement of non-government stakeholders, including industry and trade associations, environmental organizations and indigenous groups, in</li> </ul>

<sup>6</sup> While a new ITTA was negotiated in 2006 (ITTA2006), project PD51/00 was designed, approved and implemented under the ITTA1994. Even at the time this report was written (January 2008) the ITTA2006 was still not in force.

	<p>the activities of the Organization with a view to promoting transparency, dialogue and cooperation in furthering ITTO's objectives.</p> <p>(i) Support the sharing of information, knowledge and technology to improve sustainable forest management, product processing, utilization and understanding of the marketplace as related to ITTO's priorities.</p> <p>(l) Support research and development studies and projects to improve understanding of the marketplace, efficient product processing, industrial utilization and better forest management.</p>
<b>Economic Information and Market Intelligence</b>	
Goal 2	– Promote tropical timber from sustainably managed sources
Actions 5, 7ii and 7iv	<ul style="list-style-type: none"> <li>– Examine the market and product requirements that may have to be met in order to develop exports of added-value products.</li> <li>– Identify... other factors that may affect the access and marketability of tropical timber, and propose measures to overcome them.</li> <li>– Develop awareness of market and end-use requirements for tropical timber.</li> </ul>
<b>Reforestation and Forest Management</b>	
Goal 2	– Promote sustainable management of tropical forest resources
Actions 10i, 10iv and 10xii	<ul style="list-style-type: none"> <li>– Implement forest inventories and determine the sustainable yield capacity of each forest management unit through the application of appropriate resource assessment methods and incorporate these into forest management plans (<i>Note: This project improved capacity and implemented a pilot study for rubberwood resource assessment. While not technically a 'forest' this action is still relevant here.</i>)</li> <li>– Improve the productive capacity of natural forests, where appropriate, through ... better utilization of lesser-used species.</li> <li>– (<i>Note: This project improved utilisation of rubberwood, which will - by helping the industry adapt to a new raw material - indirectly improve the long-term future productive capacity of Thailand's natural forests by reducing incentives to flout the logging ban.</i>)</li> <li>– Strengthen training institutions and intensify training of forestry personnel and other stakeholders in... resource assessment.</li> </ul>
<b>Forest Industry</b>	
<i>(Note: This area was the primary focus for the project)</i>	
Goal 1	– Promote increased and further processing of tropical timber from sustainable sources.
Actions 2, 5i, 5iii, 5iv, and 5vi	<ul style="list-style-type: none"> <li>– Study and promote policies and other measures to increase timber industry competitiveness.</li> <li>– Promote investments in timber-processing industry by taking steps to... develop a sound balance between sustainable timber production and the processing capacity of the connected industry, based on timber supply studies and other relevant information.</li> <li>– Organize workshops/seminars on the use of new and/or improved techniques and technology, including increased further processing.</li> <li>– Undertake sector-wide training needs analyses; development of training strategies, training facilities and course curricula; preparation of training manuals; and delivery of training courses.</li> <li>– Improve institutional efficiency and effectiveness through sector-wide training needs analyses; develop training strategies, training facilities and course curricula; prepare training materials; and deliver training courses.</li> </ul>
Goal 2	– Improve industry's efficiency of processing and utilization of tropical timber from

	sustainable sources
Actions 1, 4, 6, 7, and 8v	<ul style="list-style-type: none"><li>- Develop, publish and disseminate information on increasing utilization efficiency and the reduction of losses and waste throughout the production chain.</li><li>- Develop, publish and disseminate recommendations for increasing efficiency throughout the production chain through the utilization of residues and through recycling.</li><li>- Promote development of marketing, production and commercial skills in forest industry.</li><li>- Promote increased awareness and utilization of existing information on wood properties and end-use requirements.</li><li>- Undertake research into wood properties and end-use requirements, paying particular attention to the properties and availability of lesser-used species and timber plantation species and the potential markets for them.</li></ul>

### 3.3 Appendix three: Evaluation terms of reference

The two tables below set out:

- the terms of reference for the evaluation; and
- how this evaluation report addresses each item in the terms of reference.

<ul style="list-style-type: none"> <li>i. To assess the project's design and contribution to the achievement of its objectives.</li> <li>ii. To assess the achievement of the project's outputs and specific objectives.</li> <li>iii. To evaluate the impact and relevance of the project, detailing its impact on development and specific objectives as stated in the project documents.</li> <li>iv. To determine the effectiveness of technology transfer to target groups.</li> <li>v. To assess the overall post-project situation, including the conditions of their intended direct or indirect beneficiaries.</li> <li>vi. To define and assess unexpected effects and impacts, either harmful or beneficial, and present the reasons for their occurrences.</li> <li>vii. To analyze and assess implementation efficiency, including the technical, financial and managerial aspects.</li> <li>viii. To assess the overall sustainability of the project after completion, and include appropriate recommendations to safeguard the continuing of its positive impacts, and enhance utilization of the technologies and other results developed by the project.</li> <li>ix. Taking into account the results of the evaluation, make an overall assessment of the project's relative success or failure, to summarize the key lessons learnt; and identify any issues or problems which should be taken into account in designing and implementing similar projects in future.</li> <li>x. To assess the overall cost of the project against original budget provisions, and its respective linkage with the overall results.</li> <li>xi. To prepare the evaluation report in accordance with the references for the Project Evaluation Report, as contained in the ITTO Manual for Project Monitoring, Review and Evaluation.</li> <li>xii. To assess the project's contribution to the relevant ITTA objectives (1994) and relevant ITTO Action Plan.</li> <li>xiii. To prepare one or more articles of the project, for possible publication in the ITTO Tropical Forest Update (TFU), in consultation with the editor, containing an overview of the projects and summarizing the lessons learned from the evaluation work. Appropriate photographs should be provided, if possible.</li> </ul>
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Source: Ex-post evaluation terms of reference (October 2007)

The evaluation report is structured to deal with the terms of reference as follows:

Report section	Terms of reference
2.4.1 Project design	i.
2.4.2 Operational aspects	vii. x.
2.4.3 Achievement of outputs	ii.
2.4.4 Impacts and outcomes	iii. iv. v. vi. viii.
2.4.5 Project assumptions	vi. viii.
2.4.6 Achievement of objectives	ii. iii. iv. viii.
3.1 Conclusions	ix.
3.2 Lessons-learned	viii. ix.
3.3 Recommendations	viii.
5.1 Appendix One: ITTO context	xii.

### 3.4 Appendix four: Information supporting the evaluation

The following sources of information were consulted during ex-post evaluation:

- ITTO Monitoring and Evaluation Manual and Project Formulation Manual
- The project proposal, and technical and completion reports for PD51/00 Rev.2 (I,M) (2000-2006)
- Proceedings of outputs; which included final reporting by experts and feedback gathered from participants (2002-2006)
- Yearly plan of operation reports; financial statements and audit reports (2002-2006)
- Documents relating to the pre-project PPD1/98 Rev.2 (I) (1998-2000)
- Findings of the 20<sup>th</sup> and 21<sup>st</sup> meetings of the expert panel for technical appraisal of projects relevant to PD51/00 (2000-2001)
- Report of the Diagnostic Mission for assessing achievements towards the ITTO Objective 2000 and SFM in Thailand (2006)
- Thai Forestry Sector Master Plan – Mid-term Review Final Report 2002
- Summary of the 8th National Economic & Social Development Plan (1997-2001)
- Discussions with project team, and key stakeholders during the mission (2-7 December 2007)
- Statistics on wooden furniture exports by top markets (2004-2007); provided by the DEP, 7 December 2007
- National statistics and information on productivity accessed from [www.oie.go.th](http://www.oie.go.th) (December 2007)
- Presentations by ORRAF and RRI on their activities provided during the evaluation mission (2-7 December 2007)
- The Thai Furniture Industries Association Directory 2006-2007



### 3.5 Appendix five: Programme for evaluation mission

2-7 December 2007

Date	Activities	Place
<b>2/12/2007</b>	- Initial meeting with RFD (Executing Agency) for informing guideline.	Bangkok Hotel
<b>3/12/2007</b>	<ul style="list-style-type: none"> <li>- Meeting with Deputy Director General of RFD.</li> <li>- Meeting with Director Forest Management and Forest Products Research Office, RFD.</li> <li>- Meeting of project staff including Assistant Project Leaders and project secretary</li> <li>- Meeting with the FIO</li> <li>- Meet project stakeholders at the Wood Technology department KU</li> </ul>	Bangkok RFD  Bangkok KU
<b>4/12/2007</b>	<ul style="list-style-type: none"> <li>- Leave for Rayong province by van.</li> <li>- Visit East Coast Company at Klaeng; a furniture manufacturing and exporting firm</li> <li>- Visit ORRAF</li> <li>- Field survey rubberwood plantation.</li> </ul>	Rayong District
<b>5/12/2007</b>	- Further data collection and analysis, plus preparation for upcoming stakeholder interviews	Bangkok
<b>6/12/2007</b>	<ul style="list-style-type: none"> <li>- Meet project stakeholders at the Design Department, KMIT.</li> <li>- Visit RRI of Thailand.</li> </ul>	North Bangkok Chacheongsao
<b>7/12/2007</b>	<ul style="list-style-type: none"> <li>- Meeting with TFA</li> <li>- Meeting with DEP</li> <li>- Discussion of outstanding questions with executing agency and collection of further information.</li> </ul>	Bangkok

### 3.6 Appendix six: Project LFM at level of objectives

The following is an excerpt from the original LFM which sets out the project objectives, indicators and their means of verification, and assumptions made.

Project Elements	Indicators	Means of Verification	Important Assumptions
<p><b>Development objective</b></p> <p>To increase the contribution of the rubberwood industry sector to Thailand's national economy</p>	<p>Industry productivity 3% raised</p> <p>Exports of rubberwood furniture 10% increased by 2005</p>	<p>National industrial production statistics</p> <p>Foreign trade statistics</p>	<p>The political will of the Government will be translated into relevant policy measures and action plan aimed at ensuring the integrated development of the rubber and rubberwood sectors.</p>
<p><b>Specific objective</b></p> <p>The specific objectives were to:</p> <ol style="list-style-type: none"> <li>To help establish a sustainable resource base for rubberwood development; and</li> <li>To improve the international competitiveness of the Thai rubberwood industry.</li> </ol>	<p>Rubberwood resource assessment undertaken in the South and East</p> <p>Rubberwood recovery rates for primary and secondary processed products increased by 5%</p> <p>Productivity in rubberwood sawmilling and processing improved in the quality and recover rate of lumber</p> <p>Export markets diversified by various customs</p>	<p>Pilot study produced</p> <p>National statistics on wood utilization and industrial production</p> <p>National mill and industry level data</p> <p>External trade statistics</p> <p>Evaluation</p>	<p>The ability of the Royal Forest Department to undertake pilot study.</p> <p>Continuous availability of rubberwood raw material and willingness of rubberwood processing industries to adopt new technologies and diversify export markets.</p>

Source: Project proposal 2001

### 3.7 Appendix seven: Outputs, budget and work plan

Output	Description	ITTO	Thai rubberwood industry	Thai government	Work plan
1.1	Supply the methodology and guidelines for undertaking a rubberwood resource assessment pilot study	US\$22,250	US\$5,000	N/A	Q1-Q4 (2002)
2.1	Train sawdoctors and trainers from technical colleges with improved skills in rubberwood sawing	US\$18,910	US\$6,420	N/A	Q3-Q4 (2003) Q2 (2004)
2.2	Train technicians of furniture plants and technical colleges with improved knowledge of new products and techniques for the surface finishing of furniture	US\$46,865	US\$4,890	N/A	Q1-Q4 (2004)
2.3	Train plant managers and supervisors of furniture factories and technical colleges with upgraded skills in industrial management	US\$67,740	US\$7,940	N/A	Q1-Q3 (2003)
2.4	Up-skill export managers of furniture firms, relevant trade associations and government agencies to be better acquainted with major world market trends for furniture and appropriate export marketing techniques	US\$63,200	US\$7,980	N/A	Q4 (2002)– Q2 (2003)
Non-activity based expenses <sup>7</sup>		US\$104,883	N/A	US\$100,020	N/A
Refund of pre-project costs		US\$82,290	N/A	N/A	
<b>Sub-total</b>		<b>US\$406,138</b>	<b>US\$32,230</b>	<b>US\$100,020</b>	
<b>Total planned project budget</b>		<b>US\$538,388</b>			

Adapted from: Project proposal 2001

<sup>7</sup> Includes: Six project personnel (in-kind contribution by government of Thailand), travel expenses for project coordinator; office supplies; communication expenses; auditing; contingencies; and ITTO programme support costs including monitoring, review and administration

### **3.8 Appendix eight: Individual course outputs & follow-up**

#### ***Output 2.1 Training workshops on rubberwood saw doctoring***

This output was successful with 109 people over four workshops trained in improved saw-doctoring practices and diagnosis of faults and correct maintenance in sawmills<sup>8</sup> (The LFM success indicator was to hold four courses and train 70 people). FIO was contracted to hold the courses and today they are still experiencing significant demand by industry for more training to be done, but resources are constrained. In addition the project identified many other pressing issues that saw-millers need training assistance with. The RFD is currently working with other government departments that administer research funds to seek financial support for further work, but it is difficult to secure adequate resources because of conflicting policy priorities.

#### ***Output 2.2 Training workshops on surface finishing of furniture***

This output was accomplished; 105 participants over five workshops were trained in improved rubberwood surfacing finishing knowledge and skills<sup>9</sup> (The LFM goal was to hold five courses and train 85 people).

#### ***Output 2.3 Training courses in industrial management***

This output has been partially attained with four courses held and 109 people trained in upgraded skills in industrial management<sup>10</sup>. The original goal was to hold five courses and train 135 people; two of the planned courses in Bangkok and Rayong were eventually combined as there were difficulties in securing sufficient attendance.

The first two courses were generic and participant feedback called for subsequent courses to be more targeted; hence, the third and fourth were focussed on the sawmilling and furniture sectors respectively. Still, participants still found the concepts covered to be complex and abstract, and it was therefore difficult for them to implement the ideas when they returned to their factories. Exacerbating this was that the topic areas only covered a small range of industrial management issues relevant to Thai producers, but this was necessary given the limited time available for the course. Nevertheless, the courses did help raise awareness among participants that significant improvements to their operations were possible if the right changes were made.

The TFA recognised these problems and have subsequently organised an initiative called 'Change Management', which essentially makes funding available to provide individual industrial management factory assessments. This is achieved by bringing an international expert on industrial management to visit Thailand and undertake multiple factory assessments to spread the costs of the trip across industry. To date, TFA has facilitated three assessments (one trip) and plan to facilitate another trip in 2008. Also, the TFA are building up their own capacity in this area so that they can continue providing this assistance themselves in the future. Finally, TFA are leading by example; they have opened up the factory owned by the TFA Secretary General as a 'friendship network' so that others in the industry can learn from it and further cooperation is built. Half the funding for this initiative is provided by ITAP.

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<sup>8</sup> Based on interviews with target course participants, the workshop focussed on saw and component maintenance and the impacts these aspects had on the end quality of the sawn timber produced.

<sup>9</sup> Topic coverage included: a range of surface finishing materials, equipment and techniques (such as different types chemical coating and methods of application); sanding and sanding materials; and quality control, testing and inspection. The workshops also focused on the Japanese and American markets' finishing preferences and standards (such as international standards for volatile organic components) and how to meet such standards while also reducing processing costs.

<sup>10</sup> There was a general focus on plant layout, equipment selection, and production planning and control and specific topics ranged from: analyses of the Thailand furniture industry and its role in the global market place; strategies for industrial growth; product life cycles, manufacturing processes and process engineering; furniture engineering; costing systems; information flows; and quality systems and management.

### ***Output 2.4 Seminars on export marketing of furniture***

This output has been achieved with two seminars being held to improve export marketing knowledge and skills with a focus on North American, Japanese and European markets<sup>11</sup>. While only two seminars were held instead of the three that were originally planned, 98 people attended the two seminars which exceeded the goal of 60 people. One of the seminars was planned for Songkhla, but as most exporters were located in Bangkok and Rayong, the Songkhla event was cancelled and the Bangkok event expanded to be held in conjunction with the Thailand International Furniture Fair (TIFF) which resulted in more than adequate participant numbers.

Many factories only sold to one market and so the seminars were an eye opener for them. But, there was a desire to hear from new speakers from different emerging markets for example, Middle East and from other areas of Europe. Also, many of the participants were from companies that were already successful exporters. The challenge now is how to target those that haven't yet succeeded in exporting.

Since the project, the TFA has secured funds from both its members and the government to progress further programmes in this area. For example, they plan to approach universities to discuss new machinery development to meet export market needs. In addition, the TFA have also changed how they design and operate the furniture exhibitions. Thai rubberwood furniture has now been exhibited in Milan, France and New York as well as the design fair in Tokyo. Rubberwood now has its own separate category at the TIFF. Despite these gains, feedback suggested that public relations efforts for the furniture fairs could be still be significantly improved.

### ***Output 2.5 Training course on wood identification and preservation***

This output was achieved with two courses held and 101 people trained in wood anatomy and wood preservation<sup>12</sup> (The goal was to hold two courses and train 60 people). Subsequently the KU are planning to hold four more short training courses in cooperation with TFA.

### ***Output 2.6 Design camp***

Two Design Camps were held as planned but only 44 people attended in total (the goal was 60 people) because of difficulties in securing attendance at the time. The idea was to expose design students to the practical realities of furniture design in a business setting as well as to promote cooperation and hopefully generate future employment opportunities for those students<sup>13</sup>. This output can be considered accomplished because even though actual attendance was not as planned, the output impacted positively on target beneficiary groups and some promising follow-up initiatives driven by strong leadership by the KMIT more than offset the lack of attendance.

Since the ITTO project, the KMIT secured a grant from the Ministry of Industry to undertake similar training in the factories, with the people already working on the shop floor. Eighteen people have been trained in this way during 2007. Manufacturers are asking KMIT to train more furniture designers with the academic background as well as practical experience, but there aren't enough lecturers. Also, securing funding across different departments is difficult hence why the training has moved its focus away from specialist designers because of difficulties in coordinating with both the Ministries of Education and Industry.

The KMIT has also been working with high level politicians to support follow-up initiatives but they don't realise the potential value in the work for the country. In parallel, the KMIT have also been raising awareness about the value of design skills to Thailand's industry in media such as newspaper interviews and columns.

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<sup>11</sup> The first event - a National Forum - aimed to improve participant understanding about marketing techniques, fashion trends, importance of good design and branding, quality standards, market access and distribution channels prevailing in major target markets. There were North American, Japanese and a number of national speakers. The second event was a seminar / workshop, which essentially covered the same issues as the National Forum, but with a focus on the European market and with a stronger emphasis on design and the role of designers in the company.

<sup>12</sup> The topics covered: how to identify wood properties that are critical to maintaining processing quality; understanding the causes of wood deterioration; wood drying technology and maintenance of equipment; wood machining, adhesion and associated quality issues; and engineered wood.

<sup>13</sup> The course covered: factors influencing consumer preferences for furniture design (e.g. psychology, social and cultural aspects); how consumer preferences and trends translate to practical designs; planning for market positioning; how to integrate the theory of design with manufacturing methods, and also to consider capital, material and workmanship needs of the company to deliver such quality designs; fostering creativity in design; and practical experience in a furniture factory to develop a prototype of their design.

With their improved awareness about export marketing and design, factories are starting to think about green / eco design as a higher value market opportunity. KMIT has since been asked by industry to give lectures to interested factories. In addition, factories are asking to contact students that attended the Design Camps for prospective employment opportunities. So far, at least one of the ITTO Design Camp students has secured a job in a rubberwood furniture factory.

\* \* \*

**ITTO Project PD 69/01 Rev. 2 (I)**

**Improved and Diversified Use of  
Tropical Plantation Timbers in China to Supplement  
Diminishing Supplies from Natural Forests**

**EX-POST EVALUATION REPORT  
[Executive Summary]**

**Prepared for the ITTO**

**by**

**Dr. Bipin Behari  
&  
Dr. Dike Kari**

## EXECUTIVE SUMMARY

### 1. BACKGROUND INFORMATION ABOUT THE PROJECT

The Project 69/01 Rev. 2 (I) “**Improved and Diversified Use of Tropical Plantation Timbers in China to Supplement Diminishing Supplies from Natural Forests**” was approved in the 30<sup>th</sup> Session of International Tropical Timber Council (ITTC) at Cameroon in May, 2001. This project was developed as an output of the pre-project PPD 18/99 Rev. 2 (I) titled “Utilization of tropical plantation timber in the southern part of China” which was implemented between July, 2000 and the December 2003 by the Research Institute of Wood Industry, Chinese Academy of Forestry (CAF). The aim of the project was thus to improve and diversify the use of tropical plantation timbers in the provinces of Guangxi, Guangdong and Hainan, where large-scale plantations of fast-growing species (Eucalyptus species; 0.7 million ha. and Acacia species; 0.2 million ha) were established. The project was focused on research work to develop and adopt an appropriate set of processing techniques for solid wood products such as joinery products, furniture and building components from the existing Eucalyptus and Acacia plantations to promote the production of value-added wood products and wide dissemination of the results. The project proposal was planned to be completed within 48 months.

In addition to the above aim / development objective, this project was also intended to facilitate the formulation of a key forest management strategy in China to supplement the diminishing supply of timber from the natural forests. The specific objectives include:

- To develop and adopt an appropriate set of processing techniques for solid wood products such as joinery products, furniture and building products from the existing eucalyptus and acacia plantations (*E.exserta*, *E. citriodora*, *E. grandis*, *E. urophylla X grandis* and *Acacia magnium*); to evaluate the suitability of newly-planted eucalyptus and acacia plantations (*E. torelliana*, *E.pellita*, *e. cloeziane*, *E. camaldulensis* and *A. auriculiformis*). These species hold promise for the production of a wide range of solid wood and composite products by conducting a series of studies on their wood properties; and
- To transfer the technologies and disseminate the scientific knowledge obtained in this project to the relevant public by conducting a series of activities such as a market study, training courses, seminars, brochure release and by demonstrating solid wood products made from plantation timbers in South China.

In China, the per capita average forest land, forest stock volume and amount of timber consumption account for approximately 15,11 and 17% of that of the world respectively. The Government of China launched a National Forest Conservation Programme and thus imposed a ban accordingly on timber harvesting in Natural forests in July 1998, which had an overall effect on reducing of log production. This project was an attempt to broaden the wide resources and reduce the timber waste to meet the demand of the industries from the available plantations of eucalyptus and acacia in the country. The scientific research was intended to establish that the eucalyptus and acacia plantation timber have very good properties and qualities suitable as solid wood production.

The Intended direct beneficiaries of the project are the farmers, rural communities, provincial Governments, industries and the policy makers. The project covers Guangxi, Guangdong and Hainan provinces in the southern part of China.

The intended situation after the project completion was:

- Creating awareness about improved processing technologies of eucalyptus and acacia species and their scientific knowledge.
- Making available processing technology for producing high value wood production such as joinery products, furniture and building products from the existing tropical plantation species.
- Utilisation of tropical plantation species as solid wood products to promote the economic return from tropical plantation resource and its sustainable development and utilization.



In the first project steering committee meeting held on 19<sup>th</sup> July, 2002 in Beijing, the following important decisions were taken which provided a good direction and vision to the project for wider utility of research results:

- Improve proposed market study by engaging international consultant.
- Include Shanghai in domestic market study.
- Include two Eucalyptus species (*Eucalyptus tereticornis* and *E. Urophylla*) in the project research due to their potentials and exclude two species (*E. torelliana* and *E. camaludensis*).

The total project budget was US\$ 1,321,965 which was contributed by the Government of Japan (US\$ 578,815), Government of Australia (US\$ 10,000), and Government of China (US\$ 733,150). The implementing agency – Research Institute of Wood Industry, Chinese Academy of Forestry (CRIWI-CAF) has got its expenditure audited and the audit report has been submitted to ITTO. Making enough budgets or tightly adding the additional activities according to the budget would have avoided the excess of the project costs.

## 2. PURPOSE OF EVALUATION

Recognizing the potential value of the lessons learnt from the project, the Committee on Economic and Market Intelligence and the Committee on Forest Industry at their 38<sup>th</sup> Session in May 2006 in Mexico decided that the Ex-Post Evaluation of the Project PD 69/01 Rev. 2 (I) should be conducted to determine how well the project served its purpose and to draw up lessons and recommendations to improve the implementation of future projects.

The Ex-Post Evaluation of Project PD 69/01 Rev. 2 (I) was undertaken in the 2<sup>nd</sup> fortnight of June, 2008. This report presents the findings of the evaluation done approximately two (2) years after the completion of the project. The evaluation was done using the combination of personal interviews, interaction with the scientists and project staff and an exhaustive review of the project documents and publications and mainly the visit to China Eucalyptus Research and Development Center (CERDC), Zhanjiang. This all together enhanced the consultants' understanding of the project details and deepened the analysis / evaluation of the project.

## 3. SCOPE OF EVALUATION

Following are the specific **Terms of Reference (ToR)** for the Ex-Post Evaluation that guided the conduct of the study:

- (i) To provide a concise diagnosis of the project so as to point out the successful and unsuccessful outcomes of the project, the reasons for successes and failures, and the contribution of the project towards the achievement of ITTO Objective 2000, and to draw lessons that can be used to improve similar projects in future.
- (ii) To assess the project's design and contribution to the achievement of their respective objectives.
- (iii) To assess the achievement of the project's outputs and specific objectives.
- (iv) To evaluate the impact and relevance of the project, detailing their impact on development and specific objectives as stated in the project documents.
- (v) To determine the effectiveness of technology transfer to target groups.
- (vi) To assess the overall post-project situation for the project, including the conditions of their intended direct or indirect beneficiaries.
- (vii) To define and assess unexpected effects and impacts, either harmful or beneficial, and present the reasons for their occurrences.

- (viii) To analyze and assess implementation efficiency, including the technical, financial and managerial aspects.
- (ix) To assess the overall sustainability of the project after completion, and include appropriate recommendations to safeguard the continuing of their positive impacts, and enhance utilization of the technologies and other results developed by the project.
- (x) Taking into account the results of the evaluation, make an overall assessment of the project's relative success or failure, to summarize the key lessons learnt; and identify any issues or problems which should be taken into account in designing and implementing similar projects in future.
- (xi) To assess the overall cost of the project with original budget provisions, and their respective linkage with the overall results.
- (xii) To prepare the evaluation report in accordance with the references for the Project Evaluation Report, as contained in the ITTO Manual for Project Monitoring, Review and Evaluation.
- (xiii) To assess the projects' contribution to the relevant ITTA objectives (1994) and relevant ITTO Action Plan.
- (xiv) To prepare one or more articles for the project, for possible publication in the ITTO Tropical Forest Update (TFU), in consultation with the editor, containing an overview of the project and summarizing the lessons learnt from the evaluation work. Appropriate photographs should be provided, if possible.

The evaluation included the detailed review of the logical framework matrix of PD 69/01 Rev. 2 (I). The evaluation work has been conducted in such a way as to answer the questions identified in the Ex-post Evaluation check list provided in the ITTO Manual for Project Monitoring, Review and Evaluation.

#### **4. CONCLUSIONS OF THE EVALATION**

##### **4.1 Project Design and Contribution to the Achievements of the General Objectives**

The executive agency – The Research Institute of Wood Industry (CRIWI) acted as the main body among the Government, local authorities, sector organizations and industry for transferring the project outputs. CRIWI was responsible for the design, execution and reporting of the activities of the project whereas the State Forestry Administration and Chinese Academy of Forestry (CAF) were responsible for the monitoring and evaluation of the project giving necessary support also regarding the organization of study tours and the training courses.

The combination of overseas mature technology and local Research and Development with local wood company was an appropriate methodology to develop the technologies for value-added utilizing industry of tropical plantations in China.

The design of the project appears to be quite impressive but the planning is also an integral component of the overall success of the project. The duration of the project extended by 6 (six) months only which was mainly due to the publications of research results. A matured processing technology for solid wood products from eucalyptus plantations was developed and an attempt was made to disseminate via this project to wood industry for better utilization of tropical plantation resources and thereby promoting the production of value-added wood products. So far as the development of technology for sawing, drying and finger joints are concerned, the research was accomplished in an excellent manner achieving the necessary objectives to that extent. The project contributed successfully towards achieving the following ITTO objectives as set out in Article 1 of the International Tropical Timber Agreement (ITTA, 1994):

- (c) To contribute to the processing and sustainable development;
- (f) To promote and support research and development with a view to improve forest management and efficiency of wood utilization as well as increasing the capacity to conserve and enhance other forest value in timber producing tropical forests;

- (i) To promote increased and further processing of tropical timber from sustainable sources in producing member countries with a view to promote their industrialization and thereby increasing their employment opportunities;
- (l) To encourage members to develop National policies aimed at sustainable utilization and conservation of timber producing forests and their genetic resources and at maintaining the ecological balances in the regions concerned, in the context of tropical timber trade;
- (m) To promote to access to technologies and technical cooperation to implement the objectives.

All the above indented ITTO objectives as per ITTA, 1994 (c), (f), (i), (l) and (m) were by and large achieved except the export earnings from such research experiments and motivating efforts. The transfer of technology vis-à-vis market study and economic analysis have to cast visible and reasonable impact. Therefore, the project has successfully achieved ITTO Objectives 2000 so far as sustainable management of forests is concerned whereas its trade development and transparency are the follow up actions.

#### 4.2 Achievement of the Project Outputs and Specific Objectives

Following are the most significant achievements of the project towards the improved and diversified use of tropical plantation timbers. The achievements are specified output-wise below:

**4.2.1 Output No. 1.1:** Appropriate techniques for sawing and drying of *E. exserta*, *E. citriodora*, *E. grandis*, *E. urophyllaxgrandis* and *Acacia magnium* by using existing sawing machines and drying facilities.

##### Achievements:

- (i) Split and deformation of lumber could be greatly reduced after four (4) months water spraying on logs.
- (ii) Suitable sawing strategies developed for the four species:
  - Cant sawing for *E. citriodora*
  - Live sawing for *E. exserta*
  - Live sawing for *E. grandis*
  - Around sawing for *E. urophyllaxgrandis*.
- (iii) Completed four technical reports and 4 papers and one National conference.
- (iv) Gained the drying characteristics of four species of eucalyptus and one species of acacia. Based on the results, the lab testing of drying schedules were made out.
- (v) Controlled air drying is suggested to pre-dry these tropical plantation woods to moisture content of 30% and then kiln drying to final moisture content.
- (vi) Activities of international consultants were carried out and the consultant's report submitted.
- (vii) Participation in XXII IUFRO Conference at Brisbane in 2005.

**4.2.2 Output No. 2:** Appropriate techniques for finger-jointed lamination of *E. exserta*, *E. citriodora*, *E. grandis*, *E. urophylla X grandis* and *Acacia magnium* by using existing machines.

##### Achievements:

- (i) International consultants conducted the activities and the reports were submitted.
- (ii) Study tour was conducted to Australia and the report was submitted.

- (iii) Completed one technical report and published 8 papers.

**4.2.3 Output No. 3:** An assessment report on the suitability of newly-planted promising species: *E. torelliance*, *E.pellita*, *E. cloeziane*, *E. camldulensis* and *Acacia auriculiformis* as solid wood products.

**Achievements:**

- (i) Completed 10 reports on the physical properties and mechanical properties according to Chinese National Standard.
- (ii) Two study tours to Brazil and Malaysia were undertaken and the reports were submitted.
- (iii) Ten technical reports and three research papers were completed.

A package of processing technologies for solid wood products from the existing eucalyptus and acacia plantations, consisting of sawing, drying, finger-jointed lamination and furniture and building products was developed for high efficient utilization of mainly eucalyptus plantations.

Moreover, a set of scientific evaluation results was established and carried out to assess the suitability of newly planted eucalyptus and acacia plantations, such as *E. urophylla*, *E.pellita*, *E. cloeziane*, *E. tereticornis* and *Acacia auriculiformis*. These species hold promise for the production of a wood range of solid wood and composite products by conducting studies on their wood properties.

**4.2.4 Output No. 4:** A market study report on the potential application of eucalyptus and acacia plantation timber in the domestic markets.

**Achievements:**

- (i) The first market study report deals with the supply ability of eucalyptus and acacia wood grown in the tropical area of China, the current status of hardwood utilization in china's market. The market opportunity, the competitive ability of related wood products and developing strategy of tropical plantations in China have been described.
- (ii) The second report is purposely oriented to the market analysis for solid wood products made of Eucalyptus grown in Southern China.

In this way, two market reports on market opportunities of eucalyptus and acacia plantations for solid wood products in China were completed.

**4.2.5 Output No. 5:** Training course and an international seminar for operators, technicians and scientists for dissemination of the improved processing technologies and scientific knowledge.

**Achievements:**

- (i) Finalised two handbooks for training course materials.
- (ii) Two training courses were organized in Guangxi Province (October 13-15, 2003) and Zhanjiang City of Guangdong Province (November 25-27, 2005) respectively. Total about 65 persons participated in the two training courses.
- (iii) The International Conference on plantation Eucalyptus: challenge in products development held in Zhangjiang City of Guangdong Province, the People's Republic of China, on November 28-December 1, 2005. More than 70 representatives from 10 countries participated in this four-day international conference.

**4.2.6 Output No. 6:** Publication of a brochure to disseminate the findings of this project to operators, technicians, scientists and officers.

**Achievements:**

- (i) Compiled a brochure on the processing and utilization of Chinese tropical plantation timber based on the project outputs.
- (ii) Completed one technical book (in Chinese) disseminating the findings of this project.
- (iii) Completed three technical reports in English on the utilization of eucalyptus and acacia.
- (iv) Finished three project brochures both in English and Chinese.
- (v) Finished a practical technical manual in Chinese for eucalyptus saw milling and drying techniques before the conduct of the second training course in the second half of 2005.
- (vi) Dissemination of the outcomes of the research results through training courses, international conference, internet and mail etc.

**4.2.7 Output No. 7:** Demonstration of the solid wood products, such as flooring, furniture and window frame etc. to show the better way to utilize tropical plantation timber.

**Achievements:**

- (i) Design and manufacture of solid wood products such as flooring, furniture and window frame etc.
- (ii) Besides, the two domestic market studies, two training courses, an international conference, a number of handbooks and brochures, the following three international consultant reports were also completed:
  - (a) International consultancy report for eucalyptus and acacia lumber processing
  - (b) International consultancy report on economic analysis of eucalyptus and acacia plantations for supply of solid wood products in China
  - (c) International consultancy report on market investigation on the utilization of tropical plantation woods in China.

**4.3 Significant Observations:**

The major achievements output-wise have been specified above but some of the important observations in the whole evaluation of the outputs, activities and their achievements are as follows:-

- (i) The research work and publication of technical reports are excellent.
- (ii) The project implementing agency has researched on the sawing, drying, and gluing technologies and thereby assessed the adaption ability of tropical plantation species of eucalyptus and acacia for solid wood utilization.
- (iii) With the properties of fast growing, high density and beautiful grain, eucalyptus provides a favorable perspective of wood processing and utilization.
- (iv) At some places in the completion report, conclusions were drawn without analysis / survey after the completion of the project while making its comparison with pre-project scenario.
- (v) More value added products of acacia have not been developed.
- (vi) Acacia wood is rarely used. Its supply chain from the limited plantation base (200,000 ha.) to the processing industries has yet to be formed.

- (vii) Even acacia finger-jointed panels are not seen in the market because of its lower log price.
- (viii) Very little market or processing information is available on acacia.
- (ix) Quality control of solid wood products made from eucalyptus and acacia is very poor which needs attention.
- (x) One of the verifiable indicator in the project document was that wood industry productivity will be raised by 5%, which is yet to be seen in the context of this project.
- (xi) Invited speakers from other countries for international conference need to be carefully chosen giving emphasis to their expertise or the working experience in the concerned field.
- (xii) After a research experiment when a result is arrived at, on the basis of data and its statistical analysis, the reasoning for arriving at such a result need to be specified.
- (xiii) China Eucalyptus Research and Development Center (CERDC), Zhanjiang is an excellent research centre with superb infrastructural facility. It has a good research capacity which can be more vividly utilized.

#### 4.4 IMPACT AND RELEVANCE OF THE PROJECT

China has about 2 million ha. of eucalyptus plantations spread over 600 counties of 17 Provinces. The growing stock volume has reached about 17 million cum. Similarly, acacia plantation in China has also increased over the years and it is about 200,000 ha. with an average newly planted area of more than 20,000 ha. per year. Its growing stock is 4 million cum. *E. urophylla* and its hybrids; *E. grandis* and its hybrids, *E. globulus* and *Acacia magnium* are the main plantation species. Guangdong province has the biggest area of eucalyptus plantations whereas Hainan has the largest track of acacia.

Eucalyptus and acacia plantations in China are widely used for pulp wood and wood chips and therefore, the attempt of the project to develop the necessary processing techniques for solid wood products from the existing eucalyptus and acacia plantations is no doubt very much relevant for the country. Moreover, this project further confirms to the Chinese policy about forestry and forest product industry. The technological aspects are relevant in view of the processing difficulties being focused in case of eucalyptus and acacia.

There are four difficulties in processing and utilizing the eucalyptus wood:

- (a) eucalyptus that contain crisp heart at most have high growth strain and its logs are easily to crack so that it is difficult to sawing,
- (b) eucalyptus shows great deformation, surface split and serious crimple when drying,
- (c) some species have bad stability in use process along with mutative climate and environment, and
- (d) diameter of eucalyptus tree is commonly small and juvenile wood is comparatively large, and sapwood is mostly not rotten resistant.

The major problem faced in processing of eucalyptus wood is high growth stress which is further made worse by smaller diameter logs harvested from younger trees. The considerable distortion occurs in eucalyptus lumber as it passes through, resulting in sawing inaccuracy, distortion in products and loss in both recovery and productivity. Stress releasing suitably is the threshold for wood processing with high recovery based on eucalyptus and acacia characteristics. Wood drying is one of the most important steps in wood processing. This project is very much relevant in view of the development of technology to overcome the wood processing problems in case of eucalyptus and acacia.

The major target beneficiaries of the project are the private timber companies, State owned Forest Farms (about 65% of proportion) and private owners (about 35%) of tropical plantation trees. There has appeared a growing interest in manufacturing high value-added products from eucalyptus plantation for the better economic returns, because of the decrease of chip price and demand pressure resulting from protecting the natural forests. The project has no doubt helped the beneficiaries to learn about the success and failures they have committed by using obsolete technology and to realize the better

technology to be adopted to upgrade the efficiency and competitiveness of the tropical plantation industry in China.

#### **4.5 EFFECTIVENESS OF TECHNOLOGY TRANSFER TO LOCAL COMMUNITIES**

The project technical achievements are divided into the following three parts:

- (a) the assessment of the properties of eucalyptus wood of main species,
- (b) the drying and sawing techniques of eucalyptus timbers, and
- (c) the finger-joint technique for value-added eucalyptus products.

The major research work and the development of technology were confined largely to eucalyptus in comparison to acacia.

The transfer of technology through publication of research results, reports, technical reports and papers, training courses, international conference, handbooks and brochures & thereby creating awareness are excellent. But their translation into the field to the rural communities, poor people, farmers, growers and industries is yet to take a reasonable shape.

The Pilot sawing experiment was conducted in Chengda Wood Industry Company and Qibo forest farm in Nanning for domestic eucalyptus logs and in Yuzhu saw mill in Guangzhou, Guangdong Province for Australian eucalyptus logs. The lumber recovered reached to 43% but sawing quality was not up to the mark. The transfer of technology developed through research analysis, pilot wood industry was a good effort but it's a beginning. It has to reach to the large number of people and the industries for the wider benefit of the stakeholders. Chengda Wood Industry Company in Nanning had technical cooperation with CAF, which was financed by ITTO since 2002 but it was closed subsequently. Otherwise, it would have been the best model to exhibit the transfer of technology regarding the processing of eucalyptus for the manufacture of value added products.

The training courses and international conference made good efforts to understand the international technology and attain knowledge and thereby disseminating to the local industries and stakeholders. This also gave an opportunity for further strengthening of Research and Development in the filed of improving and diversifying the use of tropical plantation timber in China.

Eucalyptus plantation development and transformation into solid wood products is in its early phase in China. The project would no doubt offer atleast partial solution for southern China's large scale wood manufacturing industries to improve their self-sufficiency and innovate for new business models. The small volume of eucalyptus and acacia wood for solid wood products could not effect on the market. The necessary efforts in continuity regarding the transfer of technology through demonstration of the utilization of eucalyptus and acacia wood can go a long way in having a desired impact.

#### **4.6 OVER ALL POST-PROJECT SITUATION AND SUSTAINABILITY**

This project has attempted successfully and established that some of the fast growing eucalyptus and acacia species have wood properties that are well suited for higher value solid wood products e.g. furniture, joinery, veneer, plywood and laminated lumber. As a result of the successful completion of the research component of the project, a good corporation has been built up between CRIWI, local authority and forest industry sector. This relationship may be maintained in continuity to promote the technological and production development derived from the project achievements.

To upgrade the efficiency and competitiveness of tropical plantation industry by adopting a mature technology, the survey, Research and Development and the extension of technology carried out in this project still have large space to continually spread the project effects on public. It is only in the early stage. The demonstration of processing technology, market acceptability of the new technology and the manufacture of new product using the new technology, market study and market promotion, necessary training and demonstration are thus very necessary and important to further promote sustainable plantation resource and industry in China.

#### **4.7 UNEXPECTED EFFECTS AND IMPACTS**

The project did not witness many unexpected effects and their impacts but publication of papers delayed the completion of the project by 6 (six) months whereas development of technology on acacia was very much limited. Moreover, the transfer of technology developed for eucalyptus could be confined to identified industry with limited demonstrative effect.

The closure of Chengda Wood Products Company in Nanning which had a technological cooperation with CAF was no doubt an unexpected event which underscored the great efforts of demonstration and transfer of technology by the implementing agency. The involvement of industries for carrying out the successful research, experiments for the demonstrative effect of the transfer of technology must be done very carefully as it has far reaching impact. The low volume of eucalyptus and acacia wood and their products could not have reasonable effect on the market.

The delay of the visa approval by the Embassy of related countries affected the study tour and caused the postponement. Additionally, the schedule of local market survey was influenced in some degree by the time restrict of local government authority, industry and trader who assisted market investigation of project group.

#### **4.8 IMPLEMENTATION EFFICIENCY**

The project implementing agency with the Project Leader Ms. Jiang Xioamei was found very much effective in its efforts. A number of publications of research results in the form of technical reports, brochures and papers are testament to their herculean efforts for the wider utility of findings of the project. The most important aspect regarding the successful and effective implementation of the project is that an excellent cooperation exists between the Project Leader, her staff, local Government and all stakeholders, which is key to its success.

Whatever shortfalls were observed, it was regarding the acacia and non-visible impact of technology in the market which perhaps require further efforts to carry the message of the good technical achievements in economic terms to the people, industries and other stakeholders.

#### **4.9 STRENGTHS AND WEAKNESSES**

The major strengths of the project are:

- (i) The implementing agency and the project leader have formed a very good team for conducting the research.
- (ii) The capacity exists for conducting research and publication of research results.
- (iii) For sustainability, the CAF is committed for necessary technological and financial support.
- (iv) Industries are available for making experiments in consultation with the scientists.
- (v) Potential market is available for eucalyptus and acacia solid wood products.
- (vi) Sufficient plantations of eucalyptus and acacia are available for the utilization of the developed technology to meet the domestic market demand.
- (vii) The necessary infrastructure for research in the form of lab etc. is available.
- (viii) The favourable Government policy to promote diversified use of tropical plantation timbers.

The major weaknesses are:

- (i) Economic and market studies and analysis were not given adequate attention for the acceptance/transfer of technology to the industries, farmers and other stakeholders.
- (ii) More value added products of acacia have not been developed.



- (iii) The lack of demand-supply analysis of Eucalyptus and acacia before and after the project, could not specify the project impact assessment more lucidly.
- (iv) New developments in wood processing technology in the neighbouring countries can also be seen while developing and transferring the technology to the stakeholders.
- (v) Non-existence of a native tropical plantation solid wood marketing strategy across a variety of complementary products.
- (vi) The selection of pilot factory for conducting experiments regarding transfer of technology for demonstration needs more care and share approach.

## 5. LESSONS LEARNT

### 5.1 Significant development lessons learnt from project implementation

1. **Project Co-ordination:** The project executive agency played a key role to advance the project progress by communication among different sectors and involving partners and harmonization of their effective cooperation during the project implementation period.
2. **Research Planning and Project Design:** The basic project design was to improve and diversify the utilization of tropical plantation timbers in china to supplement diminishing supplies from natural forests. The project design was well accepted by the Government, local authorities, forest industry sector and other stakeholders. The research planning for the development of sawing and drying technology and development of finger-joint technology for value-added products of eucalyptus was excellent, taking the advantage of the knowledge in other countries. The participation of local Government, Wood industry and other stakeholders in the training courses and international conference revealed the active adoption of the output of this project 'in principle' by the stakeholders. Well structured project design is key to success of the project especially when it is largely research oriented. Technical survey, Research and Development, demonstration and documentation well designed in the project could achieve the desired success with the herculean efforts of the project implementing staff. The reasonable project design makes great contributions in achieving the objectives leading towards the success of the project.
3. **Project Objectives and Outputs:** The project objectives were in conformity with the Government policy whereas the project outputs were released at many sites both verbally and in black and white. The project activities and the research outputs have been well documented and up dated on the website which is a very effective force to share the information. The market acceptability of the new technology and the new product manufactured using the new technology is the most important factor for project outputs.
4. **Government Policy:** The Government policy on the restriction of natural forests virtually resulted in more silviculture and high value-added use of tropical plantation timber. This will continue to promote the development of tropical plantation industry. Such a Government policy further provided a good basis for the development of the project with its objectives to promote improved and diversified use of tropical plantation timbers. It will continue to be very much instrumental for the sustainability of the project in future.

### 5.2 Operational lessons learnt during project implementation

There were also operational lessons learnt during project implementation that could be considered in efforts to improve similar project activities in future:

1. **Project organisation and management:** The organization of the project activities with the splendid coordination and effective management could yield useful results. The responsibilities of every project members were specified at the beginning of the project execution. The project leader was in-charge of making the over all arrangements and management including the detailed work plan and action plan, managing the execution of the activities and preparation of reports.

The transfer of technology so developed, to the people and industry for larger benefits required more attention on market study and research and the cost-benefit analysis. The extension activities by way of creating awareness through publications, conference, trainings have made a good beginning in this context.

2. **Project documentation:** The project documentation was kept in origin and released to the parties who were interested in the project. All the research results and findings were well documented in the form of technical reports, brochures and papers etc. The efforts made for documenting research results, tabulation of data and their analysis and publications for creating awareness are remarkable. The project implementing agency requested for the extension of the project duration for another 6 (six) months, which was duly accepted / approved by ITTO.
3. **Monitoring and evaluation:** During the project implementation, 5 (five) Project Screening Committee (PSC) meetings including representatives from ITTO, Chinese Ministry of Commerce, State Forestry Administration, CAF, Executive Agency and project partners and 5 Project Technical Committee (PTC) meetings consisting of participants of executive agency and consultants were held in July, 2002, October, 2003, June, 2004, May, 2005 and April, 2006, to monitor and evaluate quality of project implementing and planning. Qualified and effective recommendations and comments from PTC and PSC meeting provided good quality control for project activities and outputs.
4. **Roles and Responsibilities of the Institutions involved in the Project Implementation:** The State Forestry Administration and CAF were responsible for the monitoring and evaluation of the project, giving necessary support at the Government level. As the major project partner, China Eucalyptus Research & Development Centre (CERDC) was in-charge of co-arranging the training courses and international conference, providing the data of tropical plantation resources and industry and presenting in the training courses and workshop etc. CERDC provided necessary and excellent support for the project. It is an excellent research center with superb infrastructural facilities. It has good research capacity and large quantity of tissue culture raised seedlings of eucalyptus for large scale plantations.

Centre of Forestry Management & Development (CFMD) of the Guangxi Forestry Bureau was responsible for providing the necessary data of local tropical plantation resources and industry, and gathering the forestry centre and factories involved in tropical plantations to attend the training courses and international conference, and coordinating the market investigation.

Hainan Chengda Wood Products Company was responsible for the coordination in the pilot trails, designing and processing of some part of solid wood demonstration. Dongen Forest Farm, Guangxi and Guangxi University were responsible for the supply of the trail materials and assist to arranging the training courses.

Necessary and excellent support provided by each project partner is the key factor to better implementing the project activities and its success.

## 6. RECOMMENDATIONS

Following are some of the most important lessons learnt from the implementation and outputs and from the outcomes of the project that must be carefully considered when planning and supporting similar projects in the future:

- 1) Well structured project design is key to the success of the project.
- 2) Through the integrative analysis and evaluation on all data and information of the series of experiments conducted, it is established that Eucalyptus and Acacia plantation woods have good properties and qualities suitable for solid wood production.
- 3) Opportunity exists for the demonstration of processing technology as a follow up action of the project for the suitable development and more diversified utilization of tropical plantation resources in China.
- 4) New developments in wood processing technology need to be looked into in the neighboring countries also.
- 5) Opportunity exists for growing trees on a longer rotation-length and for long-length harvesting. This may assist in reducing end-splitting in sawlogs and veneer billets and would give the opportunity for sawing longer-length products for structural uses.
- 6) Market and market study need to be strengthened to promote the sustainable development of tropical plantation/industry.
- 7) Need to develop a native tropical plantation solid woods' marketing strategy across a variety of complementary products.
- 8) Market research should also look at opportunities for Eucalyptus wood for veneer and structural/engineering end-uses and also investigate the impact that forest certification could have on international markets.
- 9) The need to ensure compatibility between export trade expansion and sustainable forest resource utilization gives justification to certification of forest management, chain-of-custody and the related labeling of wood products.
- 10) Plantation of a species by farmers or growers depends on many factors but the predominant one is the **quick economic return** which needs to be duly addressed.
- 11) This project has more space to continually spread the project effects on public. The small volume of eucalyptus and acacia wood for solid wood products could not effect on the market. More and more emphasis may be given to value-added wood utilization.
- 12) More and more Eucalyptus suited products are required to be developed and displayed in the market.
- 13) In the technical reports and research papers, sufficient references may be given from other countries in the discussion and analysis context. Moreover, technical / research papers need to be published in international journals / periodicals for wider utility and impact.
- 14) The demand-supply analysis of Eucalyptus and acacia vis-à-vis the development of technology and adoption by industry need to be analysed for proper project impact assessment.
- 15) The China Eucalyptus Research and Development Center (CERDC) in Zhanjiang has superb infrastructural and research facility. It may be assigned further research works including transfer of technology which is very important for the success of the project. Much wider transfer and demonstration of processing technology for solid wood products should follow up for the continual production of sustainable and diversified use of tropical plantation resources in China.

- 16) The continuity of the project by way of second phase or a new project proposal must be visualized on the sustainability of the project and especially when the project proposal executed or demonstrated the technical capacity to sustain the results and undertake or follow up the responsibilities.
- 17) Where project beneficiaries are identified, it is also necessary to make clear how they would actual get the benefit. The actual benefit accruing to the people can lead to better demonstrative effect / impact of the project.
- 18) While conducting a research project, detailed literature surveys from other countries must also be done with the focus on research, which helps in better analysis and dissemination of results in lesser efforts and time.
- 19) The involvement of stakeholders right from the beginning is the testament to the success of the project.
- 20) For projects focusing on training and capacity building, the project proposal should be supported by needs assessment, clarifications of curricula or training modules and specific targets to be trained etc.



**Eucalyptus Nursery at China Eucalyptus Research and Development Center (CERDC), Zhanjiang**



**Eucalyptus Wood Processing Unit in Zhanjiang**