



**MINISTRY OF FORESTRY
FOREST DEPARTMENT, MYANMAR
AND**



INTERNATIONAL TROPICAL TIMBER ORGANIZATION

ITTO Project PD 146/02 Rev.1(I)

"Promoting Sustainable Utilization of Bamboo through Community Participation in
Sustainable Forest Management "

**Training on Bamboo Products Processing and
Bamboo Forest Management**



Hainan, Sichuan and Zhejiang Provinces, People's Republic of China

May 26 to June 9, 2004

**Training on Bamboo Products Processing and Bamboo Forest Management
at Hainan, Sichuan and Zhejiang Provinces, People's Republic of China
May-26 to June-9, 2004**

Aung Zaw Moe (Research Assistant)
Zaw Win Myint (Range Officer)
Mu Mu Aung (Research Assistant)
Khine Khine Tun (Research Assistant)
Aung Soe (Assistant Research Officer)
Khine Maung Oo (Assistant Director)

Forest Department Compound, West Gyogone, Insein, Yangon, Myanmar

Tel: (951) 681857, 681858, 664457

e-mail TEAKNET@mptmail.net.mm

CONTENTS

1.	Abstract	1
2.	Report on Bamboo Propagation and Cultivation	2
3.	Report on Bamboo Forest Management	9
4.	Report on Bamboo Plantation for Shoot Production	14
5.	Report on Bamboo Products Processing (Bamboo Shoot Processing and Bamboo Charcoal Making)	18
6.	Report on Bamboo Handicraft Techniques and Furniture	23
7.	Bamboo Products Marketing	28

**Report on Training on Bamboo Products Processing and
Bamboo Forest Management at Hainan, Sichuan and Zhejiang Provinces,
May-26 to June-9, 2004**

In Myanmar, bamboo resource is abundant, but their utilization is limited due to the outdated processing techniques and lack of quality products. Myanmar needs to utilize bamboo resources sustainability and produce quality products. "Promoting Sustainable Utilization of Bamboo through Community Participation in Sustainable Forest Management" Project, PD 146/02 Rev.1 (I) is implementing to enhance the socio-economic benefits of bamboo for the rural communities through their active participation in sustainable management and utilization of bamboo forest jointly organized by the Forest Department and the International Tropical Timber Organization (ITTO). To support this project, 6 project staff attended the Training on Bamboo Products Processing and Bamboo Forest Management at Hainan, Sichuan and Zhejiang Provinces, People's Republic of China, from May-26 to June 9, 2004. The training was organized by International Network for Bamboo and Rattan (INBAR) and International Farm Forestry Training Centre (INFOTRACE) of the Chinese Academy of Forestry (CAF). The training on bamboo shoot processing, handicraft and bamboo forest management (propagation, nursery and harvesting) was carried out in Hainan Province. The handicraft training on bamboo weaving and furniture was specifically carried out in Sichuan Province. Bamboo carving and industry on flooring, curtain, chopsticks, shoot processing, etc. were conducted in Zhejiang Province. Two staff continued to attend Bamboo Forest Management Training Course between 10.6.02 to 20.6.02 at Yunan Province.

The following staff emphasized on their specific field of interest on bamboo industry and management:

1. Mr. Aung Zaw Moe (Bamboo Propagation and Cultivation)
2. Mr. Zaw Win Myint (Bamboo Forest Management)
3. Ms. Mu Mu Aung (Bamboo Plantation for Shoot Production)
4. Ms. Khine Khine Tun (Bamboo Shoot Processing and Bamboo Charcoal Making)
5. Mr. Aung Soe (Bamboo Handicraft Techniques and Furniture)
6. Mr. Khin Maung Oo (Bamboo Products Marketing)

REPORT ON THE BAMBOO PROPAGATION AND CULTIVATION

by

Aung Zaw Moe (Research Assistant)

1. Introduction

China is very rich in bamboo resources, with about 500 species of 39 genera, covering 5 million ha of the land. Most of bamboo forests grow in 16 provinces in tropical and subtropical zones, which constitute an important part of forestry in southern China.

Chinese are well experienced in bamboo cultivation and utilization since thousands of years ago. So, China can be considered as one of the most experienced country on bamboo in the world.

ITTO Bamboo Project 146/02 Rev.1 (I) had arranged an oversea training course on bamboo in collaboration with INBAR, INFOTRACE, and sent 6 trainees to China, to observe their technologies and their application on bamboo cultivation and utilization.

2. Objective

To study the advance technology of bamboo propagation, cultivation and bamboo forest management in China.

3. Major subject studied

Bamboo Propagation and Cultivation.

4. Observation

4.1 Study on Bamboo Plantation for Shoot Production (Xinying Farm Area, Hianan)

In Hainan province, *D. beecheyana*, *D. beecheyana var. pubescens* and *D. latiflorus* were mainly cultivated for bamboo shoot production. Mostly, offsets (rhizome division method) were used for the establishment of bamboo plantation by farmers. The Bamboo Shoot Company had supporting fund for the establishment of plantation and the Forest Bureau guided the farmers with bamboo planting technique. They used the triangle collaboration approach system, which is; Company + Farmer + Government.

The bamboo plantation establishment techniques for shoot production were as follows:

1. use of offset (rhizome) as propagules
2. spacing of 3 m x 3 m were adopted
3. before the establishment, the area was cleared and then deeply ploughed
4. planting pits were dug before the rain
5. the propagules were planted in slanting or vertical position

4.2 Study at Bamboo Nursery (Boao Region, Mo Village)

The area of bamboo nursery is about 30 ha and 38 bamboo species were planted and tested with various propagation methods. This nursery was selected in a very flat area and the soil is reddish brown in color. The objective of nursery is to conserve the bamboo genetic diversity and to test the various technique of propagation through vegetative parts. In this nursery, bamboo seedlings were cultured by various propagation methods both sexually and asexually. These propagated bamboo seedlings were also transplanted from the nursery bed to an open area and maintained at suitable spacing in the nursery area. One or 2 year old clump of bamboo seedlings were further sub-divided into smaller clump division stocks for use in either plantation or in research such as hybridization, breeding, etc.

This bamboo nursery is the main nursery for distribution of bamboo seedling at Boao Region. This nursery uses the above mention propagation method, and the bamboo seedlings were propagated and maintained for further division of seedlings.

In China, Bamboo propagation was carried out for thousands of years by the people by applying the traditional method of dividing bamboo root ball for cultivation. The "Bamboo Plant Fast Growing Technology" was put on trial and tested in the sixties by the Chinese scientists and several simple methods were developed. But, as the scientific technologies are developing very fast now a day, there are more than 100 methods, in which 30 methods are practically applied in bamboo breeding in the establishment of bamboo plantation in afforestation program in China.

According to Prof. Zhou Zhahua, out of the 30 methods, the followings propagation methods were mainly observed during Training Courses and practically applied in the establishment of bamboo plantations in China.

1. Propagation by seed,
2. Propagation through Offsets (rhizome divisions),
3. Propagation through culm cutting and
4. Propagation through branch cuttings.

4.2.1 Propagation by seeds

Reproductive propagation refers to developing new individuals through seeds. This approach is that bamboos seldom flower and even when they do flower, most of the seeds are not fully developed and only a few of them can be fertile seeds. Even these fertile seeds have low viability, as most of the seeds lose their viability after one or two months. During flowering period, a few bamboo species bear viable seeds. These viable seeds can be collected and sown for propagation.

Study on seed storage has shown that if the bamboo seeds cannot be timely sown, the seeds need to be stored in dry and cold condition. It can be stored for 2-3 months in room temperature, but not longer than half a year. If stored in 0-5° C, the germination capacity of seeds can be retained for over one year.

4.2.2 Site Selection

Site for nursery is normally selected;

1. facing the sunlight and shun from the wind,
2. where there is easy access to water and the drainage condition is good,
3. where the soil is loose and fertile,
4. where there are possibilities of reducing pest and disease, and
5. where it is close to the plantation site.

4.2.3 Nursery Site Preparation

The Site of Xingying Farm Bamboo Nursery was selected and prepared as follows so as to facilitate sowing of bamboo seed;

1. ploughing completely and deeply
2. cleaning weeds, shrubs and removing stones
3. breaking soil lumps
4. making lines on seed beds
5. spreading a layer of burned clay over the beds as basal manure.

4.2.4 Bamboo Seed Sowing

In this Nursery, seed collection were made from the bamboo flowering area and sown immediately in seedbeds. Both drill and broadcast (sprinkle) sowing were made. For seed sowing, holes with diameter of 5-6 cm and a depth of 2-3 cm on the seedbed were dug with a spacing of 30-40 cm. 8-10 seeds were put in a hole, and the seeds were covered with soil so that they are not visible. Finally, the beds were covered with straw so as to keep the soil moist, and then watered.

4.2.5 Seedlings and Nursery Management

Management involves;

1. providing partial shade which is portable and is easy to move ready made frame (the suitable light penetration rate is 40-60 %)

After germination,

2. watering is done twice a day using sprinklers so as not to disturb the soil or straw covering and to conserve the soil moisture of the seedbeds
3. fertilizing should be done at 10-15 days after germination (with diluted manure or 0.2-0.3 % urea solution for young seedlings)
4. remove weeds from time to time
5. pay attention to the birds that eat the seeds
6. make spaces for healthy seedlings.

4.2.6 Transplanting

When the seedlings were 10-15 cm high, they were transplanted to individual polyethylene bags. Forest top soil was used as the soil medium and the soil was kept moist but not water logged. The best time for transplanting is after 15:00 hours when the temperature is low. After transplanting, if the seedlings are to be maintained in the nursery for the purpose of dividing seedlings, the suitable spacing are 25 x 25 cm and 10 x 10 cm and allowed to be grown for one year. Monthly fertilizer application was increased as the seedling grew.

4.2.7 Propagation through rhizome divisions

This method is one of the simplest and easiest traditional methods of propagation for bamboo. By this method, only one propagule will be obtained from one mother bamboo culm which is not very practical for the establishment of large scale plantation; besides, it is difficult to transport the mother stocks; the survival rate is also rather low.

4.2.8 Selection and collection of Offsets (Rhizomes)

Healthy 12 months old mother stocks with good branches and leaves and without any pests and diseases were selected. The buds were fat and the fibrous roots well developed. It is done in early spring (February- March) in China. Two years old stocks are not suitable, because they have already had some new shoots, the buds that are not developed may lose the ability to shoot. Usually 1-2 year old bamboo stocks are found at the edge of a clump, and the stems are deeply rooted in the ground.

4.2.9 Collection of the mother stock

- the connection point between the old bamboo and the selected mother stock was sought and was cut with sharp chisel or knife
- special care was made not to split the rhizome of the culm
- rhizome, rhizome buds, and roots were well protected
- the selected mother bamboo with its rhizome was dug out
- enough host soil was kept with the rhizomes during digging
- after the rhizome was dug out, the top part of the culm was cut slanting at about 1.5 – 2 m high.

4.2.10 Preparation of planting holes

In case of planting holes, the size of the holes must be large enough to accommodate the offset. The size of the planting hole depends on the size of the propagules, the width of the holes range from approximately 30-50 cm and the depth of the holes is 30 cm. Shoot sprouting will be affected if the propagules are planted too deep.

In digging the holes, care was taken not to mix the top soil with the sub-soil.

4.2.11 Planting

When planting the offset, the following procedures were carried out;

- the top soil was put at the bottom of the holes
- the mother stock was planted slantingly in the hole
- the hole was refilled with the newly dug out sub-soil.
- the soil was pressed to make it compact
- the mother stock was watered

Prof, Zhou Zhahua explained that, planting of offset slantingly can develop root system naturally and has better resistant to winds. No supporting pole is neither needed.

4.2.12 Planting season

In China, offset planting of bamboos are usually planted from February to April. The survival rate is the best at this time .

4.2.13 Propagation through culm cutting

In bamboo nursery of Xingying Farm Area, propagated single node and double node cuttings were observed. 1.5m x 20m size seedbeds were laid out and planted with culm cuttings under moveable shade.

4.2.14 Selection and collection of culm cuttings

1. 2-3 year old healthy mother bamboo culms without any disease or pest were selected.
2. the end branches leaving only one main branch at each internode were cut off.
3. the end of the branch at 2 cm above its first node was removed.

4.2.15 Preparation of culm cutting

- 1.the bamboo culm was cut into single or double internodes, care should be taken not to damage the buds on the stem.
2. one to two main branches and buds should be left at each node.
3. other branches around the node should be removed.

4.2.16 Season of breeding

The best season for bamboo node propagation is from the end of February to the end of March, when the buds begin to burgeon.

4.2.17 Planting and sowing

The propagules were buried horizontally, slantingly or vertically. A long trench with 12-15 cm in depth and width, spaced at a distance of 20-25 cm was prepared for planting the culm cutting in a seedbed. The whole culm cutting was put horizontally in the trench. It was covered with a soil layer of 5-10 cm which was again covered with straw or grass to conserve the soil moisture. In 5-7 days after planting, the buds from culm cuttings will begin to burgeon; in 40-100 days, they will start to develop roots. The survival rate is usually 50 – 80 %.

4.2.18 Nursery Management

1. watering was done twice a day to avoid the moisture stress.
2. after the roots developed, it is necessary to add proper fertilizer to enhance the growth of the seedlings.

4.2.19 Propagation through branch cuttings

This propagation method is carried out by planting the branches of 0.5 – 1 year old culms.

4.2.20 Selection and collection of branch cutting

1. the secondary branches of 0.5-1 year old culm was cut off in spring.
2. the end of the branches were removed at 30-40 cm from the base of the branch.
3. the trimmed branches were submerged in water and placed in shade.

4.2.21 Soil preparation and planting

When planting, a channel was made on the seedbed, the bottom part of the secondary branch was buried in the soil, the angle between the branch and the surface of land is 10°-12°, the underground part of the branch should be 3-6 cm, the top part of the branch must be above the surface of the soil, cover the bed with grass, so as to keep it moist.

The best time for branch cutting is the beginning of rainy season. After sowing, in 7-15 days the secondary branch cuttings will develop roots, in 20-30 days, they will burgeon. The survival rate usually range from 60-90 % in China.

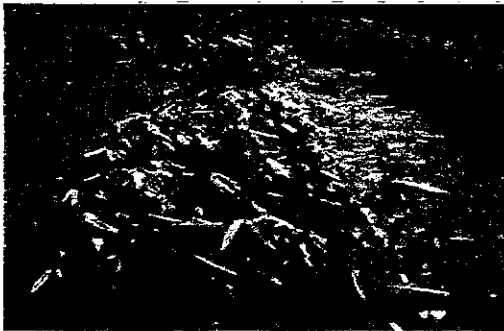
4.2.22 Nursery Management

1. the soil of the seedbed should be kept moist, but it should be prevented from flooding, which will result in rotting of the roots.
2. after new shoot came out, fertilization should be carried out and more light is preferred.
3. the preferred spacing is (1m x 1m) or (1mx 1.5m), provide appropriate irrigation for the shooting of branch cuttings.

5. Conclusion and Recommendation

Based on the observation, the following proposed will be made;

1. The best propagation technique for each Myanmar bamboo species should be observed especially the commercially important bamboo species.
2. The methods of propagation and planting technique for bamboo should be distributed to the rural people.
3. For the production of shoot and culm, high yielding research on fertilizer application, management measures need to be studied.



Propagation by seed



Collection of rhizome



Propagation through culm cutting



Propagation through branch cutting

REPORT ON BAMBOO FOREST MANAGEMENT

by

Zaw Win Myint (Range Officer)

1. Introduction

In Myanmar, although forests produce both timber and non-timber forest products, people emphasized more on the former and notified the latter just as the minor forest products. Nowadays, the world is facing rapid decrease of forest resources and suffering serious deterioration of ecological environment. Bamboo, which is one of the minor forest products, has a wide range of distribution in Myanmar. The rural population which forms 75% of the population of the country cannot survive without bamboo. It is also of great importance to some of the urban population. Therefore, bamboo plays a very important role in the life of the communities in our country and also in most of the countries in Asia. Consequently, just like petroleum, which is known as the black gold and rubber, as the white gold, bamboo is known as the green gold.

Moreover, environmental conservation is greatly needed for sustainable forest management in Myanmar. Therefore, bamboo, with its fast growth, strong regeneration capacity and versatile utility can be very beneficial for environmental conservation and sustainable forest management in our country.

2. Objectives

1. To study the nursery practice, bamboo planting systems, scientific bamboo harvesting system and bamboo forest management in China.
2. To study the practice of bamboo plantation establishment and bamboo forest management theoretically and practically in China, so as to be able to apply the technology to ITTO Bamboo Project as well as to the Forest Department activity.

3. Specialized Subject

Bamboo Forest Management

4. Observation

4.1 *Bamboo forest management*

Before 1980, China was facing rapid deforestation, as the bamboo forests in the country were harvested without systematic management. After 1980, bamboo plantations were established in the degraded areas. The area of bamboo forests steadily increased, and today, bamboo forests extend to 4.2 million hectares, which is 1 million ha more than that in the 1970s. In the 1970s, the production was less than 1350 culms/ha but, nowadays, the production has increased up to 2070 culms/ha. There are 2 portions in bamboo forest management viz: (1) management of young stands and (2) management of bamboo plantation.

4.1.1 Management of young stands

(a) Tending

In the early stage, weeding and soil loosening are needed and the essential concern is to control climbers.

(b) Fertilizing

The best time for the first fertilizer application is one month after planting. The second fertilizer application was performed 4 months later and the third 6 months later.

The first time, inorganic fertilizer which is more suitable for the vegetative growth of bamboo seedlings, was applied and (1) Nitrogen fertilizer: 20-30 kg; (2) Phosphate fertilizer 10-15 kg; (3) Potassium fertilizer: 10-15 kg; (4) Silicon 20-30 kg were recommended for every hectare of bamboo stand.

(c) Protection

Grazing should be prohibited in bamboo stands. It should also be protected from rodents and rats. In forests with serious rodent infestation, poison should be used (we observed that one way of doing this is to put the poison into a bamboo section with only one node and place it in the bamboo forest).

(d) Control of bamboo shoot collection

In the first 4-5 years after planting, shoot collection should be strictly controlled to ensure the normal growth of the stands and the collection should be limited to under developed, disease-infected or degraded bamboo shoots.

4.1.2 Management of bamboo plantations

(a) Thinning of the culms

The thinning intensity depends on the size of the culms and the density. Retention of 1-2 year old bamboos, partial removal of the 3 year old culms and the total removal of the 4 year old culms will keep the stand productivity at a high level.

(b) Thinning of shoots

Because of the biological features of bamboo species, the effect of environmental factors and the infestation of pests and diseases, not all shoots develop into culms. Some of the shoots will die after a certain time, a process called shoot degradation. Generally shoot degradation is more likely at the beginning (May and June) as well as the end of the shoot production season (September and October). Therefore thinning of shoots should be carefully done at those times and, the strong and healthy shoots should be left to ensure the stand quality.

(c) Harvest of bamboo timber

Harvesting of bamboo timber should be carefully managed in term of stand age, intensity and timing. Fully developed (3 to 5 years) bamboo culms have tight texture, maximum accumulation of both organic and

inorganic materials, high fiber content and stable physical and chemical properties. They are highly lignified with the greatest mechanical strength. Besides, their durability and pest resistance are also at their best. After this stage, the physiological process of bamboo growth will slow down gradually till the death of bamboo culms. Therefore, 3 to 5 years after planting will be optimum time for bamboo culms harvest. Generally, bamboos older than 3 to 5 years will stop yielding shoots and at this stage, their consumption begins to exceed their accumulation. The development of shoots and the growth of young culms will be both affected by a high percentage of over-mature culms, causing lower productivity and gradual degradation of stands. Thus, if the stands are mainly for shoots, timely removal of culms older than 4 years and some of the 3-year-old culms will not have detrimental effect on shoot production. Instead, it will promote stand regeneration, which often results in a more rational age structure, a higher productivity and more vigorous stand growth. For commercial stands, the appropriate time for the first harvesting is 5 years after planting.

For clump bamboo species, harvesting can be made during dry season when the clumps do not produce shoots and the physiological process is weak. Harvesting at this time will not result in serious damages to the remaining bamboos. At this time, the contents of sugar and other soluble organic substances in the culms are relatively low and the harvested bamboo is less likely to be attracted by pests. Furthermore, because of the low water content, bamboos harvested during dry season do not get affected by mold or contrast easily, and thus have superior processing quality.

To minimize waste in the course of harvesting, the culms should be cut at the point as close as possible to the basal part. For bamboo species with thorny bases, harvesting can be exercised at two times. In the first time, the culms can be cut at the point 2-3 meters above the base and the rest can be harvested half a year later. The basal section is usually stronger and can be used for furniture.

5. Recommendation

In Myanmar, natural forests and their resources are needed to be conserved as they are gradually decreasing. Today, Dry Zone Greening project and Bago Yoma greening project are being implemented, and the conservation of natural forests and plantation establishment are being carried out. Establishment of bamboo demonstration plots, promotion of public awareness and extension of technical know-how should be carried out to the rural communities in those areas.

In Myanmar, the clumps are normally congested so that it is difficult to harvest as well as to get good culms and they have low shoot production capacity. Therefore, systematic bamboo forest management should be carried out both in the bamboo plantation and bamboo natural forests.

Due to the unsystematic harvesting of bamboo shoots and stems by the local people for a long time, some of the clumps are difficult to manage and harvest. Therefore, after carrying out research concerning techniques of bamboo forest managements, the results

obtained should be distributed not only to the Forest Department, but also to other departments and the rural people.

Moreover, proper bamboo forest management technique should be applied as soon as bamboo plantations are established, and it should be clearly defined whether it is for shoot production, or culm production, or both.

The local people should be given the right to establish bamboo plantation in the secondary forests, deforested areas and to conserve natural forests. They should manage their plantation areas by themselves. The Government should also encourage the community to establish their own bamboo plantations and the Forest Department should also share the techniques and knowledge with them and, should also facilitate in finding markets for their products. By doing so, the rural people will be more interested in the establishment of bamboo plantation and will also maintain the natural forests and conserve their environment on their own accord.

6. Conclusion

The initial investment on bamboo plantation establishment is lower than that of other timber plantations. The management of plantation is easy and the return can be obtained in a short period of time. One of the benefits, is when selling shoots and bamboo timbers, the earning is almost the same as timber. Many countries, particularly in Asia, are involved in the trade of bamboo products which, according to INBAR, was worth more than US\$ 2.7 billion in 1999. China generated almost US\$ 140 million from exporting bamboo shoots alone, and the Philippines around US\$ 1.4 million from bamboo furniture. Therefore, in Myanmar, bamboo plantations should be given good and systematic management as the local people can get good income which is almost equivalent to teak and other non-teak hardwood plantations.



Girth, age and owner's name recorded on each culm



Natural bamboo forest and nature based ecotourism

REPORT ON BAMBOO PLANTATION FOR SHOOT PRODUCTION

by

Mu Mu Aung (Research Assistant)

1. Introduction

Bamboo is an important multipurpose plant that can provide food, shelter, clothing, tools, and many other basic needs for both the rural and urban people especially in the developing countries. Moreover, it can create income generation for thousands and thousands of people that are relying on minor forest products. Bamboo is a good raw material for a whole range of products, from industrial (construction, pulp and paper, composite products) to household utilities (farming tools, furniture, etc.). Bamboo shoots are also a valuable source of food. Bamboo can be widely used in watershed management, soil conservation etc., thus, making great contribution to environmental protection.

In China, there are 39 genera and 500 species of bamboos covering 4.4 million hectares of land area. The total culm standing crop amount to 97 million tons, which is distributed mainly in 18 provinces and occupies 3 % of total forest area. All 3 types of bamboos, namely, monopodial, amphipodial and sympodial occur in China. There are more than 200 species of bamboos that produce edible shoots. China has about 80 *Phyllostachys* species (including varieties and variants) and 20 *Chimonobambusa* species. The followings are lists of bamboos capable of yielding economically profitable and high quality edible shoots:

1.1 Monopodial bamboos

Acidosasa edulis; Chimonobambusa quadrangularis; Phyllostachys heterocycla var. pubescens; P. praecox; P. dulcis; P. iridescens; P. makinoi; P. nuda; P. prominens; P. sulphurea cv. viridis; P. vivax; Pleioblastus amarus; Qiongzhusa tumidinoda.

1.2 Sympodial bamboos

Bambusa rigida; B. pervariabilis; Dendrocalamus latiflorus; D. asper; D. brandisii; D. hamiltonii; Dendrocalamopsis oldhami; D. beecheyana; D. beecheyana var. pubescens; D. stenoaurita; D. vario-striata; Schizostachyum funghomii.

Intensively managed pure stands for producing edible shoots: There are more than 50 species in China, which can produce edible shoots, but usually *Phyllostachys edulis*, *P. praecox*, *P. vivax*, *P. iridescens*, *Dendrocalamus latiflorus*, *D. oldhami*, *D. giganteus*, *D. beecheyana var. pubescens* etc. are adopted. The area of real bamboo shoot stand is only 100,000 hectares, the productivity of which is around 10-20 t./ha./yr. but the maximum can be 30-35 t./ha./yr. The total shoot yield is around 1.9 million tons in China.

2. Objective

To study the development of bamboo plantations for shoot and culm production in China.

3. Observation

The sympodial bamboo plantation in Hainan province and that of monopodial bamboo in Zhejiang province in China were observed. The main objective of the bamboo plantations observed were cultivated for shoot production.

3.1 *Sympodial Bamboo Plantation*

Hainan province, situated at the southern end of China, is a tropical island with an area of 33,900 km², stretching in latitude from 18° 10' to 20° 10' N and in longitude from 108° 37' to 111° 03' E, with a surrounding coastal line of 1,528 km and a population of 7.5 million. Hainan Island, with warm and humid weather, takes up 65% of the total tropical area of China. The forest cover across the island is about 50.5% including 6,14,800 ha of natural forest, 2,55,600 ha of bush land and 8,45,900 ha of planted forest.

There are 79 species of bamboo in the island, including 38 indigenous species and 41 species that were introduced. In 1988, the plantation area for shoot production was only 3,413 ha. However, the area was increased to 4,160 ha by 1990. The major cultivated species are *Dendrocalamus beecheyana*, *D. beecheyana* var. *pubescens* and *D. latiflorus*.

The study area for *Dendrocalamus latiflorus* bamboo plantation was located in Hainan province near Haikou county. This plantation was established in 1994. The propagules for this plantation were collected from Yunnan province and the border line of northern Myanmar. The area of that bamboo plantation will be increased by 16 hectares annually.

Dendrocalamus latiflorus plantation was established using the traditional method by planting rhizome offsets. One or 2 year old culms were dugout from the mother clump. The spacing of 4m x 5m or 5m x 5m is used for shoot production. The offsets were transported from nursery to the field and planted in a 45 cm x 45 cm x 45 cm pits.

Soil piling at the base of the bamboo clumps was carried out in February before the shoots came out. Normally, soil was piled to a height of 0.3 m and a width 1 m. around the clump. The base of the clump was covered with grass or other such materials (bamboo leaves, if available, are preferable, because they have high silica content that favors bamboo growth) to reduce moisture loss from evaporation and prevent topsoil compactness. Organic fertilizer was applied within 15 cm around the clumps either at the end of February or early March so as to promote growth.

The beginning of the shoot-producing season is May. Shoot production is at its peak from October to November. The best size for shoot collection is when it is 30 cm high. In well-managed stands, shoots will be rampant within 3-4 years.

Dendrocalamus latiflorus is a sympodial type of bamboo and 4-6 culms were left in each clump for shoot production. The optimal time for bamboo shoot and culm

harvest is 3 to 5 years after planting. Generally, bamboo culms older than 3-5 years will stop producing shoots. Thus, if the stands are mainly for shoot production, timely removal of all culms older than 4 years and some of the 3 year old culms will not have detrimental effect on shoot production. For commercial stands and shoots, the appropriate time for the first harvest is 4-5 years after planting.

3.2 Monopodial Bamboo Plantation

Lin'an Municipality is located in the Tianmu Mountain, northwest of Zhejiang Province at 118° 51'-119° 59' East longitude and 29° 56'-30° 26' North latitude. It has a total area of 3,126 km and a population of 500,000. With a forest cover of 71.3%, the total forest land area in the Municipality adds up to 260,000 ha, of which bamboo forests take up 52,000 ha. The Municipality is reputed as a "Bamboo Homeland of China". Since the 1980s, the Municipality started planting bamboo on the hill and mountain slopes. In this area, the main species cultivated were *Phyllostachys praecox* and *P. heterocycla var. pubescens* both for shoot production and culm production.

There are 63 bamboo species belonging to 11 genera in Lin'an Municipality. In Lin'an Municipality, 60 % of the farmers' households are directly engaged in bamboo growing. They have built 46 shoot-processing factories. In this area, production depended upon the plantings of three major bamboo species namely, Vegetable bamboo, Moso bamboo and Shoot bamboo.

4. Conclusion and Recommendation

Bamboo, as a multipurpose forest plant, has become one of the most important non-wood forest products (NWFP) in China. Traditionally classified as a "minor forest product", bamboo has contributed much to the rural household's well being. However, the use of bamboo and its market has expanded greatly and has contributed to the national and international economy to quite a large extent. It is estimated that the production and the national/international trade values of China have reached 2 billion US\$.

Superior species (including superior varieties, provenances and clones), optimal cultivation methods and best economy and policy situation are the most important three factors for sustainable management of bamboo.

Based on the study in China, it is recommended that:

1. Establishment of bamboo plantations for shoot production should be encouraged.
2. Cultural operations for the enhancement of shoot production such as, soil piling at the base of the clumps, and the application of bio fertilizer both in plantation and natural forests should be adopted.
3. Myanmar bamboo species that are suitable for shoot production should be identified.
4. The technology for the establishment and maintenance of bamboo plantations for shoot production should be extended to the public



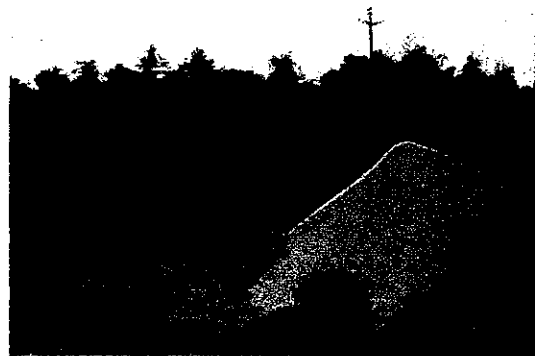
Bamboo shoot collection
(Dendrocalamus latiflorus)



Sympodial Bamboo Plantation
(Dendrocalamus latiflorus)



Bamboo shoot
(Phyllostachys heterocykla
var:pubescens)



Monopodial Bamboo Plantation
(Phyllostachys heterocykla
var:pubescens)

REPORT ON BAMBOO PRODUCTS
(Bamboo Shoot Processing and Bamboo Charcoal Making)

by

Khine Khine Tun (Research Assistant)

1. Introduction

Bamboo is widely utilized in industry and agriculture. The life of about 1/3 of the world's population is closely related with bamboo. Bamboo, as identified as the second largest sustainable forest resources, began to show its significance in people's daily production and life since 1980. With over 500 species in 40 genera, China has the richest bamboo resource in the world in terms of number of species, area and reserve of bamboo. In the 50 years since the founding of the People Republic of China, particularly in the last 20 years since China's economic reforms, the bamboo industry has witnessed rapid development. Bamboo utilization has spread to more areas. In the old days, the use of bamboo was traditionally confined to construction. Today, it is widely used in the fields of construction, paper making, transportation, medicine, health, food and for tourism.

2. Objectives

- (1) To study the advance technological process of bamboo products (especially in bamboo shoot processing and bamboo charcoal making) from China.
- (2) To disseminate the advance technology of bamboo products from China to Myanmar's rural people and private sector.

3. Observation

2.1 Bamboo Shoot Making

The annual yield of fresh shoots in China is approximately 1.7 million tons. The main products are those that preserve the freshness and flavor of shoot, such as plain juiced shoot, flavored shoot and salted shoot, and dried shoot products namely dried shoot slices, salted dried shoot, Tianmu dried shoot and fermented dried shoot. The main freshness-flavor preserved product is plain-juiced shoot, which ranks the first in output accounting for 90% of the products of its kind.

2.1.1 Hainan Fudonghai Foods Co., Ltd., Danzhou City, Hainan Province

Bamboo resources in the Hainan Island are products of both planted and natural forests. The main use of the planted stands are for harvesting shoots for food, timber for construction and weaving materials, and plants for beautifying home gardens and village/ town environments and for establishing shelters. At present, the main products of bamboo are fresh shoots, pickled shoots and canned shoots. With the development of bamboo plantations, a large bamboo shoot canning industry was established in Danzhou, Fudonghai Food Processing Confectionery of Danzhou City, jointly funded by Danzhou and Japan. Raw material used for this product was *Dendrocalamus latiflorus* (sympodial bamboo species) and was purchased from the farmers at 0.85 yuan/kilogram. The farmers harvested the bamboo shoots, when they are 30cm above the ground. In the year 2003, 2,000 tons of raw material were used for canned shoot.

2.1.2 Hangzhou Kang Xin Foods Co., Ltd. (Lin'an County, Zhejiang Province)

Since in 1980s, the municipality of Lin'an started planting bamboo on the hill and mountain slopes, and focus was laid on planting "three bamboo species" – vegetable bamboo (*Phyllostachys praecox* and *P.vivax*), Moso bamboo (*P. heterocycla* var. *pubescens*) and shoot bamboo (*P. nuda*, *P.acuta*, *P.iridescens*). In Lin'an municipality, there are 130,000 farmer households, 60% of which are directly engaged in bamboo growing. They have built 46 shoot-processing factories and over 100 bamboo timber products factories. Bamboo shoots produced in Lin'an are mostly processed into three categories of products namely boiled shoots (canned), dried shoots and preserved shoots.

Hangzhou Kang Xin Foods Co., Ltd is jointly funded by Janpan, which is one of the most famous canned shoot factories in Lin'an County. This company introduced modern Japanese machineries, such as thread-cutting, slicing and vacuum-packing machines. Such measures have significantly upgraded the product quality. They produced top quality products which have become famous product of Hangzhou. Therefore, they also got support from Forest Bureau and Government. Raw material used for canned product was Moso Bamboo shoot (*P. heterocycla* var. *pubescens*) (monopodial bamboo species). 800,000 cans were made in 2003 and were mainly exported to Japan.

2.1.3 The Technological Process for Making Bamboo Shoot Products.

The technical process for producing boiled shoots (canned) is as follow:

Raw material ⇨ cleaning ⇨ Boiling ⇨ Cooling ⇨ Peeling
⇨ Sorting ⇨ Rinsing ⇨ Canning ⇨ Vacuum (deoxygenating) ⇨
Pressurized Sterilization ⇨ Adding Boiling Water ⇨ Storage

2.2 Bamboo Charcoal Making

Bamboo charcoal is a fairly recent product. As bamboo possesses a micro-porous structure, the carbon formed by them is highly adsorptive and the activated bamboo carbon has an even greater absorption capacity. Activated bamboo charcoal is widely used in food, pharmaceutical, chemical, defense and metallurgical industries. Activated bamboo carbon absorbs pigments and foreign substances from solutions as well as from gases and vapor mixed in the air. It can also be used as a catalyst or catalyst carrier, or directly applied in medicinal use. In the last two or three years the export of bamboo charcoal to Japan has fetched several hundred million of Yuan. The bamboo charcoal products include wainscot, tile, flooring, ceiling, mural decoration, basin coat, kneecap, cups, and clothing articles.

There are many kinds of bamboo charcoal. In line with their origin, bamboo charcoal can be divided into two parts: raw bamboo charcoal and charcoal stick of chips. Raw bamboo charcoal is made of small sized bamboo, old bamboo, bamboo top, roots, which are not fit for making other bamboo products. Charcoal stick of chips is made of residue from bamboo processing industry. In the process of making bamboo floorboards bamboo mats and other kinds of commodities, there will be many residues of different sizes and forms. Consequently, they must be broken into chips, dried and pressed into sticks before carbonization.

Depending upon the temperature, carbonized charcoal can be divided into three groups: charcoal of high, medium and low temperatures. Physical and mechanical properties of bamboo charcoals differ due to the different temperature of carbonization. Charcoal for regulating humidity is made at temperature of 600°C, that for absorbing impurities, gas and color is at 700°C ~ 800°C, and that for high electric conductivity is higher than 1000°C.

2.2.1 Bamfox Bamboo Products Co., Ltd. (Lin'an County, Zhejiang Province)

The residues from bamboo floor processing are carbonized with brick charcoal kiln. The capacity of kiln is 5 tons. The method for charcoal making is direct kiln method. In the process of direct kiln burning, the heat resulted from fuel burning curls up to the top of and spreads in the kiln. Most of the heat moves about in the upper part of the kiln, the rest of it radiates on all sides. Step by step the heat goes down to dry and pre carbonize the bamboo material. In the process of carbonization a small part of bamboo material is being oxidized and burnt, raising the temperature in the kiln and removing volatile matter. The smoke and steam move in circles, regulating the temperature in the kiln thus, complete the carbonization and refining process, producing charcoal that are fine and close in texture. In this process bamboo material undergoes stages of pre-drying, drying, pre-carbonizing, carbonizing, refining and natural cooling. The temperature of refining stage influences the density and electric conductivity of charcoal greatly.

The temperature is set depending upon the end products required. The time taken for the carbonization of bamboo was 20-21 days. Five tons of raw bamboo produced 600-700 kilogram of Charcoal. All the products were exported to Japan.

3. Recommendation

According to the studies on bamboo shoot processing and bamboo charcoal making, the following recommendations can be made.

3.1 Bamboo Shoot Processing

Bamboo shoots are available in mass-volume in Myanmar natural forests. Rural people in Myanmar very rarely harvest bamboo shoots systematically. Their ways of consuming bamboo shoots are by; boiling shoots, making pickle, making dry shoots, and processing with salt. Bamboo shoots are processed by traditional method and the products seldom reach export quality. Shoots are therefore normally sold locally and the income from the bamboo shoot is not attractive to them. There is therefore no bamboo plantation formed for shoot production.

First, quality shoot production should be prioritized to increase rural income and to promote income from non-wood forest products sector.

The followings are recommended for quality shoot production.

1. Bamboo species suitable for canned shoots should first be selected.
2. Analyze chemical properties of the selected species.
3. Identify suitable areas for the establishment of bamboo plantation for shoot production of the selected species.
4. Disseminate shoot harvesting technology to farmers through extension means.

5. Import, if necessary, advanced machines for quality shoot production.
6. Encourage those who are interested in bamboo shoot production industry.

3.2 Bamboo Charcoal Making

The use of bamboo charcoal is almost non-existent in Myanmar. However, there are 2 entrepreneurs that are exporting bamboo charcoal, but there is no local market in existence. The rural, as well as urban people are still not aware of the usefulness of bamboo charcoal. The project is now carrying out studies on the technology of bamboo charcoal burning and selection of suitable bamboo species. Therefore, the following recommendations can be made so far as bamboo charcoal making is concerned.

1. The usefulness and the technology of bamboo charcoal making should be disseminated to the rural people and the private sector.
2. For the value added products production of bamboo, the residue from the bamboo processing factory should be used for carbonization.

Bamboo Shoot Processing Factory (Hangzhou Kang Xin Foods Co.,Ltd)

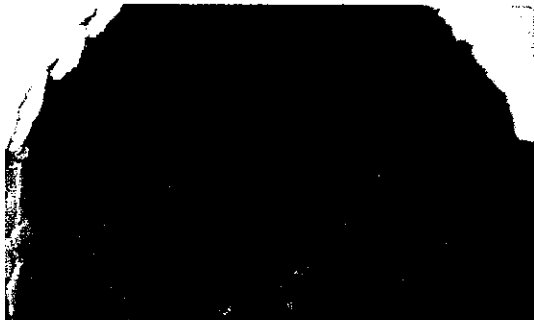


Bamboo shoot for processing

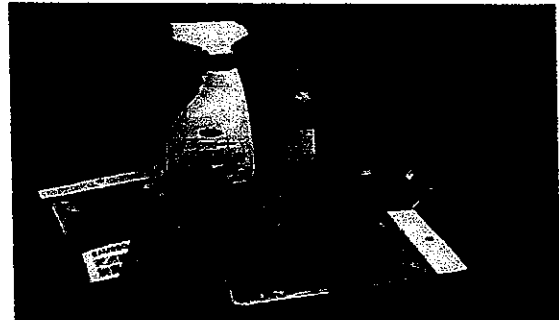


Cutting the boiled bamboo shoot

Bamboo Charcoal Making (Bamfox Bamboo Products Co.,Ltd)



Bamboo charcoal



Products made from bamboo charcoal

**REPORT ON BAMBOO PRODUCTS
(Bamboo Handicraft Techniques and Furniture)**

by

Aung Soe (Assistant Research Officer)

1. Introduction

Bamboo is a non-timber evergreen plant mainly distributed in sub-tropical and tropical zones. Because it is widely distributed, fast growing, with a high regenerating rate, utilization, and economic value, it is considered an ideal substitute for timber. Bamboo can also provide plenty of shoots, which provides food. The above characteristics make bamboo an important non-timber forest resource for most developing countries in Asia, Latin America and Africa. Bamboo can play an important role in the reduction of timber consumption, environmental and forest protection, poverty alleviation and sustainable development of the rural economy.

Many developing countries in Asia, Africa and Latin America have rich bamboo resources but poor bamboo utilization and processing technologies. China has a long history of bamboo utilization and processing, especially, since the reform and opening policy was implemented, and China's bamboo industry has been developing very fast. Currently its bamboo processing techniques are among the most advanced in the world.

China is a mountainous country. Over 90% of the bamboo forests in China are located in upland or hilly areas (inhabited by ethnic minorities), frontier areas or poor areas. Over 10 million farmers are directly involved in bamboo production work. The bamboo utilization in China is very efficient, since, from the root to the tip of the culm (100%) are utilized for different purposes. China has a good market management; each factory has many groups of farmer association to prepare raw materials in the vicinity of the factory, saving transportation cost.

2. Objectives

- (1) To study the advance technological process of bamboo products (especially in bamboo handicraft techniques and furnitures) from China.
- (2) To disseminate the advance technology on bamboo products making from China to Myanmar rural people and private sector.

3. Observation

The field studies consisted of visits to villages and bamboo industries in Hainan, Sichuan and Zhejiang provinces.

3.1 Handicrafts

Bamboo handicraft items are traditional products of China which include bamboo carving, knit-ware and musical instruments. Bamboo knit-ware carvings have refined workmanship and are praised as the "pearl of oriental arts." Bamboo carving, calligraphy and paintings are ideal indoor decorations, and add to the beauty of interior decoration. Bamboo handicrafts are steeped in cultural traditions and may

command very high prices, even a hundred times higher than ordinary bamboo products. They are important items for earning foreign exchange and occupy a prime place among tourist-oriented products. With its cylindrical shape and excellent physical qualities, bamboo is the most important material for making musical instruments. The bamboo music has always been an important component of the Chinese civilization, and bamboo musical instruments play a vital role in people's cultural life.

3.1.1 Weavings

As a traditional art, bamboo weaving in China has a long history. Among the handicrafts produced in China, those made in Sichuan Province and Zhejiang province are report to be the best for their delicate weaving techniques, beauty and variety. Mr.Chen and his colleagues are the pioneers on the development of bamboo weaving industry. They taught us how to identify the age of bamboo and how to process the raw material for weaving into different products, i.e. hat and basket, furniture, mat, ceramic cover, painting and weaving for picture etc. We had a chance to practice how to do bamboo weaving.

3.1.2 Bamboo floor

Hangzhou Bamfox Bamboo Products Co. Ltd. is a leading agriculture venture with the authority of import and export, specializing in Bamboo flooring, Bamboo accessory, Bamboo decorative board, bamboo veneer and Bamboo charcoal products for export. Their company comprised of three core parts: (1) Bamfox Bamboo Flooring Factory, (2) Bamboo Charcoal Manufacturing Site, and (3) Zhejiang-Bamfox Research & Development Center in partnership with Zhejiang Forestry College.

Bamboo floor panel (planing). Floor panels use thick bamboo strips, assembled in one direction. After applying adhesive, the assembly is hot-pressed from both sides.

The process outline is:

Bamboo culms → cutting into section → splitting into strips → coarse planing → steaming & boiling (treatment against borer attack, longitudinal splitting and color fading) → drying → fine planing → adhesive application → assembling → hot-pressing → lumbering → cross cutting (trimming) → four-side planing (including fluting/grooving) → polishing → painting/finishing → grading → packaging → storage.

3.1.3 Bamboo Mat

Bamboo Mat Factory at Zhejiang, where all the processes use machinery. In this factory bamboo mat machinery order can be made one machine per day.

3.2 Furniture

Bamboo furniture is light and cheap and has been in wide use in the southern provinces of China for thousands of years. Bamboo species that are traditionally employed in furniture making include *Phyllostachys heterocycla* var. *pubescens*, *P. viridis*, *P. congesta*, *Pseudosasa amabilis* and some species of *Bambusa* because of their tough timber. Furniture making involves several steps such as node smoothening, scorching, bending, steaming, drilling, grooving and assembling. Bamboo is used to make many traditional furniture items such as tables, chairs, beds, cupboards and tea tables, many of which are now in demand for use in places such as hotels and restaurants.

Bamboos are widely used in furniture making. Bamboo furniture is light-weighted, elegant, natural, and of reasonable prices. It is welcomed by a great number of people all over the world.

The manufacturing process for bamboo furniture can be divided into (3) major segments: (1) raw material selection, (2) treatment and (3) drying.

3.2.1 Raw Material Selection

The design and processing technologies of traditional Chinese bamboo furniture are greatly different from western style bamboo furniture (in the Philippines and in Colombia), so is the raw material selection. It is because the framing of Chinese traditional bamboo furniture usually apply the technology of cutting grooves on the bamboo tube and to make a collective bent mortise. This technology can join parts of furniture closely and form a strong framework.

3.2.2 Treatment and Drying

Bamboo is a natural material that deteriorates with time. It is prone to attack by insects and fungi and has to be treated to prevent degradation of the material.

The objective of seasoning are to obtain uniform moisture content (MC) suitable for it's intended use and to minimize defects such as checking and collapse. Air-drying is the process of drying bamboo by exposing it to the natural element either in the open air or under shed. This is the most economic method of drying bamboo since it does not require investment on equipment other than those needed to handle and transport the materials. However, it is a very slow process. Drying is dependent on the prevailing temperature, relative humidity (RH) and natural movement of the atmospheric air to which it is exposed.

4. Recommendation

Bamboo which belongs to the family Graminaceae has a wide range of distribution in Myanmar. Bamboo which is one of the abundant forest resources has a very great impact on the economy of the rural population.

In Myanmar, some bamboo species Kyathaungwa (*Bambusa polymorpha*), Tinwa (*Cephalostachyum pergracile*), Hmyin (*Dendrocapus strictus*), Thaikwa (*Bambusa tulda*), Wanet (*Dendrocalamus longispathus*) and Wabowa (*Dendrocalamus brandisii*) are used for making handicrafts and furniture parts.

Bamboo has been found to be used by the rural communities for many years and the procedure for traditional use of bamboo has been handed from generation to generation by the rural communities in our country. They make weavings, variety of shapes of baskets, containers for paddy storage, mats, chicken basket, bamboo hat, bamboo sheath hat, kitchen tools, toys, bamboo novelties and houses. Bamboo raw materials are obtained from the public forests as well as the reserved forests. The light and elegant lacquer boxes, trays and ornament produced in Myanmar are often based on light baskets of fine woven bamboo.

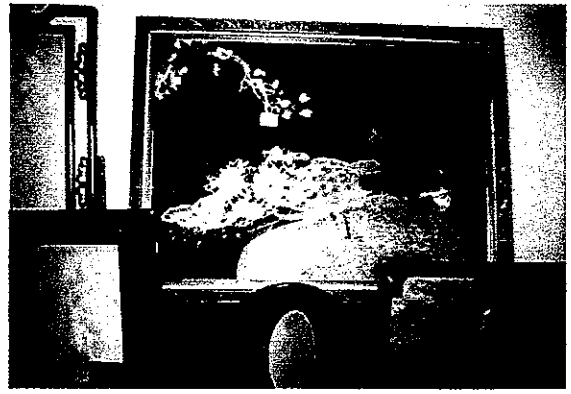
Bamboo parquet manufacturing factory has started in Myanmar. It makes semi-finished parquet that are being exported. The development of private enterprise and earning of foreign exchange should be encouraged, and the Forest Department concerned should take care of the proper management of the natural bamboo forests. Bamboo mat ply manufacturing is at the very early stage of production, while the manufacturing of bamboo mat parquet board is only at the trial stage. The plastic coated bamboo poles (*Melocanna bambusoides*) are being export to Singapore.

Based on the training and observation in China, the followings are recommended for handicraft and furniture production.

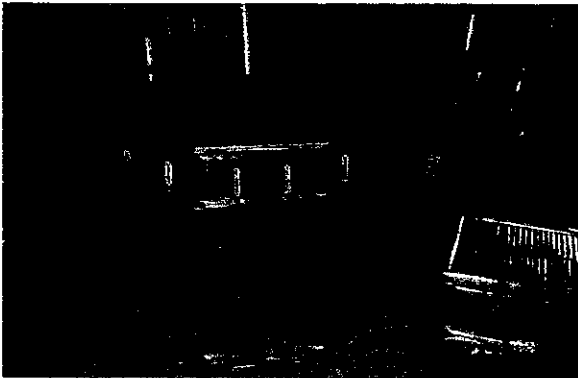
1. Proper training on the arts is an urgent need for the development of handicraft and furniture.
2. Individual product manufacturing needs a skillful and delicate arts which should be acquired.
3. Apart from the private enterprise, the forest dwellers and the people in rural area should be involved for the sustainable utilization of bamboo.
4. To improve the quality of development based on science and technology.
5. Formulation and improvement of preferential polices and strategies for attracting local business people and absorbing foreign investment.



Bamboo splitting by hand



Bamboo handicrafts



Bamboo furniture



Bamboo lighting shades

REPORT ON BAMBOO PRODUCTS MARKETING

by

Khin Maung Oo (Assistant Director)

1. Introduction

People Republic of China has been famous for bamboo products making and bamboo forest management since many years ago. Nowadays, the improved and modernized techniques for bamboo propagation, bamboo plantation establishment and bamboo products making are being operated in great momentum in China. Systematic bamboo forest management provides not only economic development in the country, but also environmental conservation. China is taking great strides in bamboo plantation establishment, bamboo products making and research concerning bamboo.

Myanmar is rich in bamboo resources and it is greatly used by the rural people. However, the utilization of bamboo and processing techniques are outdated and the quality of bamboo products is not up to the standard to compete in the international market.

Taking the situation in hand, the Forest Department decided to strengthen the management capability of the project key staffs from ITTO Project, PD 146/ 02 Rev.1 (I) by sending them to China to study the developed technologies in bamboo forest management and marketing in May, 2004.

2. Objectives

- (1) To study the bamboo planting techniques and bamboo forest management in China
- (2) To obtain the experiences and improved technologies on bamboo based value added products making and marketing
- (2) To study the bamboo management technologies not only for the promotion of export earning but also for promotion of income generation for the rural people

3. Observation

The study tour group visited Hainan Province, Zhejiang Province and Sichuan Province, where bamboo plantations were established. In addition, we visited the bamboo plantations which were especially aimed for bamboo shoot production and bamboo handicrafts and furniture industries were also visited.

As China is the most advanced country in bamboo planting and bamboo products making, export earnings by bamboo forest products has been very fruitful. The export earnings by bamboo products in China were Yuan 1,200 million (US\$ 150 million) in 1992. In 2002 however, China produces Yuan 28 billion worth of bamboo products. Up to Yuan 6,400 million (US\$ 800 million) was earned from export of bamboo products in 2003. As the national income increases, the income of the bamboo farmers also increases. Annual income of a bamboo farmer is nearly about Yuan 200,000 recently.

3.1 Bamboo Products Making and Marketing

Among the exported bamboo forest products, some of the largest demanding products are canned bamboo shoots, bamboo curtains, bamboo parquets, bamboo baskets, bamboo arts and bamboo handicrafts.

3.1.1 Canned bamboo shoots

There are 46 bamboo shoots producing industries in Lin' an, Zhejiang province. Generally, the products are exported to Japan, Taiwan and Hongkong. 11kg of bamboo shoots can get Yuan 80 (10 US\$) and 800,000 cans of bamboo shoots are exported annually.

3.1.2 Bamboo Curtains

In Anji township, 30 containers of bamboo curtains are exported daily. Depending on the size and design, a bamboo curtain can get from Yuan 80 (10 US\$) up to Yuan 800 (100 US\$). The bamboo curtains are generally exported to America, Australia, New Zealand and European countries. One of the industries that were visited in China produces Yuan 40 million worth of bamboo products, and from the proceeds received from these products, Yuan 10 million were reinvested annually on top of the original investment.

3.1.3 Bamboo parquets

Bamboo parquets are exported to Germany, Italy, America, Mexico and Japan. The measurement of an exported parquet is (920 x 92 x 15) mm and 1 cubic meter of bamboo parquet fetches from Yuan 480 (60 US\$) to Yuan 720 (90 US\$). 150,000 to 180,000 Cu m of bamboo parquets are exported annually.

3.1.4 Bamboo Artworks

In Qingshen which is commonly known as "Bamboo Art City", there are many artworks which are made of weaving with very small and thin slice of bamboo. Depending on the size and design of the artworks, a piece of artwork can get from Yuan 80 (10US\$) to Yuan 80,000 (10,000US\$). The countries that are most interested in these products are Singapore and European countries.

3.1.5 Bamboo Poles and Split Bamboo

Bamboo poles and split bamboo which are treated are exported to Japan and European countries for hotel decoration and relaxation centre. A split bamboo with 2m length and 0.052m width can fetch Yuan 4 (0.5 US\$).

The byproducts from various bamboo products making are used for production of bamboo charcoal, teeth-picks and tea spoon, etc.

4. Recommendation

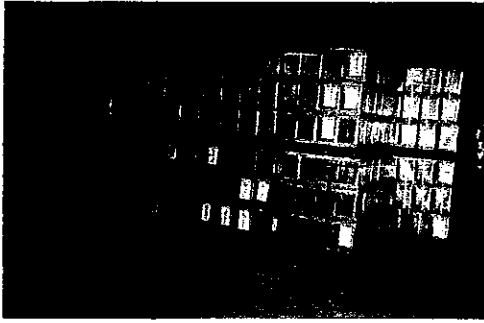
Based on the observations from the tour to China, the followings are recommended to be adopted in Myanmar for the successful management of bamboo.

1. Systematic strategy for bamboo management should be prepared.
2. To identify, and clarify the taxonomy of all the species of bamboo in the country
3. The private enterprise and cottage industries should be encouraged so as to get the maximum benefit out of the natural bamboo forests of Myanmar
4. International cooperation should be sought as much as possible.
5. To promote income generations for rural people by providing market oriented processing technologies of bamboo based value added products.
6. To strengthen the institutional capacity building and human resource development programme in the rural areas.
7. Markets and bamboo based technologies should be promoted
8. More research should be carried out as information on bamboo in Myanmar is still limited

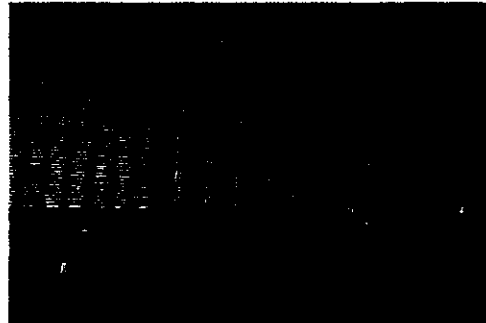
5. Conclusion

It is imperative to take note of the important role of bamboo for the rural people and also for the urban people. Export and exported earnings from bamboo based products were beneficial in China as the systematic management of bamboo forests and bamboo plantations were absolutely successful. On the other hand the Government encourages and supports the companies and private sectors to invest on bamboo plantation establishment and bamboo products making industries. Moreover, the advanced technologies and extensions to the people played an important role in bamboo business.

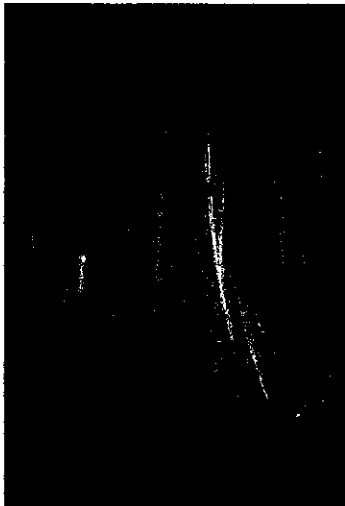
Export Bamboo Products in China



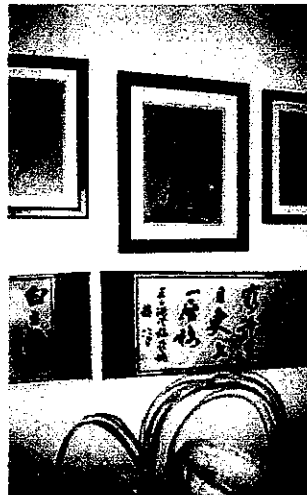
Bamboo shoot cans



Bamboo curtains



Sliced bamboo



Bamboo weavings art

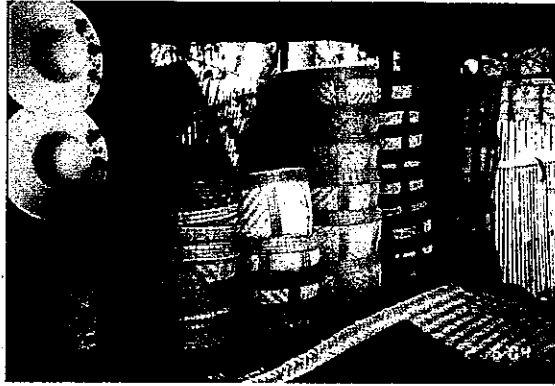


Bamboo Flooring



Bamboo handicrafts

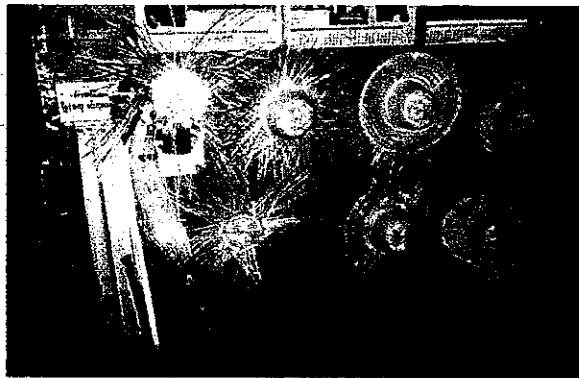
Bamboo Products in Myanmar



Bamboo products



Bamboo tray making



Different stages of bamboo hat making