Preliminary Assessment of the IDRC Project: Bamboo Mat Board (India)

Report to IDRC

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Contents

Executive Summary

An IDRC-sponsored evaluation team of experts visited Indian Plywood Industries Research and Training Institute, Bangalore (IPIRTI) to review the bamboo mat board project. Both the project progress reports and in-depth discussions at the Institute provided adequate information for this evaluation. The socio-economic impact of this project became clear after a visit to the Kerala Bamboo Corporation Bamboo Mat Board mill in Angamaly and a visit to the villages to see the bamboo mat production.

Bamboo mat board technology developed at IPIRTI could be used at any of the existing plywood mills in Asia. The most significant achievement made by IPITRI is the development of an appropriate phenolic resin mix with appropriate applicator design to suit the manufacturing operation. The finished product could meet all the requirements for an exterior grade plywood. Another important achievement lies in the ease of introducing environmentally friendly wood preservative in the resin to increase the durability of the product. Application of the bamboo mat board in such applications as apple packing cases, door shutters, grain storage bins etc., was demonstrated with supporting and convincing techno-economic feasibility data.

The technology transfer to Asian countries for commercialization can be achieved. The process lends itself to existing practices in China and Thailand. For Bangladesh, Sri Lanka and the Philippines, the infrastructure for the production of bamboo mat needs to be developed.

The evaluation team strongly recommends continuation of the project into a second phase. The development of low cost resins and a cost effective manufacturing process, preparation of manuals along with audiovisuals for technology transfer activities, and socioeconomic and environmental impact studies should be continued. New areas of studies suggested are in the mechanization of sliver production, weaving, thicker bamboo mat boards, raw material supply, composite board with other materials (e.g. rice husk boards), and training center capability.

We recommend that IDRC provide funding for further research,for procurement of bamboo splitting and weaving machines and a steam-injected press at IPIRTI.

Introduction:

This report presents observations and information collected by the Bamboo Mat Board Project evaluation team during the October 18-25 visit to the Indian Plywood Industries Research and Training Institute, Bangalore, India (IPIRTI). A list of the members of the evaluation team is enclosed in appendix 1. The visit was sponsored by the IDRC and the main objectives were to review and evaluate the achievements of the project and asses its applicability to other Asian countries; to examine aspects related to commercialization of the technology and to recommend a program of work and further directions for a possible second phase of the project. Appendix 2 provides a list of objectives under the IDRC-supported project at IPIRTI and these objectives were used as a guide for this project evaluation exercise.

Meetings were held with the Director and the project staff of the IPIRTI. The team also traveled to a bamboo mat board manufacturing facility in Angamaly, Kerala State and a facility for collection and weaving of the bamboo mat in the nearby villages. Although the schedule was quite hectic, the overall trip was very successful because of the excellent support and cooperation of the IPIRTI .

Achievements:

IPIRTI began the project with a thorough evaluation of the exiting bamboo mat board production technologies in Asia. Lessons learned from these evaluations were used appropriately e.g. Urea Formaldehyde (UF) based resins used provide an interior product of poor durability; and a mechanical device for bamboo splitting and weaving is available from Taiwan. For socioeconomic reasons, production of the bamboo mat should be kept as a cottage industry with assistance where required from mechanical jigs for production of the slivers and the mat.

Remarkable achievements have been made in the field of phenol-based adhesive use in the production of bamboo mat boards. The great achievements of the project are attributed to the efficient gluing technology and the treatment for better durability of the products. The amount of resin has been reduced from 1.3 kg/m^2 to 0.33 kg/m^2 and the production cost from Rs. 160 to Rs. 103 per board. A significant reduction in the amount of resin and in the production cost will make bamboo board more competitive to plywood.

IPIRTI has produced some encouraging results in the development of low-cost adhesive by making use of lignin from the black liquor obtained from the pulp and paper mills. Up to 30% of the phenol formaldehyde (PF) resin could be replaced without adverse affect on bond quality and strength properties with the accompanying savings in the manufacturing cost of the bamboo mat board. Further studies are in progress.

Great strides have been made in bamboo mat production technology. A simple cost effective method has been developed for resin application and for incorporating environmentally friendly preservative in the resin before its application on to the bamboo mat. The evaluation team was highly impressed with the refinements in production technologies and inclusion of a preservative for increasing the durability of the final product. The simple dip tank method for resin application needs further modification to ensure worker health and safety. Further investigations are in progress for incorporating the preservative in the vapor phase to the bamboo mat before resin application or if required to the finished product.

New standardized methods have been developed to test the final product for its physical strength and durability characteristics. A draft of the standard submitted to the Indian Standards Institute on the bamboo mat board was distributed to the evaluation team.

Bamboo mat board can be an economical substitute to wood products and other conventional materials in construction, packaging, storage, and transportation through innovative engineered application technologies. IPIRTI has developed and tested a few products made from the finished bamboo mat board such as apple cases, door shutters, grain storage bins, and roof sheathing. Appropriate tests for individual product requirements have been carried out and some tests are in progress. Some of these applications merit consideration for commercialization.

IPIRTI had conducted socioeconomic studies and promotion of small units with promising results. A financial feasibility study for establishing bamboo mat board units in a small-scale sector with a investment of less than Rs. 6 million indicates good profitability. Techno-economic feasibility studies are in progress with sensitivity analysis to find out alternative scenarios of benefits and costs related to changes in production and raw material costs.

Applicability to other countries in Asia:

Evaluation team members considered the applicability of IPIRTI technology to other countries in Asia. Bamboo boards have been produced in China, Taiwan, Thailand and India under a different technology of gluing, treatment, and mat preparation, but the processes are similar in nature.

China and Taiwan pioneered bamboo production and use. The IPIRTI technology could easily be incorporated with the Chinese technology for better products and process. The technology transfer could be achieved by several methods, e.g. research publication, videos, and IPIRTI specialists giving lectures and demonstrations. An international bamboo workshop will be held in Beijing in December 1992, providing an excellent opportunity for technology transfer. IPIRTI could hold training workshops for visiting technicians and factory management staff of Asian countries.

Thailand has produced bamboo board for more than a decade mainly for export to be used for interior decoration. Thailand could easily adopt the IPIRTI technology with little modification, and use of low-cost PF-modified resins. A training workshop for interested technicians and management staff, videos, and exchange visits could assist in a smooth technology transfer.

The Philippines could use the technology without any serious problems. Except for the process of resin application, the mat board technology is similar to the plywood manufacturing technology. At present, bamboo mat production is not practised in the Philippines and an infrastructure has to be established before commercialization of bamboo mat board is possible. Mechanized bamboo splitting for sliver production and mechanized weaving technology will greatly assist in using IPIRTI technology.

In Sri Lanka the existing plywood mill could be used to adapt IPITRI technology. At present bamboo raw material is used for other end product usages. An infrastructure has to be established to produce bamboo mat. Work will also be required in selecting the available raw material from indigenous bamboo/reed species that are suitable for making bamboo mats.

Bangladesh could easily apply the IPIRTI technology. However, because UF resins are cheaply available, further studies are required to develop a modified UF resin system suitable for bamboo mat board production. Small hand splitting and weaving machinery is required to commercialize the IPIRTI technology.

Commercialization of IPIRTI technology:

The evaluation team believes that it is both technologically and socioeconomically feasible to bring the IPIRTI bamboo mat board technology to commercialization. IPIRTI is pursuing the commercialization in the existing facility in the Kerala State Bamboo Corporation factory in Angamaly, Kerala and other operations in Meghalaya and the Andaman Islands. In general, the successful commercialization would depend on the following issues:

raw material (appropriate species and supply of bamboo/reed culm; resin)
quality control - both raw material and products
marketing
product diversification (after certain market share is assured)
publicity material - both in the form of manuals and videos for manufacturing and applications.

Recommendations:

The evaluation team strongly recommends continuation of the project into a second phase with the following studies :

1. Development of low-cost resin. Using lignin from black liquor from pulp mills has so far shown promise and this work should be brought to a successful completion with mill trials and a manual for preparation and use of the modified resins.

Consideration should also be given to a modified UF resin for countries like Bangladesh, Thailand, and China. These countries have either traditionally used UF resins for interior applications for decades or have a source of supply of UF resin.

2. Development of a more cost effective manufacturing process with consideration for health and safety of the workers. Using environmentally friendly wood preservative in the process has shown great promise and this work should be completed.

3. Manuals for manufacturing bamboo mat boards with easy to follow instructions on each step of the process should be completed. If possible this should be supplemented with audiovisuals - videos/slides.

4. Quality control manuals with standard test procedures should be prepared.

5. Application manuals for a few of the highly marketable products should be prepared, e.g. for packaging, storage bins, doors, and decorative sheathing material.

6. Completion of reports on the socioeconomic and environmental impacts of bamboo mat board industry.

New areas of studies that warrant immediate attention are :

1. State of art of bamboo mat board production and use in the region.

2. Mechanization of sliver making and weaving. A recommendation is made for IDRC to assist in procurement of a mechanized sliver making and weaving working unit for IPIRTI. This will greatly assist in further research and optimizing manufacturing parameters for consistently good quality bamboo mat board.

3. Thicker bamboo mat boards as a second generation of products requires a steam-injected board manufacturing technology. The evaluation team recommends that the Forintek Canada Corp. proposal for thicker board production should be supported for IDRC funding.

4. Impact of raw material supply has not been a part of this project in the past. A separate IDRC project should be initiated to study the impact of bamboo/reed culm propagation technology on raw material supply for the future of the bamboo board manufacturing industry. This study should include the availability of bamboo, the selection of the appropriate species, and the new propogation techniques of bamboo. The production of bamboo mat technology should also be studied.

5. A study on using of bamboo mat board to manufacture a composite board with other materials such as rice husk board, particle and veneered boards, and inorganic boards should also be undertaken.

6. A training centre for technicians and managerial staff for all phases of the bamboo mat and bamboo mat board manufacturing and applications. IDRC assistance is recommended in preparation of training material in the form of manuals and audio-visuals. Exchange visits from scientists and technicians for technology transfer purposes should be encouraged.

APPENDIX I.

Bamboo Mat Board (India) - CF:89-0228

Evaluation Team, 19-24.10.1992

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OBJECTIVES

General objective

24. The general objective is to develop appropriate technologies for the production of good quality, low-priced bamboo mat boards to increase the income of poor bamboo mat workers (mostly tribal women) while reducing the dependence on imported wood for plywood production.

Specific objectives

25. The specific objectives are:

a) to conduct a thorough review of previous research carried out on bamboo mat board production and of existing technologies;

b) to develop phenol formaldehyde adhesive by modified methods to reduce quantity of resin, pressing time and temperature;

c) to develop and test low cost, lignin-based adhesives from chemical wastes as partial substitute to phenol in conventional resins;

d) to refine and optimize the technology at different stages of the production process;

e) to test the working properties of bamboo mat boards for different end uses and assess their economic advantage; and,

f) to measure the socio-economic impact of implementing the technologies developed and promote the establishment of small production units in rural areas.