PROJECT IDENTIFICATION

a) Title          Processing and Utilization of Almaciga (Agathis Philippinensis Warb.) as source of Industrial Chemicals

b) Serial Number  PD 36/99 Rev.4 (I)

c) Executing Agency  Forest Products Research and Development Institute (FPRDI)

d) Host Government  Republic of the Philippines

e) Starting Date  15 August 2001

f) Actual Duration  84 months

g) Completion Date  31 July 2008

h) Actual Project Costs  US$ 342,743.00 ITTO
                        US$ 381,000.00 Philippine Government
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>PROJECT IDENTIFICATION</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PART 1. EXECUTIVE SUMMARY</strong></td>
<td>1</td>
</tr>
<tr>
<td>1.1. Background Information About the Project</td>
<td>1</td>
</tr>
<tr>
<td>1.1.1 Key Problems the Project Intended to Solve</td>
<td>1</td>
</tr>
<tr>
<td>1.1.2 Specific Objective</td>
<td>2</td>
</tr>
<tr>
<td>1.1.3 Specific Outputs</td>
<td>2</td>
</tr>
<tr>
<td>1.1.4 Strategy adopted in carrying out the project</td>
<td>2</td>
</tr>
<tr>
<td>1.1.5 Planned Duration and Overall Costs</td>
<td>5</td>
</tr>
<tr>
<td>1.1.6 Relevance to Regional and National Policies to which the Project Relates</td>
<td>6</td>
</tr>
<tr>
<td>1.2 Project Achievements</td>
<td>6</td>
</tr>
<tr>
<td>1.2.1 Outputs Achieved</td>
<td>6</td>
</tr>
<tr>
<td>1.2.2 Specific Objective(s) Achieved</td>
<td>8</td>
</tr>
<tr>
<td>1.2.3 Contributions to the Achievement of the Development Objective</td>
<td>9</td>
</tr>
<tr>
<td>1.2.4 Prevailing Situation after Project Completion</td>
<td>9</td>
</tr>
<tr>
<td>1.3 Target Beneficiaries Involvement</td>
<td>10</td>
</tr>
<tr>
<td>1.4 Lessons Learned</td>
<td>11</td>
</tr>
<tr>
<td>1.4.1 Development Lessons</td>
<td>11</td>
</tr>
<tr>
<td>1.4.2 Operational Lessons</td>
<td>13</td>
</tr>
<tr>
<td>1.5 Recommendations</td>
<td>16</td>
</tr>
</tbody>
</table>
PART 2: MAIN TEXT

2.1 Project Results

2.2 Synthesis of the Analysis

PART 3: CONCLUSIONS AND RECOMMENDATIONS

3.1 Development Lessons

3.2 Operational Lessons

3.3 Recommendations for Future Projects
PART 1. EXECUTIVE SUMMARY

1.1 Background Information About the Project

1.1.1 Key Problems the Project Intended to Solve

The project engaged on development works for increased and further processing of raw almaciga (*Agathis philippinensis* Warb.) resin, also known as Manila Copal in export market, to produce higher value-added products. Since time immemorial, the almaciga resin, has sustained its market presence in the form of raw resin. One of the concomitant problems in marketing raw almaciga resin is attributed to the resin’s poor quality. A considerable amount of impurities such as bits of bark, twigs, stones, soils, clay, and other foreign matters contaminate the resin during resin gathering by tapping method. The presence of dirt reduces the market value of raw almaciga resins by as much as 80%, as the quality of almaciga resins is based according to its cleanliness. The raw almaciga resin has already commercial values, however, since the resins required by most industries are clean resins and in modified forms, the raw almaciga resins have to be modified or improved to sustain their commercial importance. For lack of resin manufacturer in the country, the industry users are compelled to import more than 90% of their resin requirements, whether natural or synthetic resins. Such expenditures drain our dollar reserves.

At the same time, now that the Philippine forest is depleted of its valuable timber, coupled with the government’s decision to ban logging in natural forest, the key problem of the government is on how to provide income to indigenous people who are dependent on forestry for their livelihood. Attention has been shifted to the efficient and effective management and utilization of non-wood forest products (NWFPs). One source of NWFP that has the potential for full development into an industry is the almaciga resins. The almaciga trees abound throughout the country. However, almaciga resins are commercially produced in only two provinces of the country, i. e., Palawan and Samar Provinces. In many parts of the country almaciga trees remained untapped for resin production. If tapping and gathering of almaciga resins are organized in many places where almaciga trees exist, there would
be source of livelihood for indigenous people living in the neighborhood of and within forest communities. The income potential of resin tapping will serve as a significant brake on their tendency to migrate to congested urban areas.

1.1.2 Specific Objectives

The specific objectives of the project as originally stated in the Project document are the following:

a. To study the techno-economics of refining crude almaciga resin in a pilot-scale operation, and develop some industrial chemicals from refined resin; and

b. To conduct training on improved tapping techniques for almaciga resin.

1.1.3 Specific Outputs

The project’s specific outputs after the completion of the project are:

a. A comprehensive feasibility study on refining almaciga resin in a pilot-scale operation;

b. Chemically-modified resins from refined almaciga resins as paper sizes, resins for varnishes and paints and cat-ion exchange resins, including their physicochemical properties, performance and applications;

c. Training on proper tapping procedures for almaciga resin collection.

1.1.4 Strategy adopted in carrying out the project

The project envisioned to increase the market value and expand the commercial applications of almaciga resin. This is to be achieved by developing technologies that would homogenize the quality of almaciga resins from different places through refining and chemically modifying the refined resins to produce higher value-added products. Since the viability of these technologies is influenced by many factors other than technical aspects, the project employed the multi-disciplinary and inter-sectoral collaboration with
concerned sectors from the industry, almaciga producing forest community and regulatory government institutions in the local and national level.

The project team was composed of technical and support staff of diverse disciplines, expertise and skills. Among the technical staff were five chemists working in the field of organic, analytical, environmental and wood chemistry, three mechanical engineers, two chemical engineers and two electrical engineers. There were also two foresters, one papermaking specialist, and two economists. Most of the support staff (5 skilled personnel) was males who conducted continuous operations of the pilot plant to evaluate its performance, and gather production and financial data needed for the feasibility study and commercialization plan. The selection of the project staff was done by the project management in consultation with the executing agency (FPRDI), and approved by ITTO.

The project team was grouped in three components, namely: (a) the piloting group that designed, fabricated, and transferred the pilot-scale resin refining plant to the project’s identified cooperator. The piloting group, with the assistance from the project consultant and cooperator, also conducted the feasibility study to refine raw almaciga resins and defined all issues and factors that would impede or push the full commercialization of the resin refining technologies; (b) the research and development group that developed the process of refining raw almaciga resins and converted the refined almaciga resins to much higher value-added products in the laboratory scale; and (c) the training group that introduced the proper tapping techniques to resin gatherers who collected the raw almaciga resins’ requirement of the pilot plant.

The team benefited greatly from the information, suggestions, comments and insights during consultation meetings with concerned sectors engaged in almaciga resin business. The piloting group conducted site assessments in the Provinces of Samar, Palawan and Negros Oriental to gather all pertinent information needed to identify the suitable project location and cooperator. A set of criteria was formulated as a guide in the selection process. A Memorandum of Agreement (MOA) between the FPRDI and the prospective cooperator was prepared. Before
the start of the engineering works to fabricate the pilot-plant, a miniature equipment was first fabricated to get the preliminary data such as percentages resin recovery, temperature of condensate and reactor, among other parameters. The miniature equipment was set-up to eliminate problems that would be encountered during the piloting study. Through the miniature equipment, the resin refining techniques for raw almaciga resins obtained from different places were studied. The information gathered served as a useful guide prior to scaling up of the operation in a pilot-level. Besides, the miniature equipment was used to supply the refined resins needed by the R and D group while awaiting the completion of the pilot plant’s fabrication.

The R and D strategies of the project on downstream processing of refined almaciga resins to produce typical higher value-added products like paper sizes, modified resins as ingredients for paints and varnishes, and resins for wastewater treatment were based on the context that almaciga resins contains resin acids similar to commercial rosins which are monobasic and contains unsaturations. In this regard, the refined almaciga resin was further improved by chemical modifications using esterification, addition and polymerization processes. The suitable reaction parameters were established in laboratory scale. The physicochemical properties of the modified resins were determined using standard analytical procedures. The applications and performance evaluations of the above-cited end products were carried out by separate testing laboratories based on standard test methods. The generated information was disseminated during technology exhibits, seminars, and conferences with industry partners and customers of FPRDI.

To ensure that the resin requirement of the project would come from a sustainably managed almaciga trees, training services on proper tapping techniques were provided to the resin gatherers in the Samar Province. The trainings consisted of lecture-cum-discussions, visual aid presentation, field demonstration and exercises. The training was supplemented with handouts, illustrations and tapping materials.
1.1.5 Planned Duration and Overall Costs

The project was originally planned for implementation for 30 months from 15 August 2001 until February 2004. However, it was extended for another 54 months until 31 July 2008. These extensions were conducted at no additional financial support from ITTO.

The first extension period of 12 months was requested during the 3rd Project Steering Committee meeting held on 21 January 2004 at FPRDI, and attended by Dr. Emmanuel Ze Meka, as ITTO representative. The extension request was intended to further improve the performance of the pilot-scale refining plant, and replicate the piloting study used for Samar resin to Palawan resin, as well as the R and D component of the project on downstream processing. The extension request also covered the suggestions of Dr. Ze Meka to complete the feasibility study first before transferring the equipment to the cooperator and accordingly study the mode of transfer. The approved budget to finance the additional activities was taken from the savings of the project amounting to US$ 92,132.

The second extension request made by the project management was discussed during the 5th Project Steering Committee meeting held on 25 April 2005 at FPRDI. This meeting was attended by Mr. Paul A. Vantomme from ITTO. The purpose of the extension request was meant to address the additional activities for techno-transfer. The project’s unspent balance amounting to US$49,567.00 was used to finance the proposed additional activities.

The project experienced a major setback when the project’s cooperator, the West Coast Rattan and Almaciga Gatherers Cooperative (WECRAGCO) withdrew from the project on 06 August 2005 due to insufficient funds to finance the commercialization of the project. This problem was presented during the 6th Project Steering Committee meeting attended by Dr. Lauren Flejzor on 23 February 2007. The FPRDI management reviewed the MOA between FPRDI and the cooperator and selected a new cooperator from among previously identified prospective cooperators who signified their interest to the project. This time the cooperator,
Habagat Corporation, was chosen from the industry sector. The project was extended four times to ensure that the targeted outputs and the intended situation of the project will be met after project completion.

The overall costs of the project amounted to US$342,743 contributed by ITTO and US$381,000 representing the counterpart funds of the Philippine government. The ITTO grant included the US$18,000 for monitoring and evaluation activities of ITTO. The total ITTO contributions spent by the project amounted to US$324,743.

1.1.6 Relevance to Regional and National Policies to which the Project Relates

The project’s aims of generating technologies to increase the value and utilization of raw almaciga resins are within the country’s policy of increasing economic productivity through utilization of the country’s natural resources, import substitution and development of new enterprises. The project has pioneering attributes. For similar initiatives, it is the policy of the government to provide fiscal and monetary incentives by making them tax-free in its six years of continuous commercial operations.

The project supports the short term and long term S & T policies of the national and local government which aim to promote innovation and improve product quality of NWFP in order to propel development opportunities and income in forest communities. As such, the government banned cutting of almaciga trees to ensure the livelihood of tribal people who depends on almaciga resins as source of income.

1.2 Project Achievements

1.2.1 Outputs Achieved

The major output of the project is the pilot-plant model for refining raw almaciga resin. The plant is multi-functional intended to cater to the future piloting activities of the project. It was assessed safe to
the environment by both national and local regulatory agencies before permit to operate was given to the cooperator.

The design capacity of the pilot-plant is 250 kg of raw almaciga resin per batch of operation. The daily output depends on the buyer’s preferences whether the refined resin is in the form of solid or concentrated liquid. Each form has its own advantages and disadvantages. In solid form, the plant’s maximum daily capacity is only around 0.750 ton raw resin in three batches of operations. This is equivalent to almost 16.5 tons raw resins per month calculated with 22 working days. For buyers who prefer concentrated liquid, the maximum daily capacity doubled to 1.5 tons raw resin equivalent to 33 tons raw resins per month.

A feasibility study that proved the commercial viability of producing refined almaciga resin was prepared in collaboration with the project cooperator. A holistic approach was employed in the feasibility study which covered all issues that could either impede or push the commercial sustainability of producing refined resin from almaciga. The study focused on industry and raw material (almaciga resin) analysis, market opportunity assessments, technical and organizational analysis, financial assessment, and socio-cultural analysis, among others. The data gathered were used as inputs in the preparation of the commercialization plan for producing refined resins from raw almaciga resins.

A comprehensive comparative study between Palawan and Samar resins, the only two provinces in the country where almaciga resins are commercially extracted, was conducted in the project. The results of the study were applied during the piloting study, feasibility study and in the preparation of commercialization plan.

Results of the piloting study were disseminated to industry partners and clients of FPRDI by means of dialogue, trade exhibits, training, posters, press releases and video presentations.

The project generated processes and products to further improve the properties and performance of refined resin through chemical modifications. The refined resin was converted into higher value resins used for paper size, paints and varnishes, and wastewater treatment. The performance of these downstream products was
evaluated against commercial resins, as control. The suitable reaction parameters, physicochemical properties and application techniques were established.

Two training courses on proper tapping of almaciga trees for resin extraction were conducted to 11 groups of people’s organization composed of 53 participants from the Province of Samar. Since trainings on almaciga tapping was already covered by previous ITTO project (PD 15/96 Rev.2) and FPRDI offers it as a regular assistance, the trainings on tapping techniques became FPRDI’s counterpart support to the project. The project covered only the resin gatherers who are directly involved in the project. This was to ensure that the resin requirements of the pilot plant came from properly tapped almaciga trees. Other than tapping, the resin gatherers were also taught proper handling, manual sorting and grading of raw almaciga resins.

1.2.3 Specific Objective(s) Achieved

In the original Project Document, the first specific objective of the project was to study the techno-economics of refining crude almaciga resin in a pilot–scale system, and develop some industrial chemicals from refined resin. This was achieved by initially fabricating a miniature resin refining equipment (capacity of 1kg resin) in order to eliminate problems that would be encountered during the piloting study. The data gathered were used as important references and parameters in the design and fabrication of the pilot-plant for refining raw almaciga resins. To finally achieve the project’s first specific objective, the project developed processes and equipment for resin refining in a pilot-scale system. A pilot plant was designed and fabricated, production and financial data were generated and analyzed to determine the viability. Some industrial chemicals developed by the project were outputs of downstream processing of refined almaciga resins as paper size, resins for paints and varnishes and resins for removal of heavy metals from wastewater. The miniature equipment was also used to provide resin samples needed by the R and D group.

The second specific objective was to conduct techno-transfer on proper tapping techniques for almaciga resin. This objective was attained through the trainings conducted to 11 groups of people’s
organizations composed of 53 participants from Samar Province who gathered the resin requirements of the pilot-plant and continued by FPRDI to resin gatherers from other sources as counterpart support to the project.

1.2.4 Contributions to the Achievement of the Development Objective

The contributions to the achievement of the development objective are:

(a) Full institutional support from the Funding source (ITTO) and the Executing Agency (FPRDI);

(b) Commitment, dedication and competence of the project team and the project cooperator;

(c) Cooperation of various stakeholders engaged in almaciga resin business;

(d) Efficient management of project funds; and most importantly

(e) Divine intervention the source of strength and inspiration of the project.

1.2.5 Prevailing Situation after Project Completion

The resin refining technology developed by the project mechanized the process of cleaning raw almaciga resin that is currently based on manual sorting of dirt. Almaciga resin is a traditional commercial product with established name in the international market as “Manila Copal”. But it is only traded in raw form until now. This limits its commercial application only for resin ingredient in making natural varnish. With the developed technology, the industry users admitted that they have varied ways of using the refined resins compared to raw resin. Besides, other claimed benefits of industry users for refined resins include increased efficiency, reduced energy and labor cost, and produced products with consistent quality. The technology was recognized by various stakeholders engaged in almaciga resin business.
The project has put in place the basic groundwork that will spearhead the full commercialization of the resin refining technology for almaciga resin. A pilot-plant was designed and fabricated, together with comprehensive feasibility study, commercialization plan and technology adoptor, as partner of FPRDI in the commercialization phase. With the interest expressed by industry users, there is no impediment that would hinder the attainment of intended situation after project completion provided the needed interventions are fully addressed.

1.3 Target Beneficiaries Involvement

The target beneficiaries of the project are the stakeholders involved in the almaciga resin business, like resin users and buyers, resin gatherers and traders, and the concerned government offices in the local and national level. The information, suggestions, comments and wisdom they unselfishly shared during consultation meetings were used as significant inputs during the project implementation.

The resin users and buyers (the concerned industry sector) were represented by chemical importers and manufacturers whose customers are the handicraft and furniture makers, ink manufacturers, paper producers, among others. They directly participated in the project by (a) evaluating the performance of the refined resin during the market acceptability tests, (b) providing information during industry analysis, market opportunity assessments and the feasibility study that were used in the preparation of technology commercialization plan. The project’s cooperator that is pushing the full commercialization of the resin refining technology was selected from the industry sector. The partnership of FPRDI and the cooperator was formalized through a Memorandum of Agreement.

The resin producers (the almaciga forest community) are the traders and organized groups of gatherers of almaciga resins who collected the resin requirements of the pilot-plant. These organized groups of gatherers were represented in the project by their leaders. They were the source of primary information that widened
the perspectives of the project management with regard to almaciga resin as a valuable forest resource.

From the government side, the concerned offices involved were DENR (Department of Environment and Natural Resources) and its regional offices in the local government. DENR assessed the environmental safety of the plant, together with offices under the Department of Interior and Local Government (DILG) like the Bureau of Fire Protection. These offices issued the permit to operate for commercial purposes after assessing that the pilot plant met the requirements for environmental compliance. DENR also signified their interest to the project as they intend to use the results of the project to review their policy with regard to issuances of licenses to almaciga resin gatherers.

1.4 Lessons Learned

1.4.1 Development Lessons

Aspects in project design which most contributed to its success or failure in achieving the Development Objective

- The piloting study determined the technical and economic viability of refining almaciga resin in upscale system. The refining of raw almaciga resin has been the subject of interest for a long time by various stakeholders of almaciga resins. Because the piloting study entailed high financial requirements, it was materialized only with the assistance from external funding source, like ITTO.

- The site assessment and participative dialogues with concerned stakeholders were found important lessons and experiences during the project implementation. For instance, the pilot plant was originally planned to be installed in the Province of Samar. But this plan was revised after site assessments and dialogues with stakeholders. Moreover, the pilot-plant’s original design was to use biomass as source of energy. But the DENR regional office in Samar province resented to the
proposal. Accordingly, they want to prohibit the use of biomass energy for commercial purposes because it is not environment-friendly. Since the project must secure a license from DENR, being the regulatory agency for environmental protection, the project team modified the initial pilot-plant’s design until approved. The information gathered during site assessment and consultations were essential inputs in re-focusing the project design and strategic framework.

- The results of the techno-economic study showed that the pilot-plant requires big operating capital which the resin gatherers will not meet and sustain. It must be operated by people with technical capability, marketing skills, management and organizational capabilities. Hence, the suitable project cooperator should be a private investor. However, the private investor will not succeed without the support of the community of resin gatherers. A strong partnership between the private investor and the resin gatherers is essential to sustain the commercialization of resin refining technology.

- The conduct of market acceptability tests, or product testing, was the project’s attempt to enter and penetrate the market. The assessments of the industry users were employed in the preparation of marketing strategies and commercialization plan.

*Changes in intersectoral links which affected the project’s success.*

There were no changes in inter-sectoral links of the project. The project management recognized the important roles of every concerned stakeholder for the project’s successful implementation. FPRDI will continuously establish and maintain institutional linkages with various sectors involved in almaciga trade even beyond project completion.

*Additional arrangement that could improve cooperation between relevant parties interested in the project.*
The technologies developed by the project are highly dependent on availability/sustainability of almaciga resin. Almaciga is a natural forest resource under the governance of DENR (Department of Environment and Natural Resources) and the local government. The project cooperator should exert more efforts on building strong partnership with these regulatory offices and the resin gatherers.

Factors which most likely affect project sustainability after project completion

The technology on resin refining was assessed by the industry with high market potential based on performance and cost of refined almaciga resin. But the technology is very dependent on raw material sustainability. Since the imposition of total logging ban in the natural forest, the collections of NWPFs, like almaciga resins, became more difficult due to lost of transport systems that bring down these equally important natural resources from the forest.

1.4.2 Operational Lessons

Project Organization and Management

The project implementation was effective and efficient due to the team-work established by the dedicated and committed project members, from the FPRDI management and its staff, project management and its consultants, to the technical and support personnel. The project team was composed of technical and support staffs of diverse disciplines, expertise and skills. The technical staffs have adequate background and work experience in chemistry, engineering (chemical, electrical and mechanical engineering), forestry, economics and paper technology. Likewise, the project benefited from the expertise of the project’s local consultants in mechanical engineering and community building during the regular monitoring and evaluation of the project.
Project Documentation

Effective documentation of the project’s progress reports including financial updates facilitated the smooth monitoring and evaluation of the project. While the three groups of the project worked separately, the reports were readily accessible to other groups for references and info-sharing.

Monitoring and Evaluation

The project management conducted regular meetings to monitor and evaluate project’s progress. This is to ensure that the planned activities were well-implemented as targeted and the expected outputs were met. The FPRDI management also monitored and evaluated the project every quarter thru the PDEM C (Project Development, Evaluation, and Monitoring Committee). But the project benefited most from the suggestions and comments of the ITTO representatives during the annual Project Steering Committee (PSC) meetings. Their suggestions greatly improved the project design and strategy. The PSC meeting was an effective medium used by the project management in project planning, to discuss research gaps and address related problems and issues. Their suggestions were usually taken as additional activities without additional funds from ITTO.

Definition of roles and responsibilities of the institutions involved in the project implementation.

As contained in the Project Agreement, the ITTO provided the amount of US$342,743 for the project implementation. ITTO monitored and reviewed the project’s status thru the submitted progress reports and attendance to PSC meetings. The FPRDI, on the other hand, implemented the project with counterpart funds amounting to US$381,000 for the utilities (electricity and water), testing equipment and the conduct of trainings for resin tapping. The DENR assessed the environmental safety of the pilot-plant and provided the permit to operate. The project’s cooperator

Completion Report 14 PD 36/99 Rev.4 (I)
(Habagat Corporation) from the business sector shouldered the land, building, and other fixed investments used in the project, except for the resin refining plant. They financed the transport of the pilot-plant to the project location and the test production runs which were carried out many times in order to determine the performance of the equipment and gather financial data needed for the feasibility study and the commercialization plan. Their financial counterpart amounted to about US$30,000.

*Action to be taken to avoid variations between planned and actual implementation*

To avoid variations between planned and actual implementation, there should be an in-depth situational analysis, site assessments, and, if funds permit, a pre-feasibility study. But in most cases, the implementing agency does not have financial capability to cover these preliminary research activities.

*External factors that influenced the project implementation and that could have been foreseen*

- New post-qualification requirements set forth in PD1594 requiring the bidder to obtain a license from Philippine Contractors Accreditation Board.

- Additional work and time needed to complete the engineering work for the fabrication of the resin refining plant and the techno-transfer activities.

- Additional requirements imposed by the newly introduced Philippine Government Procurement Reform Act. (Republic Act 9184); activities.

- The time-line in the conduct of public bidding from pre-qualifications to post-qualifications of bidders who participated in the project.
• The timeline for securing environmental compliance certificate and other permits to operate from regulatory bodies, both public and private.

External factors that influenced the project implementation and that could not have been foreseen

• The withdrawal of the previous cooperator, the WECRAGCO, which happened at the later stage of the project.

• The effect of total log ban on NWFP’s collection and utilization as alternative forest resources. The transport systems that bring down NWFPs from the forest are debilitated.

1.5 Recommendations

The following are recommended to improve efficiency and efficiency of similar projects that might be implemented in the future:

• Future pioneering projects should have completed the comprehensive feasibility study first before transferring the technology to the cooperator and to industry users. The feasibility study should address the technical, economic, institutional, socio-cultural factors and all influential indicators of success or failure in the sustainable commercialization of similar technologies. Further, the feasibility study is a measure to identify the suitable cooperator and strategic site of the project.

• Since the technology is highly dependent on raw material, an exhaustive study that would support the sustainability of raw material base is recommended, including policy studies that would facilitate the delivery and movement of raw material from the forest to industry users.
• The issues on who should be the right cooperator that would pursue the commercialization of the technology and the strategic location of the processing plant depend on what level the technology has reached. While the project is still at the piloting level, the best cooperator should come from the private sector that can manage the risks and has full capabilities in terms of technical, market and organizational skills. Up-scaling of the processing plant can be located later at the resources site. Moreover, the distance of the project site to the project implementer, the FPRDI, should be near, as much as possible, for close monitoring and to avoid expenditures on travels.

• The pilot-plant should be continuously improved to produce products at the least cost and highest product quality. Research and development is a critical activity that the plant should undertake aside from its normal operation. There should be continuous research and development aimed at generating a variety of improved products that could service a wider target market.

• The best mechanism to sustain the commercialization of the project is for all concerned stakeholders from the private investor, policy makers in the local and national level, and resin producers composed of traders and tapers to sit down and develop a strong tri-sectoral partnership.

PART 2: MAIN TEXT

2.1 Project Results

Situation existing at project completion as compared to the pre-project situation

Several researches had been done in the past at the Forest Products Research and Development Institute on almaciga resin in attempt to bring this important NWFP to its fullest utilization. But none of these technologies has reached to pilot study, mainly because of insufficient funds. Through ITTO’s
support, FPRDI has reached a milestone on processing almaciga resins to produce higher value added products.

At project completion, technologies, information and services to improve the chemical properties, performance and quality of raw almaciga resins are available for dissemination. These technologies include (a) refining the raw almaciga resin and converting almaciga resins for (b) paper sizes, (c) removal of heavy metal ions from wastewater, and (d) resins for paints and varnishes. A model pilot plant equipment to showcase the refining of raw almaciga resins has been developed with corresponding studies on its viability and commercialization plan. The project cooperator is working towards the full commercialization of the resin refining technology.

**Extent to which the project Specific Objective(s) was achieved**

The specific objectives stated in the original Project Document were completely achieved in collaboration with our partner in the private sector, together with financial and management supports from ITTO and FPRDI.

**Impact of the project results on the sectoral programmes, on the physical environment, on the social environment, on the target beneficiaries**

- **Impact on Sectoral Programmes and Target Beneficiaries**

  The project results support the primary development programs of the forestry sectors to shift the economic activities in the natural forest from the timber to NWFPs’ utilization. This is spelled out in the provisions under the National Science and Technology Plan 2020 which aims to develop and bring under sustainable management the NWFPs for the benefit, first and foremost, of the upland communities. As such, DENR through its line agency, the Environment Management Bureau (EMB) signified interest to use the project results to review and reform their existing policies on almaciga trees as NWFP. In addition, the industry users who depend on imported naturals resins are also awaiting the availability of the developed products in the local market. Accordingly,
there is price stability using local materials than imported ones due to fluctuations in dollar exchange rates.

- **Impact on Physical and Social Environment**

The pilot-plant for refining almaciga resin was declared environmentally safe after strict evaluations of various agencies like the Environment Management Bureau (EMB) of the DENR, Bureau of Fire Protection and Meralco, the local supplier of electricity. Almaciga resin is one major income-generating activity of indigenous people. Almaciga traders and the indigenous people are direct links to the resources and thus hold the key to sustainable management of almaciga forest, including other NWFPs. To assure that the project results will trickle down to these people, the project cooperator signed an agreement with FPRDI as one of the conditions stated in the MOA.

Project Sustainability after project completion as a result of project conceptualizations, assumptions made and conditions prevailing at completion

The raw almaciga resin has already market value. But when the resin’s quality was improved by the project, this resulted to increased demand for almaciga resin. The issue on the project sustainability depends, on a great extent, to the raw almaciga resins’ accessibility. Since the imposition of the total logging ban, there is no commercial activity in the natural forest which resulted to impairment of transport facilities that bring down NWFPs to the market.

2.2 Synthesis of the Analysis

a. Specific Objectives Achievement

All specific objectives of the project were achieved.

b. Outputs

All targeted outputs were realized
c. Schedule

There were several unforeseen activities that caused project delays. However, the delay did not affect the achievement of project objectives.

d. Actual Expenditure

Other financial requirements of the project were shouldered by the project cooperator. This amounted to about 10% of the project’s budget.

e. Potential for Replication and Scaling-up

Since there is an assured local market, there is a significant potential for replication and scaling up of operation once the needed interventions are fully addressed by the private investor through the assistance of the government sector.

PART 3: CONCLUSIONS AND RECOMMENDATIONS

3.1 Development Lessons

- The integrated equipment developed by the project for a pilot-scale model of refining the raw almaciga resins proved the technical and economic viability of resin refining technology. The pilot-plant has 95% efficiency based on input-output. The comprehensive feasibility study which included all influential factors that would hinder or push the commercialization of the resin refining technology was carried out in collaboration with the cooperator. The result of the study indicated there is high market potential for refine almaciga resin but this would require interventions. Without interventions, full-scale commercialization is not feasible and the high potential for effective market will not be attained. The interventions should focus on accessing the raw material through linkages with almaciga resin traders and organizing the community of resin gatherers.
• Almaciga resins varied according to their sources. This variability limits the usefulness of the almaciga resins. The project developed processes to homogenize almaciga resins using the pilot-plant. However, there were differences on financial data. If resin tapping and gathering would be organized in all places where almaciga trees exist, the pilot plant can be upscale or replicated to meet the volume requirements of the resin market.

• The results of the techno-economic study also showed that the pilot-plant requires big operating capital which the resin tappers will not meet and sustain. It must be operated by people with technical capability, marketing skills, management and organizational capabilities. These requirements can be best captured by a private investor. However, the private investor will not succeed without the support of the community.

• Of the three downstream products from refined almaciga resin, only two have the biggest chance of success to enter the market. These are the modified resins for paper sizes and modified resins for paints and varnishes. The modified refined resin as cat-ion exchange resin for wastewater treatment has no local market at this point in time. Considering that most industries place low priority on environmental compliance, the market for cat-ion exchange resin for wastewater treatment is quite small. This is compounded by the fact that the technology is only applicable for removal of heavy metals, which makes the market even smaller. In essence, the target market for cat-ion exchange resins for wastewater treatment does not recognize that the technology offers a business solution and more importantly, the market is not willing to pay for the offered solutions.

• The site assessments and participative dialogues/consultations with concerned stakeholders were found important tools in the project design. The strategic location and the right cooperator among stakeholders, while the project is still in the piloting level, were identified after site assessments and consultations. Moreover, the
pilot-plant’s proposed design was to use biomass as source of energy. But the DENR thru its regional office resented to the proposal. Accordingly, they want to prohibit the use of biomass energy for commercial purposes because it is not environment-friendly. Since the project must secure a license from DENR, being the regulatory agency for environmental protection, the project team modified the initial pilot-plant’s design until approved. The information gathered during site assessment and consultations were essential inputs in re-focusing the project design and strategic framework.

- The conduct of market acceptability tests, or product testing, was the project’s effective strategy in entering and penetrating the market. Price, performance and volume were main deciding factors of the industry users. The reactions of the resin users resulted to improved and expanded ways of resin refining. Also, data gathered were employed in the preparation of marketing strategies and commercialization plan for refined almaciga resin.

### 3.2 Operational Lessons

- The team-work established among members of the project staff and between the project management and the FPRDI management proved effective and efficient in delivering the targeted outputs. The successful project implementation relied on commitments and support of the FPRDI management to the project.

- The full support of ITTO to the project as demonstrated by the smooth release of funds for the project implementation and the ITTO experts they sent for every Project’s Steering Committee meeting greatly contributed, not only to the project, but also to the project staff through the additional knowledge they learned from them.

- The proper documentation of the project’s progress reports including financial updates facilitated the
monitoring and evaluation of the project. While the three groups of the project worked separately, the reports were readily accessible to other groups for references and info-sharing.

- The regular in-house and ITTO's monitoring and evaluation of project's progress ensured that the planned activities were well-implemented and on targets towards the attainment of the objectives. The project benefited most from the suggestions and comments of the ITTO representatives during the annual Project Steering Committee (PSC) meetings. Their suggestions greatly improved the project design and strategy. The PSC meeting was an effective medium used by the project management in project planning, to discuss research gaps and address problems and issues of the project. Their suggestions were taken as additional activities without additional funds from ITTO.

### 3.3 Recommendations for Future Projects

- Future pioneering projects should have completed the comprehensive feasibility study first to best identify the suitable cooperator and location for a piloting project. The feasibility study should address the technical, economic, institutional, socio-cultural factors and all influential indicators of success or failure in the sustainable commercialization of similar technologies.

- Since the technology is highly dependent on raw material, an exhaustive study that would support the sustainability of raw material base is recommended, including policy studies that would facilitate the delivery and movement of raw material from the forest to industry users.

- The issues on who should be the right cooperator that would pursue the commercialization of the technology
and the strategic location of the processing plant depend on what level the technology has reached. While the project is still at the piloting level, the best cooperator should come from the private sector who can manage the risks and has full capabilities in terms of technical, market and organizational skills. Up-scaling of the processing plant can be located later at the resources site. Moreover, the distance of the project site to the project implementer, the FPRDI, should be near, as much as possible, for close monitoring and to avoid expenditures on travels.

- The pilot-plant should be continuously improved to produce products at the least cost and highest product quality. Research and development is a critical activity that the plant should undertake aside from its normal operation. There should be continuous research and development aimed at generating a variety of improved products that could service a wider target market.

- The best mechanism to sustain the commercialization of the project is for all concerned stakeholders from the private sectors, policy makers in the local and national level, and resin producers composed of resin traders and gatherers to sit down and develop a strong tri-sectoral partnership.

- The host institution that will implement the project should have a good track record in R and D management, with adequate facilities and manpower resources.

- An effective monitoring and evaluation system, both internally and externally, should be maintained by the project management and ITTO.

Responsible for the Report
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