

# BAMBOO MARKETING IN THAILAND



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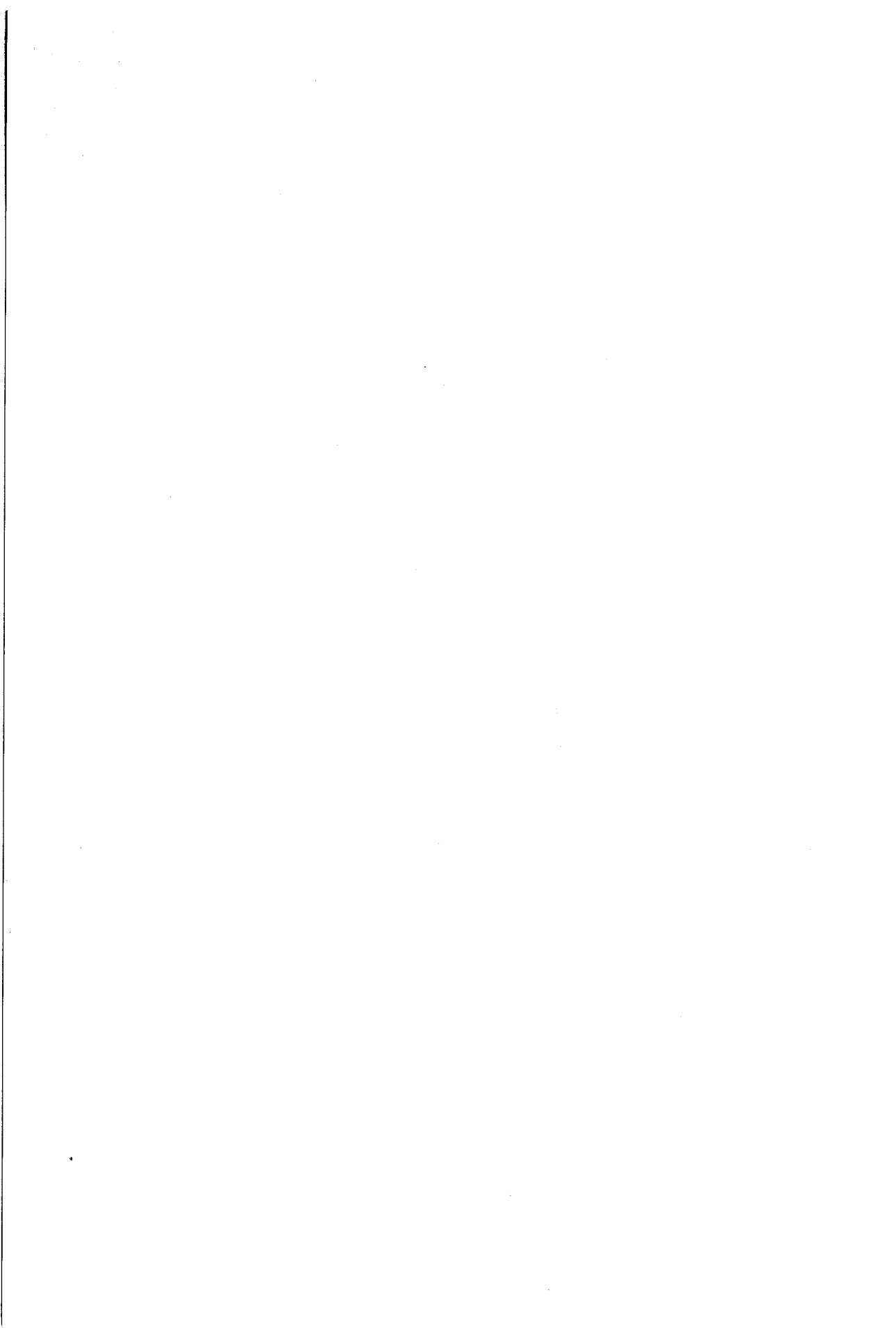
Promotion of the Utilization of Bamboo from Sustainable  
Sources in Thailand

Royal Forest Department



International Tropical Timber Organization  
(ITTO)







## **Bamboo Marketing in Thailand**

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## EXECUTIVE SUMMARY

The Royal Forest Department (RFD) of Thailand is implementing an International Tropical Timber Organization (ITTO) project on bamboo entitled "Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand". The Forest Products Research Division of RFD is the implementing unit of the study. The Study engaged the services of a Consultant on Utilization and Marketing to: make a quick assessment of the demand for bamboo products; identify potential products for the project; identify machines and instruments for laboratory research work; and prepare a technical report in English.

The engagement of the Consultant was from August 20 to September 1, 2002. The Consultant conducted visits to bamboo processing firms in northern and central Thailand with the assistance of the Project Leader and project staff. Among the enterprises visited were furniture, house wares, décor, handicrafts (woven and wicker works), incense splints, and charcoal production. A bamboo shoot plantation was also visited. Government sector was also visited to determine the assistance provided by government to processors and exporters and to obtain additional information of exports and demand for bamboo products. Likewise, a furniture-testing laboratory was visited.

Some of the findings of the study included the following:

1. There is limited information available on resources, supply and demand for bamboo;
2. There is claim that the supply from the natural forest has dwindled;
3. There appears to be a widespread interest of the private sector to develop bamboo plantations;
4. Middlemen play a vital role in the movement of raw materials from the forest and finished products to the market;
5. The quality of bamboo products destined for foreign markets are high and certainly competitive in the export markets;
6. There is viable support to the industry provided by the government, albeit limited particularly in participation in foreign trade fairs;
7. There are furniture industry associations but none from the bamboo furniture sector as well as in the weaving, wicker works, house wares and décor sub-sector; and
8. Products coming from the bamboo industry are traditional products.

Some recommendations coming from the findings include:

1. Establishment of a database for bamboo resources and products, and this could be started by the ITTO study;
2. Establishment of a bamboo industry association to promote the interests of bamboo collectors, farmers/plantation developers, processors and exporters as well as local enterprises marketing products locally;
3. Conduct studies on emerging bamboo products such as cement-bonded bamboo particle boards, bamboo veneer tiles/table tops and paneling; and solid bamboo tiles;
4. Continue study on charcoal and distillate production from bamboo; and
5. Establish village cooperatives to harness the skills and knowledge of village weavers and wicker works experts in the rural areas as basis for building rural enterprises.

# BAMBOO MARKETING IN THAILAND<sup>1</sup>

## 1.0 INTRODUCTION

Thailand has a long history of forest management. At the turn of the 20<sup>th</sup> century the country had an estimated 75 percent of the land area under forest cover. However, this has dwindled down and the estimates of the Royal Forest Department (RFD) is about 26% although other estimates indicate that only about 19 percent of the land area remain under forest cover<sup>2</sup>. With the reduction in forest cover other resources have also dwindled.

Bamboo resources have also rapidly declined over the years. This has been due to over cutting, improper harvesting, illegal cutting as well as the insufficient knowledge on the efficient utilization of bamboo materials. The Regional Director of the RFD in Chian mai and Lamphoon provinces indicated that the supply of bamboo in his region has become unreliable and not sufficient to support the growing bamboo processing industries in the area<sup>3</sup>. Bamboo processors in the area have voiced the same sentiment. The owner of the Northern Enterprises Lamphoon L.P., which produces bamboo plywood, expressed that the reason they cannot expand their production is the insufficiency of bamboo raw materials. The VC Bamboo Industry Ltd. Part. in Tak Province, which produces and exports furniture, house wares and décor, complains of the declining supply of bamboo. In fact some of its supply comes from Myanmar.

The increasing domestic and export trade of bamboo and bamboo products and the diminishing supply of the resource has prompted the Royal Forest Department of Thailand to undertake a project on "The Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand" with funding support of the International Tropical Timber Association (ITTO). The project aims to study sustainable management of bamboo with a view to developing guidelines for improving sustainable management as well as promote the efficient and diversified utilization of bamboo to generate income sources for rural communities.

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<sup>1</sup> Report of the International Marketing Consultant to the ITTO project "Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand" in Bangkok, Thailand. August 20-September 1, 2002

<sup>2</sup> Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand, ITTO Project

<sup>3</sup> Personal communication with Dir. Pisan Vasuvanich, Regional Director, Chiang mai and Lamphoon. August 23, 2002.

## **2.0 TERMS OF REFERENCE OF THE UTILIZATION AND MARKETING CONSULTANT**

The efficient utilization of bamboo encompasses efficient and effective marketing of products. The project incorporates the engagement of a utilization and marketing consultant for ten days. The Terms of Reference (TOR) of the utilization and marketing consultant include:

1. Quick up access the demand of the market for bamboo products;
2. Identify potential products for the project;
3. Identify the machines and instruments for the laboratory; and
4. Prepare technical report in English at the end of the mission including findings and recommendations and submit to the project.

## **3.0 DEMAND AND SUPPLY OF BAMBOO**

There is not much available information on the supply of bamboo in Thailand. Forestry Statistics<sup>4</sup> indicate that the recorded quantity of production has been decreasing. The reported production in 1998 was 122,810 pieces valued at B2,251,349 and in 2000 the production was 71,210 pieces, a reduction of almost 50,000 pieces from 1998 production, valued at B2,018,695. The figures represent those reported. It is highly possible that there are unreported harvesting of bamboo from the natural forest.

The demand for bamboo poles differs from one industry to another. The bamboo plywood production in Lamphoon has the largest requirement among the enterprises visited, about 228,000 poles a year. The manufacturer of furniture, house wares and décor in Tak Province comes next with a requirement of 72,000 poles a year. It is estimated that there are 50 firms in Thailand engaged in the production of house wares and décor. If each firm has an average requirement of only 50% of the requirements of the manufacturer in Tak Province, the total demand from this sub-sector would be around 1.8 million poles. One village producing bamboo incense splints needs about 15,000 poles a year. There are an estimated 60 villages engaged in the production of incense sticks, toothpicks and barbecue skewers. This would translate to about 900,000 poles a year. The village weaving groups have the lowest pole requirements, amounting to only about 360 poles a year. It is estimated that there are 175 villages engaged in weaving and wicker works and their estimated requirements a year would be around 630,000 poles a year. The demand for bamboo poles in Thailand by manufacturers could be better estimated if the total number of firms under each category is known.

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<sup>4</sup> Forestry Statistics of Thailand 2000. Data Center, Information Office, Royal Forest Department.



## 4.0 DEMAND AND SUPPLY OF BAMBOO PRODUCTS

### 4.1 Foreign Demand for Bamboo Products

There is a wide range of commercial products produced in Thailand from bamboo. These include construction materials such as the bamboo plywood; furniture ranging from sala set, chairs, cabinets, tables, lounging chairs, others; house décor such as picture and mirror frames, candle holders, lampshades, etc; woven and wicker products that include trays, baskets of various shapes and sizes, ladies handbags, place mats, others.

The value of worldwide demand for furniture of various kinds is estimated at US\$ 32 billion<sup>5</sup>. The share of wood furniture is estimated at US\$12 billion. However, there is no estimate of the value of bamboo furniture export worldwide.

The export value for all kinds of furniture from Thailand for the 2000, 2001 and part of 2002 is shown in Table 1. There was a decrease in value from 2000 to 2001 although it is expected that the furniture exports will rebound in 2002. The total value of furniture exports in 2001 was US\$868.39 million. Of this value US\$505.39 was from wood furniture (Table 2). There was no indication of the share of bamboo furniture. However, in 2000 the value of furniture of other materials including cane, osier, bamboo or similar materials in 2000 was B339.73 million of close to US\$8.09 million<sup>6</sup>. From January to July 2002, the value of exports of furniture of bamboo, cane, osier and similar materials is reported at US\$1.8 million<sup>7</sup>.

Table 1. Value and percentage of furniture (all kinds) exports of Thailand

Countries	US\$million					
	2000		2001		Jan-July 2002	
	Value	%	Value	%	Value	%
USA	277.74	22.66	261.97	-5.68	144.76	25.37
Japan	351.54	11.33	327.29	-6.84	142.72	-11.07
UK	47.49	35.19	55.16	16.17	32.67	22.74
Australia	22.79	36.74	19.20	-15.76	16.64	94.07
Canada	22.77	16.43	29.50	29.58	16.47	66.72
Germany	26.19	9.22	21.86	-16.47	7.93	-35.15
Saudi Arabia	9.44	32.32	10.30	9.17	6.76	33.79
South Korea	11.95	24.90	10.62	-11.17	6.28	33.39
France	23.53	6.08	14.46	-38.54	6.25	-24.49
Singapore	9.82	20.71	6.88	-29.95	5.57	-97.41
Total	803.00	17.35	757.27	-5.69	386.07	9.03
Total of other countries	119.56	8.33	111.12	-7.06	52.88	-5.24
Grand Total	922.56	16.09	868.39	-5.87	438.95	7.08

Source: Department of Export Promotion, Ministry of Commerce

<sup>5</sup> Furniture and Handicraft Industry Research and Development Program. 2000. Forest Products Research and Development Institute, Department of Science and Technology, Philippines.

<sup>6</sup> Forestry Statistics of Thailand, 2000. *Op cit.*

<sup>7</sup> Department of Export Promotion, Import and Export Statistics. 2002.

Table 2. Value and percentage of wood furniture exports of Thailand

Countries	US\$ million					
	2000		2001		Jan-May 2002	
	Value	%	Value	%	Value	%
USA	226.59	22.02	207.98	-8.21	91.91	27.20
Japan	197.81	16.32	189.46	-4.22	72.17	-5.40
UK	15.40	13.22	16.56	7.55	8.73	42.15
Canada	14.86	10.19	19.45	30.91	7.76	64.87
Germany	12.88	5.11	10.88	-15.52	3.49	-33.18
South Korea	8.23	14.22	6.04	-26.61	3.13	30.78
France	11.93	12.87	6.48	-45.70	2.82	-0.84
Italy	5.80	10.00	5.69	-1.96	2.14	-21.92
Netherlands	6.47	19.20	5.09	-21.31	2.13	-16.58
Spain	2.63	41.38	2.56	-2.69	1.27	75.12
Total	502.91	16.45	470.19	-6.77	195.55	16.22
Total of other countries	40.18		35.20	-12.39	14.79	
Grand Total	543.09	17.02	505.39	-6.94	210.34	11.38

Source: Department of Export Promotion, Ministry of Commerce

At least three manufacturers export bamboo furniture to Japan, the US, Japan, Italy, and France. However, the value and volume of export of bamboo furniture are not known.

The demand for other bamboo products from Thailand is worldwide. The only manufacturer of bamboo plywood in Thailand exports to Germany, France and the United States. Other countries in Europe and elsewhere import bamboo products from Thailand such as lampshades, woven and wicker products, and handicraft, baskets, trays, boxes, place mats, candle holders, etc. The list of exporters is shown in Appendix A.

#### 4.2 Local Demand for Bamboo Products

In addition to the export products mentioned above, other products for the local markets include incense splints, charcoal, bamboo shoots, broom sticks, ladder, bamboo poles for mussel culture, and others.

Information on local demand for bamboo products in Thailand is not available. This may be due mainly to the informal nature of the market. Most products are traded locally without being recorded through local government offices. Indications of demand however, can be perceived from statements of bamboo products manufacturers. One firm producing furniture, house wares and décor indicates that markets have been increasing by an average of 40 percent during the last 3-4 years and this increase in demand is not mainly due to foreign exports of their products. A producer of lampshades would also like to expand production but lacks capital.

## **5.0 SHARE OF BAMBOO FARMERS OF THE SELLING PRICE OF BAMBOO PRODUCTS**

Most of the poles used by bamboo products manufacturers come from the natural forests. Middlemen procure the poles from collectors. The price of the poles varies according to species and sizes and the distance from the forest to the point of delivery. It cannot be readily estimated how much is the share of the bamboo collector of the price of the finished products. Most of the movement of bamboo poles from the collector to the manufacturer and from the manufacturer to the market is through middlemen.

In village where incense splints are produced, some illustration of the distribution of the price of splints can be roughly made. The middleman buys the raw poles at an average of B31/pole. One pole is estimated to produce 10 kg of dried splints that is priced at B12/kg. One pole therefore, would have a value of B120 of splints. The maker of the splints would take half a day to turn one pole of bamboo into splints and is paid B4/kg or roughly B40 for one pole. The middleman sells the splints at B12/kg or roughly B120 for the 10 kg of splints from one pole.

The share of the bamboo collector is B31/B120 or about 26%, the splint maker B40/120 or 30% and the middleman B49/B120 or 41 percent. The collector has the lowest share in price of the product produced.

## **6.0 STRATEGIES FOR MARKETING BAMBOO PRODUCTS**

There are a number of marketing strategies practiced by producers and manufacturers of bamboo processed products in Thailand. It varies from manufacturer to manufacturer depending upon the products being sold and upon the philosophy of the manufacturer. Hereunder are some of the strategies employed by producers of bamboo products.

### **6.1 Production of high quality products**

This strategy is based on the proposition that the best selling point of a product is the quality of the product. The products and the enterprise will get to be known from word of mouth if the products are of highest quality in the market. This is the philosophy of a producer of high quality furniture, home decor and house wares in Chang mai. The firm sells directly to customers who come to their store in Chang mai to make the order. The company does not rush the production of the ordered products lest the quality may suffer. Customers normally wait for two months to get their orders. It also does not want to expand not mass-produce so that the quality of the products can be controlled. Workmanship is highly supervised by a quality control officer. Workers are paid by piece and if the quality of workmanship does not meet the standards of the firm the workers have to do it again. About 40% of its sales are for export and the rest for domestic.

Maintaining good quality of products result in repeat orders. About 40% of the export sales of a manufacturer of bamboo baskets, trays, photo frames and mirror frames, candle holders and other items, is repeat orders. This is attributed to producing and maintaining high quality products. It used to be plague by rejection of delivered goods, once of twice a year. Now they have not any rejection since they became mindful of the causes of rejects which are related to the quality of their products.

Another producer of lamps and lampshades made of bamboo in Pa Bong Luang Village in Chiang mai province has experienced rejection of export products because of the quality of its goods. This was during the first three shipments that were made. The color of the products was not uniform. If the number of pieces is small it is easy to maintain a uniform color of the products. This becomes difficult when producing in large quantities and there is a schedule of delivery to meet. Focusing on the quality of the products resulted in repeat orders.

Consistency in product quality also avoids costly rejection of delivered goods.

## **6.2 Trade Fairs and Product Exhibitions**

Export sales have often started as a result of the products being exhibited in trade fairs, both local and abroad. A producer of bamboo plywood in Lamphoon province launched the export of its products more than 23 years ago by participating in a building exhibition in Netherlands and later in Cologne, Germany. Since then it has been exporting 30 percent of its production to Germany, France and the USA. It still continues to participate in the trade fair every two years.

Similarly, the firm in Chiangmai producing high quality furniture and house décor joined a trade fair in Bangkok about four years ago. This gave an exposure of its products to the public. Another bamboo processor in Tak Province joined the international trade fair in Bangkok in April 2002 and is planning to join the trade fair in Hong Kong next year. The producer of bamboo lampshades is not planning to join any trade fair because her company is too small and would not be able to handle any increase in orders. Furthermore, the owner contends, it takes too much time and she does not have sufficient time to prepare products for the exhibition.

The Department of Export Promotion (DET) through its Office of International Marketing Development holds annual international furniture fair. The next Thailand International Furniture Fair will be held on March 5-9, 2003 at the Bangkok International Trade and Exhibition Center. There is also the ASEAN Trade Fair that will also be held in Bangkok on October 14-20, 2002.

DEP is also assisting furniture manufacturers exhibit their products in international trade fairs abroad. These fairs include the Index Fair in Dubai in 2003, the Cologne Fair in Germany also in 2003, the International Fair in Singapore, in Lebanon, Poland and in China. The exhibitors pay for participation in the fairs but DEP prepares a catalogue on the exhibitors. In the International Furniture Fair in Tokyo on November 25 to December 1, 2002, DEP will assist a bamboo exporter to participate by paying half the plane fare of the representative to Tokyo.

DEP also operates the Thailand Furniture Mart, a display center for furniture. The participants pay rent for space at the mart.

### **6.3 Advertisement**

One of the most effective ways of promoting sales in consumer goods is through paid advertising in the papers, on radio or TV, and in billboards. For bamboo products in Thailand this is not a common medium for product promotion. Among the manufacturers visited only one had the experience in advertising in magazine such as El Décor and Home Décor. However, it does not regularly advertise now.

Exposure through advertising medium can create a market. The government has a "One Tambon (village) one product program" for promoting indigenous products from the rural areas. Because of this program of government TV channels visited a village weaving center women's cooperative in Pa Bong Luang Village in Chiang mai to feature this bamboo-weaving cooperative. After the TV feature, the manager of the cooperative claims that sales have greatly improved.

### **6.4 Through the Internet**

The DEP has a web page, [www.depthai.go.th](http://www.depthai.go.th), where manufacturers post their products. The bamboo furniture and house décor manufacturer in Chiang mai is posted in this website. Others are also posted. Eleven exporters of bamboo products have their own websites (see Appendix A). Only two of the 18 bamboo products exporters are not connected with the internet. The rest have their emails with which to correspond and conduct business with their foreign counterparts.

## **7.0 EXISTING SUPPORT MECHANISMS FOR MARKETING**

Efficient and effective marketing of bamboo and bamboo products locally and abroad depends on a number of factors. Paramount is the quality of the products. Product quality in turn depends on the inherent properties of the raw material, treatment provided, processing and workmanship, design of products, packaging and post-processing handling. Quality refers to properties of the product satisfying sets of standards. This report will not

dwell on treatment and processing as other consultants have studied these aspects in the project. This report looks at support mechanisms for marketing bamboo products.

### **7.1 Standards and Testing Facilities**

More and more buyers from Europe and North America require that products meet certain standards of quality of strength and durability. They require certification that samples of the products have undergone testing in International Standard Organization (ISO) certified testing laboratories, or their equivalents.

In Thailand the Department of Industrial Promotions (DIP) is mandated to provide this service through its Furniture Testing Laboratory. The Thai Industry Standards Institute is mandated to prepare standards. The committee members that formulated the standards for wood furniture included representatives from the private sector, the RFD and from the College of Forestry of Kasetsart University. The standards for wood furniture were adopted 15 years ago (1987) following the ISO Standards for chairs and stools (ISO 7173), for stability (ISO 7174-1), for cabinets (ISO 7170) and others.

There are no standards yet for bamboo furniture and if a manufacturer would like to have his furniture tested the DIP would use the standards for wood. However, there has not been any request for testing of bamboo furniture.

More and more furniture importers from countries such as in Europe and the United States are requiring that the products satisfy certain standards and certified by an accredited testing laboratory. The Furniture Testing Laboratory of the DIP has now started preparations for obtaining an ISO accreditation for ISO/IEC 17025. Prior to the accreditation, the DIP issues a *report of test* to manufacturers requesting for tests.

### **7.2 Design Center**

The design of the product enhances its quality. It is for this reason that manufacturers of high quality furniture, house wares and décor as well as handicrafts often engage the services of a designer. The designer could be in-house or on contract basis.

The DIP has an array of 80 designers assisting manufacturers. Among them are 4 designers providing villagers assistance in the design of handicrafts. The assistance is free for the villagers but the buyer of the products pays for the design. The buyer goes to DIP for the design of a product and when they agree on the design it is given to a producer in the village.

The manufacturer of high quality furniture and house décor in Chiangmai has an in-house designer. For others such as the manufacturer of furniture and house wares in Tak Province, the buyers have their own design of

products, which they bring to the firm for production. The exporter of lampshades made of bamboo and metal frame in Chiang mai, designs her products. Her buyers choose items from her designs, show them to their customers, before they make the orders.

The Product Development Center of the Department of Export Promotion also has designers to help manufacturers design their products. To promote furniture and in connection with the coming Thailand International Furniture Fair on March 5-9, 2003 a design contest among students is being held where pieces of furniture will be made based on their designs and will be exhibited during the International Trade Fair.

### **7.3 Industry Associations**

The furniture manufacturers in Thailand have an association. In fact there are two associations representing the furniture industry in Thailand. One of these is the Thai Furniture Industry Club (TFIC) of the Federation of Thai Industries (FTI) founded in 1978. Actually, the FTI is an upgrading of the former Association of Thai Industries established yet in 1967. The passage of the Federation of Thai Industries Act in 1987 required that the body be under the supervision of the Ministry of Industry to strengthen the private sector and make the industrialization of Thailand more sustainable by synchronizing it with other ongoing national economic development processes. The Thai Furniture Industry Club, in turn is a member of the FTI.

The other is the Thai Furniture Industries Association (TFIA) established on March 17, 1980. The TFIA membership has grown to about 300 companies. However, none of the bamboo furniture manufacturers is a member.

It is not known if there is an association of handicrafts manufacturers and weavers. None of the industry representatives visited are members of such organization.

### **7.4 Marketing Cooperatives**

Cooperatives and informal organizations or groups among bamboo manufacturers and processors exist especially in the villages. One example is the Po Bang Luang women's cooperative in Chang mai. The cooperative was established through the assistance of the government. The Ministry of Agriculture and Cooperatives provide the village with B20,000 to establish the cooperative with a promise for another B40,000. The cooperative is pinning its hope on the "One Tambon (village) one product program" of the present government. Bamboo handicraft is one of the chosen products. The cooperative serves as marketing outlet for products produced by village households. It obtains orders from buyers, distribute the orders to households and finished products are brought to the cooperative for delivery to customers.

An example of an informal group is the weaving group of Bang Chao Cha in Phothoong District, Ang Thong Province. The group consists of 100 members. The group has a center which was established through the Miyasawa Fund of Japan which provided B100,000. The fund was used to pay for the products produced by the members. The center takes orders from buyers and distributes the production of the items to members. The center imposes a fee of 10% on the products, which goes to the operations of the center. The center exports to Japan at a frequency of twice a month with about 1000 pieces of items per delivery. The group however, does not want to join any formal association or organization.

As has been shown in the two examples, an association or grouping could help the members obtain orders and market their products.

### **7.5 Role of Middlemen in Marketing Bamboo and Bamboo Products in Thailand**

The role of middlemen in the marketing of bamboo and bamboo products in Thailand is very important. They are the agents that move the raw materials from the source to the processors and from the processors to markets and customers particularly for small enterprises. They buy the raw materials from the harvesters and supply them to the manufacturers. They intercede by obtaining the products from the processors and deliver them to retailers/wholesalers and exporters. They often supervise or orchestrate the processing of products in villages by coordinating the supply of raw materials and the delivery of products to customers in the cities.

## **8.0 SOME CONSTRAINTS IN MARKETING**

### **8.1 Policy Constraints**

There appears to be very little constraints in the marketing of bamboo-based products in Thailand. While it is true that the transport of raw bamboo poles requires a permit from the local Forestry District of the Royal Forestry Department, manufactured goods of bamboo do not require such permit for transport. There is however, a policy of government that bamboo charcoal cannot be exported although they can be traded locally. Government is afraid that there would be unmitigated illegal cutting of bamboo for charcoal production for export if no such ban existed.

### **8.2 High Cost of Participating in Trade Fairs**

Many exporters of bamboo products indicate that participation in trade fairs especially in international venues improve sales. In fact, the export of bamboo plywood got its start when the manufacturer joined a building trade fair in Europe. However, it is expensive to join trade fairs especially the small manufacturers because of the fee for the exhibit space. They cannot



afford the rent. This is doubly difficult in international trade fairs because the manufacturer has also to shoulder the expense of transporting the exhibit materials. The Department of Export Promotion (DEP) is helping some exhibitors participate in international trade fairs. In the Tokyo International Trade Fair on November 25 to December 1, 2002 DEP will shoulder half the plane fare of the representative of a bamboo furniture and house wares manufacturer. DEP will also be responsible for preparing the brochures of exhibitors in the other international trade fairs.

### **8.3 High Cost of Transportation**

Another constraint in the marketing of bamboo products especially for village processors is the high cost of transporting the products. Some processors have arranged that the customers pay for transport cost. However, this redounds to the lower price that the processors can have for their products.

## **9.0 EMERGING BAMBOO PRODUCTS WITH POTENTIALS FOR COMMERCIAL PRODUCTION**

It appears that Thailand has a well-developed bamboo industry. While there are very few furniture exporters, there are quite a number of small enterprises producing bamboo furniture and supplying the exporters. The technology for bamboo furniture is also well developed. In the case of house wares and decors the products can compete internationally in terms of quality of workmanship. This is equally true for woven and wicker products. These industry sectors have the advantage of good quality raw materials (bamboo species) suitable for weaving and also highly developed artisans in the art of weaving. The skill in weaving is handed down from generation to generation in the villages. There are new and emerging bamboo products that the Project may want to study.

### **9.1 Reconstituted bamboo products**

In the construction sector, only the bamboo plywood is produced commercially. However, bamboo lends itself to the production of reconstituted products such as particleboards, fiber boards, and veneer products. These products using wood as raw have found commercial use in construction as well as in furniture and cabinetry. Bamboo could prove to be a suitable material for such products.

### **9.2 Laminated bamboo timber**

Another construction product that can be produced from bamboo is the laminated bamboo timber. This is made of bamboo strips about 2-3 inches (5-7 cm) wide and laminated in the direction of the fibers. The width and length of the timber is dependent on its use. It could be used for doorjambs,

doorframes, window jambs, table posts, and similar uses. A variation this is one where the bamboo is crushed, mixed with adhesives and pressed. Thicker materials can be produced. The material can be used for joist, beams and posts.

### **9.3 Bamboo Charcoal and Distillate**

Although bamboo has been charcoaled probably since time immemorial the emerging technology for charcoaling bamboo allows for the production of high quality charcoal suitable for industrial uses such as activated carbon. The technology also allows the concomitant extraction of the distillate for the production of a variety of products such as air freshener, disinfectant, fungicide, for prolonging the life of cut flowers and similar uses. Japan is already commercially producing bamboo distillate or "vinegar".

## **10.0 FINDINGS**

The duration of the study is 10 days. Though limited it has allowed for some observations in the production and utilization of bamboo in Thailand. Some of the observations include:

1. There is limited information on the resources especially in the natural forests. The statistics from the Royal Forest Department do not include the estimate of the area or volume of bamboo in the natural forest. It also does not include the area of established plantations by the government and the private sector.

2. There appears to be a limited supply of bamboo materials as claimed by some of the manufacturers. Some of them are inclined to increase their production but are constrained because of the unreliable source of raw materials. While there are private plantations developed some of them are for the production of bamboo shoots and the management of these plantations produces culms that are not mature enough for furniture or for other products.

3. The collector of bamboo from the forest appears to have the least share of the price of the product. This is so in the case of the manufacture of incense splints. He gets only about 26% of the price. It is difficult to make similar calculations in the other products because of the information is not complete.

4. There appears to be some interest of the private citizens to plant bamboo. Seen in nurseries along the highways selling ornamental plants, fruit trees, and forest trees, are seedlings of bamboo. One bamboo seedling costs B15.00.

5. Middlemen play a vital role in the processing and marketing of bamboo products in Thailand. They procure and supply the raw materials of processors and they distribute products from manufacturers to customers.

6. The quality of products from bamboo particularly those destined for foreign markets is high and certainly is capable of competing in the world markets. This is enhanced by the presence of species that are highly suitable for the production of woven and wicker products, furniture, house wares and décor, and other handicrafts and by the presence of highly skilled craftsmen in the art of weaving.

7. There is a viable support mechanism for the industry. The Department of Export Promotion is assisting the industry, albeit limited only, promote their products abroad through participation in international trade fairs. It also holds local international trade fairs in Bangkok. It also provides support for designing of products. The Department of Industrial Promotion has a testing laboratory for testing the furniture products. It is now in the process of getting accreditation from the ISO. The Royal Forest Department and the College of Forestry of Kasetsart University provide the needed technologies to the industry.

There is however, a clamor for more government assistance in terms of provision technology, information about industries in neighboring countries, in design and pricing, and larger assistances in participating in foreign trade fairs.

8. There exist two associations of furniture manufacturers in Thailand, the Thai Furniture Industry Club (TFIC) under the Federation of Thai Industries (FTI), which is a creation of government, and the Thai Furniture Industries Association. These two associations promote the furniture industries of the country. However, no bamboo furniture manufacturer is listed as members in any of the associations. It is not known if there is a corresponding industry association for handicraft manufacturers and how many among the bamboo handicraft producers are members of this organization.

9. The products coming from bamboo processors are traditional products such as furniture, handicrafts, woven and wicker products, house wares and decors. The bamboo plywood has been produced in Thailand for more than 20 years and cannot be considered as new product. Production of bamboo distillate is being tried at the experimental level. There are no new products for construction purposes.

10. One major problem in bamboo processing and utilization is the general susceptibility of bamboo to damage by termites and fungi. Some processors are applying some forms of preservatives, generally water-borne.

In some instances the preservatives proved to be ineffective because of insufficient amount absorbed and the very limited depth of penetration.

## 11.0 RECOMMENDATIONS

The following are some of the tentative recommendation on further utilization of bamboo as well as in marketing of bamboo products:

### 1. Establishment of a database for bamboo and bamboo products

The unavailability of data and information on bamboo resources and products signify the need for the establishment of a database on bamboo. The database can include, tentatively, information on resources (area and volume of bamboo in the natural forest and in plantations) and if possible by species; volume of production (if possible by species) by province; volume traded (if possible by species); price of raw poles (if possible by species); volume of products produced by product type (furniture, house wares, house décor, woven and wicker products, trays, etc.); list of bamboo processors; prices of products (local and export); list of exporters; list of foreign buyers; etc.

The database will provide those interested in going into the business of plantation development as well as in processing information that will allow them to make certain decisions. It will allow government to identify the kind and extent of assistance it will provide to the bamboo industry sector.

### 2. Establishment of an industry association

The Thai Furniture Industry Association does not have any bamboo furniture manufacturer as member. Most of the members are wood furniture manufacturers. Such an association for bamboo producers and manufacturers would provide assistance to farmers, village processors, exporters and traders of the raw materials and products. The association would provide assistance in acquiring technology, raw material sourcing, policy advocacy, importation of machineries and equipment, setting up of common service facilities for groups of villages who do not have the needed resources to establish one for themselves, price negotiations with customers/buyers/middlemen and training of members.

### 3. Studies on new and emerging bamboo products

The following are some recommended products to be studied. Equipment needed for the studies are found in Appendix B.

#### *a) Cement-bonded bamboo particleboard*

The cement-bonded bamboo particleboard would expand the horizon for bamboo utilization and provide alternative materials for construction. It can also be used in furniture manufacture such as in tabletops with or with

out veneer overlays. It can be produced with a minimum of equipment and certainly would provide a base for enterprises in the villages.

The Forest Products Research Division of the RFD has the necessary equipment for studying the various production parameters for cement-bonded bamboo particleboards. The Division has a chipper and flaker, a cement-raw material mixer, and cold press. Tests for mechanical properties can be done at the universal testing machine of the College of Forestry at Kasetsart University.

*b) Bamboo veneer tiles/tabletops/paneling*

Bamboo veneer tile is a product that can find varied uses both in the construction as well as in the furniture sector. The bamboo is cut into 1-2 mm thick veneer, which is then laminated to plywood or particleboard. The resulting product can be used for floor tiles, tabletops, back of chairs, for doors, for paneling and similar applications.

The Forest Products Research Division has a 30-inch veneer lathe that is most suitable for veneering the bamboo and hot pressing for laminating the veneer to plywood. For tests of mechanical properties, the testing equipment of Kasetsart University can be availed of.

*c) Solid bamboo tiles*

Bamboo tiles are now being exported from China. Information from a knowledgeable source indicates that a square meter of bamboo tiles cost US\$30. The tile is made of bamboo slats 2.5 cm wide and about 0.5 cm thick laminated edgewise. The tile is about 60-70 cm long and about 10 cm wide. It is finished with a tongue and groove along its side in the longitudinal direction. It can be used, in addition to floor tiles, as table top, paneling and similar applications.

There is one firm producing and exporting bamboo parquet in Nontha Buri province. The type of parquet being produced, however, is not known.

The production of tiles and parquet should be studied as potential for expanding the use of bamboo. The Forest Products Research Division of the RFD has the needed equipment. It has circular a rip saw to cut the bamboo into slats of uniform width, a surfacer to produce uniform thickness and hot press to laminate the slats. Shear test is needed to determine the strength of the glue bond.

#### 4. Establishment of Village Cooperatives

The value of cooperatives or groups as a mechanism for collective efforts in production and marketing of bamboo products has been demonstrated in two such organizations at the village level that were visited

in the study. The efforts of the Project to establish such cooperatives are highly endorsed.

#### 5. Production of bamboo distillate or vinegar

Under destructive distillation of bamboo two products can be obtained, the charcoal and the distillate. The utilization of bamboo for charcoal and distillate is now being studied by the Project. Again the efforts of the Project in this area, particularly in the production of the distillate, are likewise highly endorsed. It is also suggested that the Project pursues undertaking proximate chemical analysis of the distillate and study its various uses. The product has high potential as export especially in Japan.

6. One effective and relatively inexpensive method of impregnating preservatives into wood and for that matter bamboo is the high-pressure sap displacement method (HPSD). It is a modification of the Boucherie process where the preservative is forced at one end of green (wet) material at pressures of about 100 psi. This process should be studied to determine its effectiveness for the treatment of bamboo poles.

## 12. ACKNOWLEDGEMENTS

The Consultant wishes to acknowledge the depth of gratitude he owes to a number of persons at the Royal Forest Department, owners/managers of the industry firms visited around the Thailand and for all those who in one way or another contributed to the success of the consultancy. In particular, the Consultant thanks Mrs. Wanida Subansanee, the Project Leader of the Study for her invitation and for making all the arrangements for the consultancy and her staff for assisting the Consultant visit bamboo processing firms and government organizations and in obtaining valuable information for the study.

## Appendix A

### Exporters of Bamboo Products

1. **Global Merchandise Group Co., Ltd.**

25 Soi Onnuth 36, Onnuth Rd., Suanluang, Bangkok 10250, Thailand  
Tel: (662) 917 6752 Fax: (662) 517 0827  
Email: [cpbkk@pacific.net.th](mailto:cpbkk@pacific.net.th) Web site: [www.gmgthailand.com](http://www.gmgthailand.com)  
Established: 2001 Capital: 1,000,000  
Bank: The Siam Commercial Bank PCL  
Attn: Mr. Chavasorn Phucharoenyos  
**Export Products: Bamboo baskets, handicraft**

2. **K.V.M. 555 Co. Ltd.**

3 Soi Pattanakarn 28, Pattanakarn Rd., Suanluang,  
Bangkok 10250, Thailand  
Tel: (662) 719 5827 to 9 Fax: (662) 318 3635, 314 4811  
Email: [kvmco@loxinfo.co.th](mailto:kvmco@loxinfo.co.th)  
Established: 1989 Capital: 5,000,000  
Bank: Krung Thai Bank Ltd.  
Attn: Mr. Tavesit Siriphocakit  
**Export Products: Chopstick, barbecue wood skewers,  
bamboo products**

3. **Rurban Co. Ltd.**

346/372 Soi Ratchada 36, Ratchada Pisek Rd., Ladyao, Jatujak,  
Bangkok, Thailand 10900  
Tel: (662) 930 7744, 930 7745, 930 5636 Fax: (662) 930 7746, 930 0532  
Email: [kalyakom@rurbanthai.com](mailto:kalyakom@rurbanthai.com) Web site: [www.rurbanthai.com](http://www.rurbanthai.com)  
Established: 1999 Capital: 1,000,000  
Bank: Thai Farmers Bank PCL  
Attn: Ms. Kalyakorn Phongphit  
**Export Products: bamboo & rattan furniture, decorative items-lamps,  
bamboo baskets**

4. **Star Jasmine Co., Ltd.**

24/9 Jaruworn St., T. Phanat Nikhom, A. Phanat Nikhom,  
Chonburi, Thailand 20140  
Tel: (6638) 463 823, (661) 996 4878 Fax: (6638) 463 823  
Email: [pornarong@hotmail.com](mailto:pornarong@hotmail.com) Web site: [www.starjasmine.com](http://www.starjasmine.com)  
Established: 2002 Capital: 1,000,000  
Bank: Bangkok Bank PCL  
Attn: Mr. Pornarong Ittianuntakasem  
**Export Products: Baskets with bamboo strips, bags, & baskets,  
Silverware Home textile**

5. **Thepsatit Co., Ltd.**  
 126/33 Ramkhumheang 24, Huamark, Bangakapi, Bangkok 10240  
 Tel: (662) 719 0488, 300 4969 Fax: (662) 719 0489  
 Email: [thepsatit@hotmail.com](mailto:thepsatit@hotmail.com)  
 Established: 1993 Capital: 500,000  
 Bank: Bangkok Bank Public Ltd.  
 Attn: Ms. Somchit Nitivadeeluksana  
**Export Products: Bamboo baskets, gift & decorative items, handicraft, woodcarving**
6. **Maison des Arts Co., Ltd.**  
 1334 New Rd., Suriwongse, Bangrak, Bangkok, Thailand 10500  
 Tel: (662) 234 7549 Fax: (662) 233 6297  
 Email: [mdath@inet.co.th](mailto:mdath@inet.co.th)  
 Established: 1985 Capital: 1,000,000  
 Bank: Siam Commercial Bank  
 Attn: Mr. Sunthorn Vichacharnchai  
**Export Products: Stainless steel cutlery, bamboo baskets**
7. **Nalakarn Thai Handicraft Co., Ltd.**  
 48 Sukhumvit 101, Punnawithee 28, Bangjak, Prakanong, Bangkok, 10260  
 Tel: (662) 743 4639 Fax: (662) 743 4639  
 Email: [malakarn@hotmail.com](mailto:malakarn@hotmail.com) Web site: [www.malakarn.thailand.com](http://www.malakarn.thailand.com)  
 Established: 2001 Capital: 1,000,000  
 Bank: Bank of Asia PCL  
 Attn: Ms. Savapat Soontonmongkol  
**Export Products: Bamboo handicraft**
8. **Spyme Co., Ltd**  
 54/38 Moo 8, Chimplee, Talingchan, Bangkok 10170  
 Tel: (662) 884 4176 Fax: (662) 884-4558  
 Email: [info@thespyme.com](mailto:info@thespyme.com) Web site: [www.thespyme.com](http://www.thespyme.com)  
 Established: 2001 Capital: 600,000  
 Bank: The Siam Commercial Bank PCL  
**Export Products: Bamboo products, mulberry paper, lampshade, handicraft**
9. **Kaew Tavee Ltd. Part.**  
 224/3-4 Changwattana Rd. (Near Soi 22), Parkret, Nonthaburi 11120  
 Tel: (662) 962 0720-3, 964 6112-4 Fax: (662) 583 9150  
 Email: [sktw@tcc.or.th](mailto:sktw@tcc.or.th)  
 Established: 1980 Capital: 1,000,000  
 Bank: Bangkok Bank PCL  
 Attn: Mr. Vivat Rojana-arpa  
**Export Products: Plywood, bamboo parquet**



**10. Northern Enterprises Lamphoon L. P.**

91 Moo 5 Wieng-yong, Muang, Lamphun 5100

Tel: (6653) 561 234

Fax: (6653) 561 405

Email: [psi@lamphun.net](mailto:psi@lamphun.net)

Web site: [www.a-premiumproducts.com](http://www.a-premiumproducts.com)

Established: 1979

Capital: 30,000,000

Bank: The Siam Commercial Bank PCL, Paheo (Lamphun)

**Export Products: bamboo plywood**

**11. V.C. Bamboo Industry Ltd. Part.**

76/2 Prasatvithee Rd., Maesod, Tak 63110

Tel: (6655) 532 346

Fax: (6655) 532 940

Email: [vcbamboo@loxinfo.co.th](mailto:vcbamboo@loxinfo.co.th)

Established: 1998

Capital: 3,500,000

Bank: Krung Thai Bank PCL

Attn: Mr. Wichit Ruechuroj

**Export Products: Bamboo pole, blind, tray, picture frame, baskets, furniture**

**12. Ratana Art Co., Ltd.**

105/2 Waulai Soi 1, Amphur Muang, Chiangmai 50100

Tel: (6653) 274 946, 271 816

Fax: (6653) 271 907

Established: 1988

Capital: 2,000,000

Bank: The Siam Commercial Bank, Ltd.

**Export Products: Wooden sculpture, antique reproduction, bamboo basket**

**13. Orchid Design and Export Co. Ltd.**

263 Moo 2, Sunpisua, Chiangmai 50300

Tel: (6653) 379 097

Fax: (6653) 379 636

Email: [orchids@loxinfo.co.th](mailto:orchids@loxinfo.co.th)

Web site: [www.orchiddesign.com](http://www.orchiddesign.com)

Established: 2000

Capital: 1,000,000

Bank: Bangkok Bank PCL

Attn: Mr. Sayan Suriyakam

**Export Products: Bamboo baskets, handicraft products, candles**

**14. Saint Thames Group Co., Ltd**

31/5 Moo 3, T. Sanklang, A. Sankampaeng, Chiangmai 50130

Tel: (6653) 384 399, 852 230

Fax: (6653) 384 400

Email: [stthames@loxinfo.co.th](mailto:stthames@loxinfo.co.th)

Web site: [www.stthames.com](http://www.stthames.com)

Established: 1998

Capital: 1,000,000

Bank: Bangkok Bank PCL

Attn: Mr. Somchai Intharakaset

**Export Products: Cotton fabric, handicrafts, bamboo baskets & Products**

**15. Srimhaingarm Co., Ltd.**

100/32 Moo 7, Banwan, Hangdong, Chiangmai 50230  
Tel: (6653) 433 703 Fax: (6653) 433 702  
Email: [tanno@loxinfo.co.th](mailto:tanno@loxinfo.co.th) Web site: [www.srimhaingarm.co.th](http://www.srimhaingarm.co.th)  
Established: 1998 Capital: 2,000,000  
Bank: Siam Commercial Bank  
Attn: Mr. Tanon Hongdalud  
**Export Products: Teak furniture, bamboo baskets, wood carvings,  
cartwheel Furniture**

**16. Thai Bamboo Industry Co., Ltd**

14/9 Rajchiangsan Soi 2A Rd., T. Haiya, A. Muang, Chiangmai 50100  
Tel: (6653) 282 299, 206 564 Fax: (6653) 282 192  
Established: 1977 Capital: 1,000,000  
Bank: Krung Thai Bank Ltd.  
Attn: Mr. Yothin Manaboon  
**Export Products: Chopsticks, barbecue wood skewers,  
bamboo baskets**

**17. Wongpitak Export Co., Ltd.**

82 Bosang Village, Sankamphaeng, Chiangmai 50130  
Tel: (6653) 338 305, (661) 783 3711 Fax: (6653) 338 305  
Email: [sales@wongpitak.com](mailto:sales@wongpitak.com) Web site: [www.wongpitak.com](http://www.wongpitak.com)  
Established: 2001 Capital: 1,000,000  
Bank: The Siam Commercial Bank PCL  
Attn: Mr. Pitak Intawong  
**Export Products: Handicraft (vase, pot, etc), bamboo (box, place  
mats, candle holder)**

**18. Gerard Collection Co. Ltd.**

6/23-24 Nimmanhaemin Rd., Muang, Chiangmai 50200  
Tel: (6653) 220 604 Fax: (6653) 216 567  
Email: [bamboo@chmai.loxinfo.co.th](mailto:bamboo@chmai.loxinfo.co.th) Web site: [www.thaibamboo.com](http://www.thaibamboo.com)  
Established: 1994 Capital: 1,000,000  
Bank: Thai Farmers Bank PCL, Thaphae  
Attn: Ms. Sakultala Panasampol, and Mr. Tosporn Panasampol  
**Export Products: Bamboo furniture, bamboo house wares and décor**

## Appendix B

### Recommended Studies

#### 1. Cement bonded particle boards

##### Objective of the Study

To determine the suitability of bamboo and establish the parameters for the optimum conditions for the production of cement-bonded particle boards.

##### Materials

1. Bamboo species
  - a. *Bambusa blumeana* (Pai seesuk)
  - b. *Dedrocalamus asper*
  - c. *B. sp.*
  - d. (other species)
  - e. (other species)
2. Cement
3. Water
4. Chemical accelerators

##### Parameters

1. Species: 5 species
2. Bamboo/cement ratio: 40/60 (bamboo/cement); 30/70; and 20/80
3. Cement/water ratio: water is 60% of cement by weight
4. Accelerators: Calcium chloride: 3% of cement by weight  
Aluminum sulfate: 3% of cement by weight
5. Soaking time: a) no soaking  
b) 12 hours  
c) 24 hours
6. Board density: 1,000 kg/m<sup>3</sup>, and 1,200 kg/m<sup>3</sup>
7. Pressing time: 24 hours
8. Number of samples per treatment combination: 3 samples

##### Method

1. Collect materials for each of the 5 species sufficient to produce 20 sheets of cement bonded particle boards, 12 inches (30 cm) by 12 inches (30 cm) by 0.5 inches (12 mm)
2. Prepare the particles by passing the bamboo culms through a chipper producing the particles. Soak the chips according to the soaking schedule: 0, 12, and 24 hours
3. Dry the materials to about 18% moisture content or the equilibrium moisture content (EMC) of the locality

4. Mix the bamboo materials with the cement, water and the accelerator in a mixer.

5. Form the mat in an forming box producing boards of about 30 cm<sup>2</sup>

6. Press the mat for 24 hours in a cold press. Several mats can be pressed at the same time depending upon the opening of the press

7. After pressing clamp the mats so that they are still under the same pressure, remove from the press and set the batch aside. This will free the press for the next pressing schedule. Keep the boards under pressure for 24 hours

8. Remove the clamps after 24 hours and let the boards stand on their side for further curing for 28 days

9. Obtain sample materials from the board following ASTM standards for determination of the physical (density, thickness swelling, water absorption) mechanical properties (modulus of elasticity, modulus of rupture, internal bond, nail head pull through) of the board.

#### Equipment Needed for the Study

1. Chipper for the production of chips or particles
2. Soaking tank
3. Mixer for mixing the chips, cement, water and accelerator
4. Mat forming box
5. Press
6. Universal Testing Machine for testing mechanical properties

## **2. Bamboo Veneer Tiles/Table Tops/Paneling**

#### Objectives of the Study

1. To determine the technical feasibility of producing rotary cut veneer from bamboo
2. To establish the parameters for producing veneered tiles, table tops and paneling using bamboo veneer
3. To determine the properties of the veneer overlay on plywood substrate, and
4. To determine the cost of producing bamboo veneer tiles, table tops and paneling.

#### Materials

1. Bamboo species with thick walls
  - a. *Bambusa blumeana*
  - b. *B. sp.*
  - c. (Other species)
  - d. (Other species)
  - e. (Other species)



5. Application of glue – For the hot pressing apply the UF at a spread of 190-220 gm/m<sup>2</sup> of area for a single glue line; for the polyvinyl acetate (carpenter's glue) apply the same amount

6. Hot pressing – Press the bamboo veneer on plywood substrate preferably marine plywood using the schedule of 1 min/mm and 2 min/mm of thickness at a pressure of 15 kg/cm<sup>2</sup> and a pressing temperature of 150°C

7. Cold pressing – Press the bamboo veneer on plywood substrate preferably marine plywood using the schedule of 2, 4 and 6 hours pressing time, and pressure of 15 kg/cm<sup>2</sup>

8. Bond test (delamination test) – Conduct cyclic boil test using ASTM standards

9. Service test – Conduct service tests on the bamboo veneer overlaid plywood by actually using the materials as floor tiles or as tabletops or a paneling.

10. Evaluation of tests – The probable failures of the veneer overlay may come as delamination and splitting. The materials will be evaluated separately after 1 year of service testing.. Delamination of less than 10% of the total surface area may be considered excellent, 11-35% satisfactory, and above 35% unsatisfactory.

#### Equipment Needed for the Study

1. Boiling tank for the raw materials
2. Rotary lathe, 30 cm long
3. Hot press
4. Cold press (hot press can be used without raising temperature of platens
5. Boiling receptacle for the delamination samples

### 3. Solid Bamboo Tiles

#### Objectives:

1. To determine the bamboo species suitable for solid bamboo floor tiles
2. To determine the parameters for production of solid bamboo floor tiles, and
3. To determine the cost of production

#### Materials:

1. Bamboo culms
2. Adhesives

#### Parameters

1. Five species of bamboos preferably those with thick walls
  - a. *Bambusa blumeana*

- b. *B. sp.*
- c. (other species)
- d. (other species)
- e. (other species)
- 2. Adhesives
  - a. Urea formaldehyde at 190-220 gm/m<sup>2</sup> of single glue line
  - b. Polyvinyl acetate
- 3. Pressing
  - a. Hot pressing time: 1 min/mm thickness, and 2 min/mm thickness for UF
  - b. Cold pressing: 2, 4 and 6 hours
- 4. Number of samples per treatment combination: three (3) samples

#### Methods

1. Collect bamboo culms of the species identified for materials of the study. Cut the culms to about 50 cm long (the length depends on the available hot press)
2. Split the culms into about 2.5 cm wide slats
3. Pass the slats through a surfacer to remove the inner soft portion
4. Pass the slats through a slicer to produce 7 mm thick slats
5. Dry the slats to about 8-12% moisture content for those that will be used with UF glue and about 18% MC for those that will be used with the PVA glue
6. Apply the UF on the edge of the specimens and laminate them edge-wise using a hot press and according the schedule of 1 min/mm and 2 min/mm thickness producing 15 cm wide boards
7. Apply the PVA (carpenter's glue) edge-wise and cold press the specimens at 2, 4 and 6 hours producing 15 cm wide boards
8. Laminate 3 boards on top of each other to produce 21 mm thick boards
9. Pass the boards through a tongue-and-groove machine (optional)
10. Subject the boards to a delamination test using ASTM standards
11. Service test the boards by actually using it as a flooring material in an office area

#### Equipment Needed for the Study

1. Bamboo splitting machine
2. Bamboo slicer
3. Surfacer or planner
4. Hot press
5. Cold press (hot press can be used without raising temperature of platens)
6. Boiling receptacle for the delamination tests

## 5. High Pressure Sap Displacement Method of Preservative Treatment

### Objectives:

1. To establish the parameters for the use of high pressure sap displacement (HPSD) method for the treatment of bamboo poles;
2. To determine the effectiveness of the HPSD for treating bamboo poles with preservatives

### Materials

1. HPSD equipment
2. Newly harvested bamboo poles
3. Water-borne preservatives

### Parameters

1. Five species of bamboos
  - a. *Bambusa blumeana*
  - b. *Dendrocalamus asper*
  - c. *B. sp.*
  - d. (Other species)
  - e. (Other species)
2. Two water-borne preservatives proven effective against termites and fungi
  - a. Preservative A (at 5, 7.5 and 10% concentration)
  - b. Preservative B (at 5, 7.5 and 10% concentration)

### Method

1. Harvest the bamboo culms
2. Determine the moisture content of the butt end and top of the bamboo poles
3. Without allowing the bamboo to start losing moisture, subject it to HPSD treatment. A receptacle should be placed at the other end of the bamboo pole to catch any effluent preservative coming from the bamboo.
4. Determine the time it takes for the preservative effluent to start coming from the other end.
5. Preservative treatment is completed when the specific gravity of the effluent approximates that of the original concentration of the preservative solution.

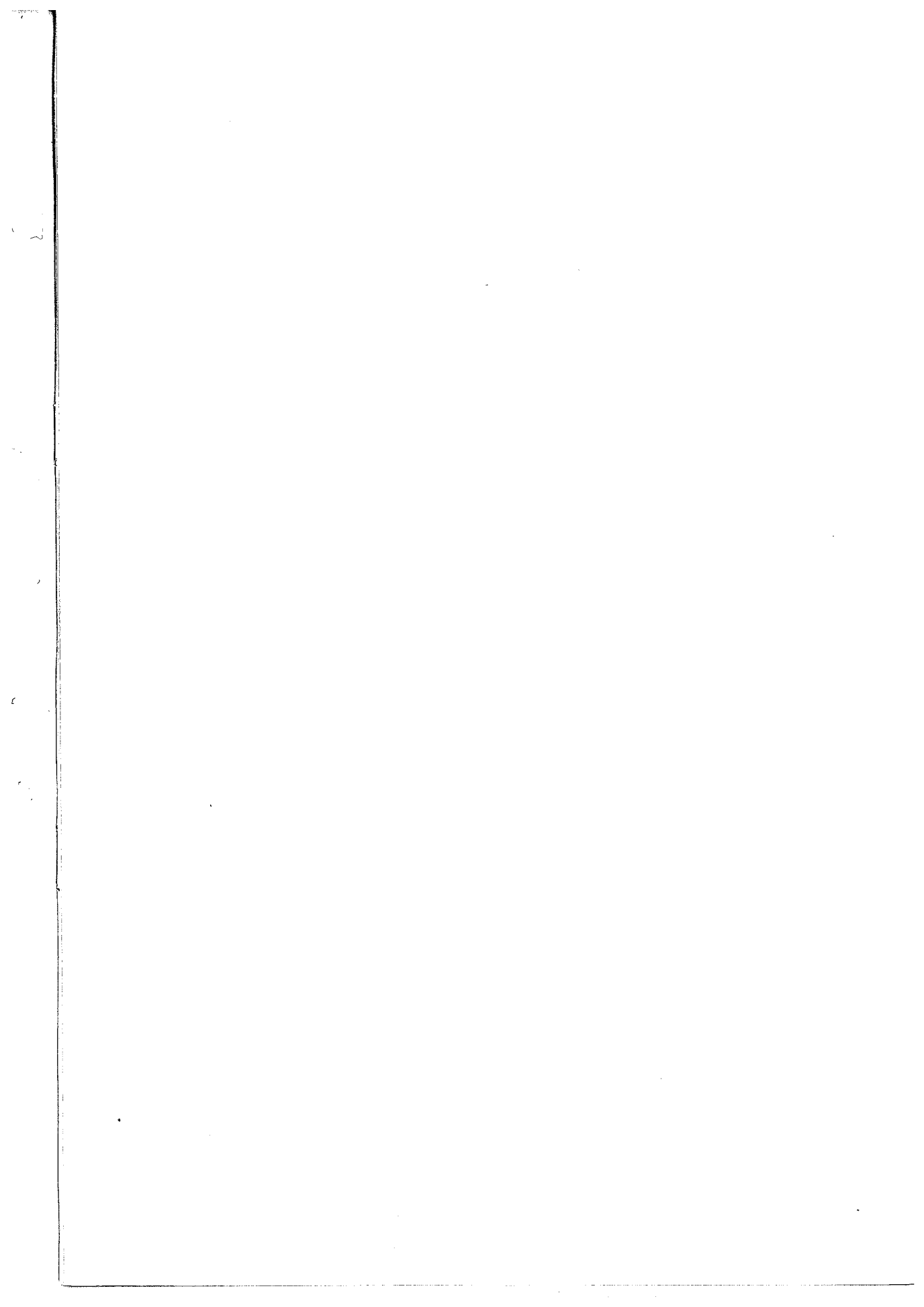


## Appendix C

### List of Persons Visited/Who Assisted in the Study

1. Ms. Wanida Subansenee  
Project Leader  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
2. Ms. Pannee Denrungruang  
Study Leader  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
3. Mr. Suchart Thaipetch  
Senior Forest Officer and Study Leader  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
4. Ms. Nuchanart Nilkamhaeng  
Scientist and Study Leader  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
5. Ms. Mayuree Jitkaew  
Scientist  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
6. Mr. Vallayuth Fueangvivat  
Study Leader  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
7. Ms. Arunee Veenin  
Scientist  
Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand  
Forest Research Office, Royal Forest Department, Bangkok, Thailand
8. Mr. Wichan Ruechuroj  
Managing Director  
VC Bamboo Industry Ltd. Part., Maesod, Tak, Thailand

9. Mr. Wichit Ruechuroj  
Marketing Manager  
VC Bamboo Industry Ltd. Part., Maesod, Tak, Thailand
10. Mr. Seubtrakul Phuphisith  
Northern Enterprises Lamphoon, L. P., Lamphun 51000, Thailand
11. Ms. Orapin Rujiphan  
Gerard Collection (Home Décor) Co. Ltd.  
6/23-24 Nimmanhaemin Road, Chiang mai 50200 Thailand
12. Mrs. Renu Thongngam  
Bang Chao Cha Weaving Group  
Bang Chao Cha, Photong District, Anghthong Province
13. Mr. Phumisak Boontam  
Bamboo Shoot Plantation Owner  
Ban Kum, Bang Bal District, Ayuttaya Province
14. Ms. Buakew Junnoi  
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สำนักวิจัยการจัดการป่าไม้และผลผลิตป่าไม้ กรมป่าไม้

สนับสนุนโดย

องค์การไม้เขตร้อนระหว่างประเทศ

( International Tropical Timber Organization - ITTO )