Proceeding No. 2

Project : PD 56/99 Rev.1 (I)
Promotion of the Utilization of Bamboo
from Sustainable Sources in Thailand

Study Tour on
Bamboo Charcoal Techniques in Japan

18 – 25 November, 2001

Royal Forest Department, Bangkok, Thailand

and

International Tropical Timber Organization (ITTO)

Proceeding No. 2

Study Tour on
Bamboo Charcoal Techniques in Japan

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CONTENTS

STUDY TOUR REPORT

on

BAMBOO CHARCOAL TECHNIQUES IN JAPAN

(18-25 November 2001)

1. INTRODUCTION

The Thai Participants were sponsored by the International Tropical Timber Organization (ITTO) to attend the study tour on bamboo charcoal techniques in Japan. The study tours were kindly organized by Prof. Hiro-yuki Watanabe, Kyoto University. The Thai participants composed of four persons, including the leader, Mrs. Wanida Subansenee, the team leader of Bamboo project (PD 56/99 Rev. 1(I): Promotion of the Utilization of Bamboo from Sustainable Source in Thailand), Mrs. Nuchanart Nilkamhaeng, Mr. Prachoen Sroithongkham, and Mr. Chirapong Kuhakanchana.

The mission of the participants was to support the output 2.4 (Development of bamboo charcoal techniques) of the project objective. The activity 2.4.2 of the project was to make the study tour to the Forestry and Forest Products Research institute and Kyoto University on charcoal techniques including furniture, weaving and management in Japan. The participants had a good chance to learn and exchange idea with experts in bamboo charcoal technique and the utilization of charcoal and it's by-products.

2. CONTENTS OF STUDY TOUR

The participants had studied many things at various organizations for the bamboo charcoal techniques with some experts. The details of each item in the study tour were as follows;

2.1 Bamboo Materials Management

2.1.1 Bamboo Experimental Plantation

At Kamigamo Experimental Forest, Kyoto University Forests Assoc. Prof. Dr. Shozo Shibata explained the background and activity of the Experimental Forest.

Address, Settlement and Area

Address:	Kamigamo Kita-ku Kyoto, 603
Tel.:	075-781-2404
Fax.:	075-723-1262
Settlement:	Sep. 1926
Area (ha):	50.82

- **Main Activities**

1. The seeds of woody species throughout the world, including about 80% of all pine species, have been collected and brought here for growth and adaptability tests.
2. Research has been carried out on cross-breeding of useful trees, prevention of insect pests, and the physiology and ecology of trees.
3. Bamboo garden consisting of about 90 species, and the specimen house contains more than 10,000 specimens.

- **Location and Climate**

The Experimental Forest is located near Kyoto University in the northern part of Kyoto City. The altitude ranges from 109 to 255 m, and its geological characteristic is of the Paleozoic group with patches of the Quarternary system. The soil consists of dry to properly wet brown forest soils, and is generally poor. The annual mean temperature is 14.1°C and the annual precipitation is 1,515 mm. The snowfall in winter is about 20 cm.

- **Forests**

A large part of the area is covered with natural forest composed mainly of "HINOKI" (*Chamaecyparis obtusa*), "AKAMATSU" (*Pinus densiflora*) and broad-leaved trees. The growth of trees here is not good, and in recent year, many "AKAMATSU" have been dying due to nematodes carried by pine bark beetles. Because of decrease in number of pine trees, "HINOKI" have become dominant in places.

- **Research and Management**

The main research topics here are:

1) the physiology and ecology of domestic and foreign trees;
2) silvicultural techniques of introduced trees;
3) the cross-breeding of useful trees; and
4) forest protection.

It has been exchanging various seeds with 150 botanical gardens and laboratories in 40 countries, mainly in the Northern Hemisphere. The present seed collection includes 4,000 species representing 380 genera in 105 families, of which 750 species representing 350 genera in 99 families have matured. In the bamboo garden, the *Phyllostachys heterocycla* which have been observed since their germination stage flowered at 67 years old. The specimens house contains approximately 5,000 wood specimens, seeds of about 700 species, bamboo products, animals specimens, rocks and stones. All these forests and facilities are utilized by students.

2.1.2 Bamboo Plantation

In the vicinity of Rakusai Bamboo Park of Kyoto City, there are some private bamboo plantations which produce bamboo sprout and culm. Dr. Masatoshi Watanabe, Specialist of Japan Bamboo Society explained the information to the participants about some cultivation techniques of the bamboo plantation in Kyoto City.

2.1.3 Rakusai Bamboo Park of Kyoto City

At Rakusai Bamboo Park of Kyoto City, Dr. Masatoshi Watanabe, Specialist of Japan Bamboo Society welcomed the participants and explained the background and activity of the bamboo garden.

Address, Settlement and Area

Address:	300-3, 3-chome, Kitafukunishi-cho, Ooe, Nishikyo-ku, Kyoto-shi, Japan
Tel.:	075-331-3821
Settlement:	Jul. 1981
Area (ha):	3.5

- **Background**

Rakusai bamboo Park was established on July 18, 1981 by Kyoto City Government at a part of hilly land and a corner of so called Rakusai New Town on the southwestern edge of Kyoto City. The purpose of Rakusai Bamboo Park is to encourage deep knowledge on bamboo and to look at a peculiarity of bamboo through the ecological observation and valuable exhibitions. This Bamboo Park is a great pride to spread the real unique of bamboo life for Japanese people.

Before the construction of this New Town, this area was covered with bamboo stands occupying more than a half of the total 260 hectares of the land and was a very famous place to produce highest qualify bamboo shoot in Japan.

Rakusai Bamboo Park was realized by the endeavor of the late Dr. Koichiro Ueda, Professor Emeritus, Kyoto University, so-called Dr. Bamboo in the world and with the pleasant favor of the Mayor of Kyoto City, who accepted the complaints by many people who love bamboos.

Rakusai Bamboo Park covers 3.5 hectares out of 9 hectares of bamboo stands of eastern green belt in Rakusai New Town. It consists of Ecological Garden of about 5,000 square meters, Children's Square of 1.8 hectares and the Museum House in particular.

- **Ecological Garden**

About 120 kinds of bamboo have been collected from all over Japan. Of these species the eye-catchers are Tortoise-shell bamboo; *Phyllostachys pubescens* var. *heterocycla*, Kikko-chiku, golden and green striped bamboo; *Phyllostachys pubescens* var. *Nabeshimaria*, Kinmei-moso, black Bamboo; *Phyllostachys nigra*, Kurochiku in Japanese respectively and others.

A tortoise-shell bamboo is especially cultivated in Kyoto and golden and green striped bamboo have been originally found at Kurume in Kyushu then indicated to be a natural monument by Japanese government. Both bamboos are really splendid as an ornamental bamboo for Japanese garden and strike people's eyes very much.

Beautiful dwarf bamboos such as *Pleioblastus fortuner*, Chigo-zasa, *Sasaella kogasensis* var. *gracillima*; Koguma-zasa, *Sasa veitchii*, Kumazasa, are useful for ground-cover plants, are wonderfully planted on the slopes of the park. On the hedges *Chimonobambusa marmorea*; Kanchiku and *Bambusa multiplex*; Horai-chiku have been distributively planted, and *Pleioblastus hindsii*, Medake, *Bambusa multiplex* var. *elegans*; Ho-o-chiku, *Bambusa multiplex* f. *alphonso-karii*; Suho-chiku, and others have been planted beside the paths.

- **Confirmation of Gregarious and Periodical Flowering Intervals**

To confirm the interval of gregarious and periodical flowering of bamboos, *Phyllostachys bambusoides*; Madake and *Sasa nipponica*; Miyako-zasa respectively, was written in Japanese which showed the time of their last flowering and carved on stone monuments, have been raised for research and educational materials in the garden.

A seedling of *Phyllostachys pubescens* germinated in 1969 has been also developed for the same purpose.

- **Observation which a Bamboo Never Increases Its Diameter Every Year**

The fact of bamboo culm never increase its diameter after matured can be observed by the iron wire rounded on sprouted young bamboo and the wire never bites into the surface of the bamboo culm after matured.

- **Exhibiting How to Make Artificial Square Bamboo and Sesame-seed Bamboo**

An artificial square bamboo and sesame-seed bamboo can be observed at *Phyllostachys pubescens*; Moso-chiku stand. The square bamboo can be made by the way that wooden square frame was put on a growing bamboo shoot when it grows up about 30cm high on the ground. The sesame-

seed bamboo can be produced by cutting off the top part of standing 3-year-old bamboo during it's living.

- **Friendship Plantations with Foreign Countries**

Phyllostachys pubescens planted in the occasion of establishing the friendship relation with Nanjing Forestry University, China grows well in the ecological garden. Bamboos presented from U.S.A. and France are also growing well and exhibiting as the commemoration plantations of establishing friendship relations.

- **Gardening and Historical Monuments**

A great waterfall along garden rocks in the central part of the garden aims to enhance a garden's sight. Dodo Bridge, stone bridge, which is a favorite spots for visitors, has a sorrowful history that the East and West Forces severely battled by each side on the bridge in the Onin War (1467-1477).

Various stone buddha images are installed in a part of the park and it is traditionally said that the images had been used for a stone wall of old Nijyo Castle constructed for the final General Yoshiaki Ashikaga in the Muromachi Shogun-ate by the military commander Nobunaga Oda. They were dug up in the occasion of subway construction in Kyoto City, then meaningfully installed here and available for rich in the view.

- **Museum House**

Museum House is about 490 square meters and one-story reinforced concrete building with Japanese style adorned by wonderful bamboo hedges. The house is divided into exhibition room, traditional Japanese tearoom, training room, and administration office.

- **Exhibition Room**

The electric light bulb made by bamboo filament invented by the most famous scientist Thomas Edison before about 120 years ago is exhibited.

Typical and wonderful Kyoto special bamboos are exhibited in wall side as;

Polished bamboo: Sarashi-dake; *Phyllostachys pubescens* and *bambusoides*

Sooted bamboo: Susu-dake; *Phyllostachys bambusoides*

Natural spotted bamboo: Unmon-chiku; *Phyllostachys nigra* f. *boryana*

Natural partly stained bamboo: Shimi-dake; *Phyllostachys bambusoides*

Tortoise-shell bamboo: Kikko-chiko; *Phyllostachys pubescens* ver. *heterocycla*

Natural black bamboo: Kuro-chiku; *Phyllostachys nigra*

Artificial square and spotted bamboo: Zumen-kakuchiku; *Phyllostachys pubescens*

Artificial Dyed and sooted bamboo: Jinko-susudake; *Phyllostachys pubescens*

Artificial sesame-seed bamboo: Goma-dake; *Phyllostachys pubescens*

Alcove post bamboo: Hashira-dake; *Phyllostachys pubescens*

Artificial flatted and spotted bamboo: Zumen-hira-chiku; *Phyllostachys pubescens*

Roped, dyed and sooted bamboo: Nawame-susu-dake; *Phyllostachys bambusoides*

In the central exhibition board, there are many picture panels to show and explain peculiar ecological and physiological characteristics of bamboo.

Traditional bamboo handicrafts from old time like artistic baskets, fans, tea whisk, typical flower pots, bamboo blinds, bamboo sword, and other rare products are exhibited in glass cases.

Some modernized industrial products like bamboo charcoal, bamboo activated carbon, bamboo paper and rayon are also exhibited. Flowers and seeds of bamboos, pictures explained how a landslide calamity had been prevented by bamboo stands, and other valuable examples are exhibited. They noticeably make visitors look at bamboo again.

In one corner, rare foreign bamboo like solid bamboos, thorny bamboos, long internode bamboos, and other peculiar bamboos are interestedly exhibited.

- **Panorama under the Ground**

The expansion of rhizome system under the ground on *Phyllostachys pubescens*, which is most important for understanding the behavior of bamboo growth, can be observed at a corner of Museum House.

- **Traditional Japanese Tea Room and Training Room**

A bamboo has close relation with Japanese culture from an ancient time. In the traditional tea room, named "Chikufuken", people can enjoy tea ceremony with the view of Japanese bamboo garden.

Training room can be used for multipurpose like bamboo training, various seminars and meetings. Some important facilities like video installation and slide projector are equipped for those events.

- **Souvenir Corner**

At the souvenir corner, typical bamboo products in Kyoto can be purchased, such as traditional flower pots, tea whisks, spoons and other equipments for tea ceremony, chopsticks, stamps and interesting bamboo products.

- **Children's Square**

A wide green turf land of about 1.8 hectares is opened in a bamboo stand where children can enjoy to play dragonfly, water gun, and other bamboo play things. The square is also useful for children's education on bamboo and picnic.

2.2 Bamboo Utilization

2.2.1 Bamboo Products

At Bamboo Shop of Kyoto City, Dr. Masatoshi Watanabe, Specialist of Japan Bamboo Society received the participants. He also explained about the cultural bamboo utilization of Japanese from the ancient time. Until now, there are diversified bamboo products such as fence, home decorate, utensils, furniture, souvenirs and bamboo board (see annex).

2.2.2 Bamboo Charcoal

At Wood Research Institute, Kyoto University, Uji city, Dr. Takaya Nomura, Instructor of Laboratory of Property Enhancement, Division of Wood Biomass Science, received the participants. He was specialist on bamboo growth and its structural formation, smoking dry of wood and fundamental study of bamboo charcoal and bamboo vinegar. He also explained the property of bamboo charcoal and his research on bamboo charcoal.

In the past, bamboo charcoal was mainly used as fuel. However, some other functions of charcoal, namely, adsorbing and reducing function have been used from the ancient times to purify water, preserve objects and adjust humidity of the living environment. In addition, at present the bamboo charcoal is also utilized as a semiconductor and a bioreactor. For making bamboo charcoal, temperature should be considered for the carbonization process. At the high temperature of carbonization, the function of acidity adsorption will be high.

2.2.3 Charcoal Kiln

Dr. Kenji Hosokawa, charcoal consultant of the project received the participants to visit the charcoal kiln factory as follows;

- **Kansai Corporation**

Address: 1666 Minamikawase-cho, Hikone-City Shiga –Pref. 522-0222 JAPAN
Tel.: 0749 (25) 1111
Fax.: 0749 (25) 1115
Settlement: 1941

This factory is successful in manufacturing an automatic rice husk carbonizer in 1967. Kansai Corporation was honored to receive the first government subsidy upon the machinery for carbonizing rice-husk under the program of Agro-Structural Improvement Project of Ministry of Agriculture Forestry and Fisheries (M.A.F.F.) of the Government of Japan. To manufacture the experimental and commercial charcoal kilns and concerning about bio-tan product plant which most of the raw materials are from the waste such as rice husk, wood chips and bamboo. The utilization of carbonized wood-chip (bio-tan) are as follows;

1. Manure
   1) Protection from damage by draught - Increase of water retention
      Weight ratio 580%
      Content ratio 88%
   2) Reforming of acid soil - pH value 8.5 to 9.1
   3) Improvement of soil construction
   4) Increase of soil temperature
   5) Protection from disease
2. Soil for seed-bed and flowerpot - to bring seedlings to have stout stems and many root.
3. Filtration plant & Deodorizer

- **KCP Company**

Address: 388 Sinasahimachi Takasimagun Shiga JAPAN
Tel.: 0740-25-6300
Fax.: 0740-25-5595
Email: kcp@mx.biwa.ne.jp

This factory is cottage industry for producing bamboo charcoal and bamboo condensed liquid (vinegar), ceramic ball made by π water system, instructing charcoal making and selling stainless steel kiln. The capacity of the kiln is about 0.7 cubic meters (approx. 300 kg.). It will yield 13-20% bamboo charcoal (by weight) of the raw materials and 10-20 liters of bamboo vinegar. The chamber is made from corrosion resistant stainless steel (type SUS 340) which is heat resistance to 850 °C. The base of the main chamber has a fire hole, an ash outlet and four air control valves for the adjustment of the carbonizing process. On the top of the chamber, there are also four side chimneys, with shutters. The inner chamber has two holes for

the temperature measurement censor. For the process of making bamboo charcoal, they used three years old bamboo and dried for approximately a half year after harvesting. After drying they are cut into 1100 mm length and split into four pieces. To ignite the bamboo, burning old bamboo in through the fire hole. After 1.5-2 hours, the temperature of inner chamber has reached about 100 °C, the bamboo has ignited and then shut the fire hole. At this time the kiln will start producing bamboo vinegar. After shutting the fire hole they will start the carbonization process. It takes about 10 hours to complete the carbonization. To achieve an optimum result, the final carbonization process should be controlled the temperature at 700-800 °C until there are only a small amount of purple coloured smoke, close the shutter of the four chimneys, then open the main chimney to increase the temperature until 1,000°C in 40 minutes to continue carbonization process and then shut all of the air control valves and the shutter to complete carbonization. Bamboo vinegar can be collected by using running water through a shuttle (7-10 m length), which connected with the chimneys, to condense the smoke. In testing bamboo charcoal quality, a small hammer hits lightly to produce the sound that the bamboo charcoal achieves an electric resistance value under 10^7 Ω.

- **KYOTIKUTAN and KYO-CHIKUTAN (Bamboo charcoal and derivative producer)**

Address: Jamura-Shinden Yuo-no sato Ide-Cho Tuzuki-district Kyoto Pref. , JAPAN
Tel.: 0774-82-2067
Fax.: 0774-82-2067
Email: narabi.k.nagata@ezweb.ne.jp

The productivity of this factory is about 15 ton/month. The raw materials are harvested from natural forest. The capacity of kiln is 1.5 ton, the yields are 0.5 ton and 120 liters of bamboo vinegar. The process of making bamboo charcoal are as follows;

1. Cut into 1 meter, split into 4 pieces and then bundle with cotton rope.
2. Bring into the kiln for smoke heat treatment at 180°C and takes 2-4 days to decrease the moisture contents until 15%. This method will preserve the bamboos from fungi and insect and can keep for 1-2 years.
3. After decreasing the moisture content, then bring into the kiln (Sumiyagi Gama – kiln's names) for carbonization by using reverse draft process at 250°C. It takes 3-5 days and the highest temperature is 380°C for collecting the bamboo vinegar.

2.2.4 Charcoal Products

They are classified into pieces and particles or dust depend on the utilization (see annex). Its price per kilogram is about 1,300 – 5,000 yen (approx 10-50 US$/kg). The utilization of charcoal products is not for fuel now. There are new uses of these charcoal as follows;

1. Humidity control in the house such as cover the ground before construction
2. Air refresher or Deodorization
3. Soil improvement for agriculture
4. Water quality improvement
5. Oil adsorbing
6. Food additives
7. Preservation of freshness
8. Rice cooking
9. Bedding
10. Baths

2.2.5 Charcoal By-Products

Bamboo vinegar is by-products from the carbonization process of bamboo. It is used for skincare, healthy drink by dropping 2-3 drops in drinking water. It can used be as insecticide for agriculture. Its price is about 1,500 yen/liter (approx. 12US$/l)

2.3 Other Visiting

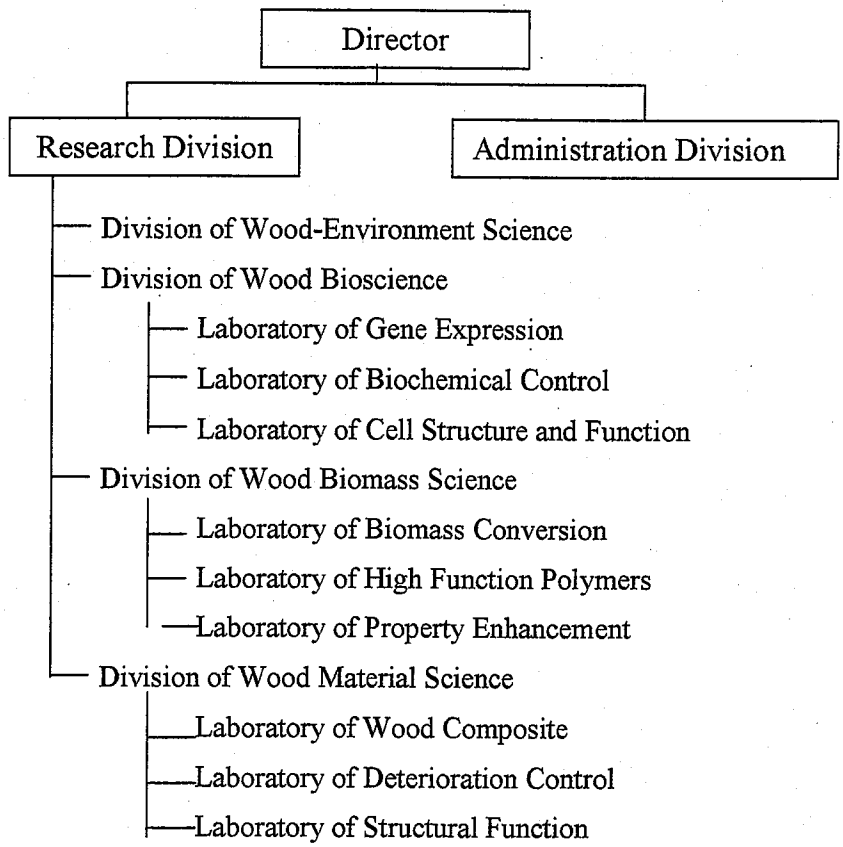
- Wood Research Institute, Kyoto University, Uji city,

In addition, Assoc. Prof. Dr. Tsuyoshi Yoshimura received the participants. He explained the background and the activity of Wood Research Institute.

Address: Gokasho, Uji, Kyoto 611-0011, JAPAN
Tel.: +81-774-38-3601
Fax.: +81-774-38-3600
Settlement: May 1944

There are 8 Professors, 8 Associate Professors, 1 Lecturer, 9 Instructors and 26 Scientists. In each laboratory there are many high technology instruments.

Organization



- **Xylarium, Wood Research Institute, Kyoto University**

The objective is to support the basic research for creating new "culture of wood" as well as investigating the footprints of "culture of wood".

1. To collect wood specimens from all over the world
2. To make microscope slides of these wood specimens
3. To support wood identification

This xylarium was founded in 1980, taking advantage of the registration of Index Xylariorum, Institutional Wood Collections of the World-2, the code address of which is KYOw in 1978. The collection of wood samples was restarted in 1944 when the Wood Research Institute was established and now about 14,975 samples from more than 3,561 species, 1107 genus and 175 families were collected. There are 8,488 microscope slides of the specimens. Most samples are botanically authenticated, some parts of

which correspond to herbarium specimens. There are also old wood samples which are important to the archaeology, geology or paleontology.

3. BENEFITS AND SUGGESTIONS

3.1 Benefits of this Mission

3.1.1. Bamboo Plantation and Management

Nowadays, there are a few bamboo plantation and management in Japan. Most of the raw materials culms are from China because of the labor wages is too high but the cost of bamboo culms from China are cheaper. Therefore, there is no harvest so the yield decline. To produce bamboo shoots it needs very intensive management. It will be covered with rice husk and then covered with soil once a year in the beginning of winter season. The age of bamboos should be 1-5 years. The density of plantation is 3,000 trees/hectare, to produce big shoot (more than 10 cm of diameter). The productivity of shoot is 1 ton /0.1 hectare.

The establishment of bamboo garden is to collect the bamboo species which is the place for recreation, exhibition of bamboo products and distribution of products.

3.1.2. Bamboo Products

The bamboo products are popular in Japan. Most of them are fine art products which increase the value added of bamboo. There are many species of bamboo which are different in characteristics, shape, size and use. The technologies to make artificial square, spotted, sooted and sesame-seed bamboo are available.

3.1.3. Bamboo Charcoal and Bamboo Vinegar

There are multipurpose uses of bamboo charcoal and bamboo vinegar in Japan (as described above). The objective is aimed at improving the environment and increase value-added bamboo charcoal. The participant received the knowledge of bamboo charcoal technique and bamboo vinegar collecting technique which can help develop the utilization of bamboo charcoal and bamboo vinegar in Thailand.

3.2 Suggestions

The study tour to Japan was mainly focused on "Development of bamboo charcoal techniques", but other activities concerning bamboo management and utilization were also included. Some suggestions can be made for Thai situation as follows;

1. Bamboo plantation should be promoted to prepare raw materials for different industries in the future.

2. Bamboo Park or Garden should be established or strengthened for species collection and recreation to support ecotourism activities and as gene conservation areas.

3. Research on bamboo management and utilization should be promoted and the practical results should be transferred to the farmers and Industries.

4. Bamboo charcoal and vinegar seems to have good markets if properly promoted, so it deems necessary to strengthen then more research in different aspects.

5. Bamboo museum should be established to exhibit and transfer knowledge to the people.

6. Bamboo association should be established to be a center for knowledge, information, and technological exchanges of the people interested in bamboos.

4. ANNEX

Annex 4.1 List of Persons Contacted

Dr. Nomura Takaya 0774-38-3656, tnomura@kuwri.kyoto-u.ac.jp
Wood Research Institute, Kyoto University

Mr. Nagata Kannji 0774-82-2067 Kyo-Chikutan, Bamboo Charcoal producer

Assoc. Prof. Dr. Shozo Shibata +81-75-781-2402, +81-75-753-6442
Kyoto University Forest, Graduate School of Agriculture, Kyoto University

Dr. Kenji Hosokawa +81-75-591-4728, ho89ke93@dream.com

Mr. Maruyama, Tsutomee 0774-82-4145 KYOTIKUTAN

Mr. Nagata Kanji 0774-82-2067, nabari.k.nagata@ezweb.ne.jp
KYO-CHIKUTAN

Mr. Kiichiro Katayama 0740-25-6300, KCP Co., Ltd. (President)

Dr. Masatoshi Watanabe +81-75- 761-3600, dkakd107@kyoto.zaq.ne.jp
Japan Bamboo Society (Specialist)

Mr. Yoshiaki Umezawa 0749-25-1111 Kansai Corporation (Chief of Development Sect.)

Mr. Ido Naoki 0749-25-1111 Kansai Corporation

Assoc. Prof. Dr. Tsuyoshi Yoshimura 0774-38-3662,
tsuyoshi@termite.kuwri.kyoto-u.ac.jp Div. Wood Material Sci., Lab. Deterioration Control. Wood Research Institute, Kyoto University

Assoc. Prof. Dr. Hiroyuki Yano +81-774-38-3669, yano@kuwri.kyoto-u.ac.jp Laboratory of Wood Composite Div. of Wood Material Science. Wood Research Institute, Kyoto University

Mr. Takayuki Kaneko, Instructor +81-75-753-6359, kaneko@kais.kyoto-u.ac.jp Laboratory of Tropical Forest Resources and Environments, Division of Forest and Biomaterials Science, Graduate School of Agriculture, Kyoto University

Mr. Fumikazu Ubukata, Ph.D. Candidate +81-75-753-6361, ubukata@kais.kyoto-u.ac.jp Laboratory of Tropical Forest Resources and Environments, Graduate School of Agriculture, Kyoto University

Assoc. Prof. Dr. Mamoru Kanzaki +81-75-753-6376, mkanzaki@kais.kyoto-u.ac.jp Tropical Forest Resources and Environments, Division of Forest and Biomaterials Sciene, Graduate School of Agriculture, Kyoto University

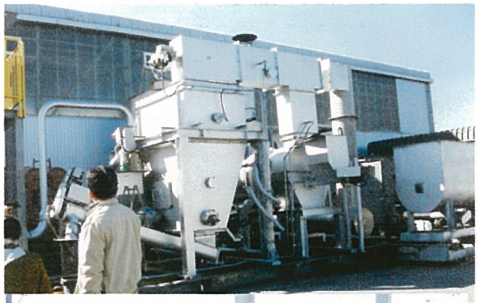
Annex 4.2 Itinerary

Nov. 18 (Sun)	Arrive Kansai 5:50 SQ974 Kansai – Kyoto
Nov. 19 (Mon)	Bamboo plantation (Kamigamo Station, Kyoto University)
Nov. 20 (Tue)	Bamboo charcoal production (Wood Research Institute, Kyoto University), Uji city
Nov. 21 (Wed)	Kansai Corporation (Kiln producer) Hikone-city, Shiga
	KCP Co.Ltd. (Bamboo charcoal and Kiln producer) Asahi Shinasahi, Shiga
Nov. 22 (Thu)	Bamboo plantation for sprout production, Kyoto City Bamboo Garden and Bamboo handicraft, Kyoto
Nov. 23 (Fri)	Kyoto Museum of Traditional Crafts
Nov. 24 (Sat)	Bamboo charcoal production Yamashiro Aotani, KYOTIKUTAN and KYO-CHIKUTAN (Bamboo charcoal and derivative producer)
Nov. 25 (Sun)	Kansai (10:30) – Bangkok

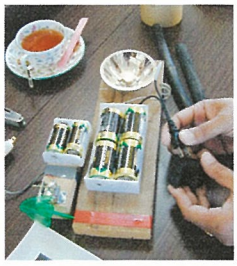
Annex 4.3 Figures

Visit Charcoal Factory

1. Kansai Corporation, Carbonizer or Charcoal Kiln Production



2. KCP Company, Stainless Steel Charcoal Kiln



3. KYOTIKUTAN and KYO-CHIKUTAN (Bamboo charcoal and derivative producer), Sumiyaki Gama (Kiln)

The Utilization of Bamboo Charcoal & Vinegar

Food Additives

Soap

Pain Relievers

Drinking Water

Air Refresher

Bamboo Vinegar – insecticide, antiseptic

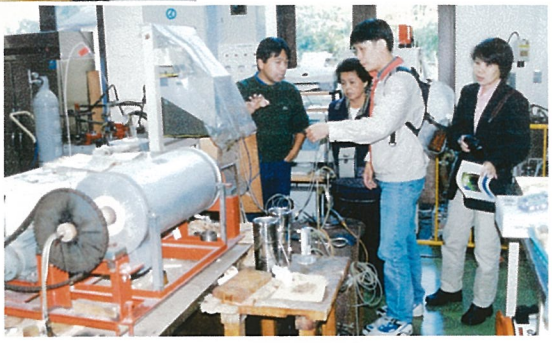
Visit Bamboo Plantation at Kamigamo Experimental Forest, Kyoto University

Bamboo Collection

Visit Wood Research Institute, Kyoto University, Uji city

Bamboo Charcoal

Bamboo Vinegar



Visit Bamboo Plantation, *Bamboo Shoot Production*

Visit Rakusai Bamboo Park Kyoto City

Square Bamboo Making

Visit Bamboo Shop