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In Recognition of the Bamboo as the Next Best Alternative *Quid Pro Quo* Modern Materials as Instant Shelter to Humanity in Times of Catastrophic Disaster

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Abstract

Originally found in the wild in Asia, Africa, Australia and South America, bamboo is used in one form or another at home or in the workplace by over half the world's population. Although bamboo is of great importance, unfortunately, not many of us recognize its quality as the next best instant alternative material quid pro quo to processed wood, steel, aluminum or fabric materials in times immediately after a catastrophe of great magnitude whence humanity needed most an instant shelter against the elements.

Written in the memory of humanity who suffered much and were unwilling victims of the horrors of natural and man made disasters, who may have prayed for humanitarian help, but when compassionate help finally came by it was a little bit too late.

This is a call for all governments, non-governmental organizations, and nature conservationists to play a role to establish zones of protection and development of bamboo reforestation to previously deforested areas caused by forest fires and defoliated by man. They should also concentrate on areas concerned with compensation for villagers affected by the reforestation and conservation schemes, hence building healthy relationships that will lead to the speedy change of environmental landscapes of vast geographical scale.

Keywords: *Turion, rhizome, culm, unique grid dome, proprietary jointing system, deforestation, global warming, civil societies, ecosystem.*

Introduction

Originally found in the wild in Asia, Africa, Australia and South America, bamboo is used in one form or another at home or in the workplace by over half the world's population. Unlike wood, bamboo is actually grass. The plants can thrive easily in temperate and tropical climatic conditions. Although bamboo is of great importance, unfortunately not many of us recognize its quality quid pro quo modern materials.

Sadly, in Southeast Asia despite the slow recovery from the economic downturn since 1997, building with bamboo is stigmatized and its value overlooked in favor of housing with imported content of aluminum, brick and cement (ABC) materials. Younger generations look down upon it as the ultimate symbol of poverty. Bamboo actually is an environmentally friendly material (Trakullert-sathien 1999); it is cheap and could readily be cultivated in deforested areas, either high or low ground, preventing severe erosion and soil degradation. It grows instantly and matures within five years; unlike trees which mature in up to 200 years. It may yet be the answer for an instant and cheap source of temporary housing in times of disaster of great magnitude, e.g. the strong earthquake that happened in Gudjarat, India on 26 January 2001, or the annual typhoons that visited Mozambique or Bangladesh, and for refugee housing in times of war or famine. This is one instant solution for governments and non-governmental organizations to resolve with compassion the timely assistance for victims of human tragedies, both man-made or from natural causes.

Scope and Objectives

The scope of this research is limited to the Asian bamboo. The objectives of this study are listed below:

- The cultural and symbolic background of bamboo.
- Bamboo forest description, anatomy, and planting bamboo.
- The practical benefits of bamboo.
- Forest rehabilitation as a resource for material in times of disaster.
- Obstacles to bamboo development.
- Bamboo fodder for the endangered species (conservationist).
- Later technology: Bamboo dome, a cheaper alternative.

The Cultural and Symbolic Background of Bamboo

Apart from its practical benefits, bamboo has its cultural and symbolic significance (Crouzet 1998).

Although bamboo has also its role in Central and South America since the time of the Incas, to avoid over-diversification, this section concentrates on the cultural significance of bamboo in Asia, and especially in China and Japan. At the beginning of 200 AD, the first paper was made from bamboo fibers in China. Fine layers of bamboo pulp, obtained by soaking and kneading the fibers were left to dry on bamboo racks, upon drying, papers are obtained by pressing the layers into sheets. Also, the calligrapher's brush and writing tablets originated from bamboo in China. The great Chinese poet Su Dong Po wrote of bamboo, "Without meat, we lose weight; but without bamboo, we lose our identity, the very essence of our culture" (cited after Crouzet 1998). In China bamboo stands for modesty and youth for symbolic significance (Crouzet 1998).

From the 15th century bamboo was used to make the utensils of the Japanese tea ceremony. The ritual of the tea ceremony reflects the desire of the participants to achieve a state of inner peace and balance in harmony with the elements, a dimension missing from western culture.

A volume would not be enough to describe the role of bamboo in the tradition and art of the Japanese. Symbolically, R. Tagore, a Japanese poet wrote, "Make sure your life is pure and straight as a bamboo flute" (cited after Crouzet 1998).

Among the Buddhists in Asia, the bamboo has great symbolic value, who refer to it as a 'blessing from heaven'. According to the teachings of Gautama Siddhartha, better known as the Buddha, 563-483 BC, bamboo enables the individual to achieve a state of inner peace. He in fact prepared for his own death by withdrawing to a forest of bamboo (Crouzet 1998).

Bamboo Forest Description

Imagine hundreds of stems shooting skyward like rockets, where regularly spaced, in twos and threes. All are tall and slender, yet resilient, and the golden branches and green foliage swaying gently in the breeze the huge culms often grow to heights of 20 meters or more, competing with some of the tallest trees in the forest (Houzeau 1906).

Anatomy

Worldwide, there are over a thousand species of bamboos, grouped into almost 70 genera.

A bamboo plant consists of rhizomes (underground stems), the roots, the culms (canes), the branches, the leaves, and the turion (bamboo shoot).

Planting Bamboos

Chinese and Japanese have an identical saying: "It takes one man ten years to create a forest of bamboo, while ten men can create the same forest in a year" (Crouzet 1998). The weightiness in the literal and figurative sense of the role played by the underground part of the plant is the future development of the group. In other words, one man could

easily plant bamboo in 15-L containers, whose weight would be 15 kg. The bamboo, 2-m tall when planted, would reach 8 and 12 m after five years. It would be possible for ten men to create a forest in one year since well-established 8 and 12 m tall and weighing 250-300 kg bamboos could be planted by ten strong men.

Bamboos dislike too little or too much water. They do not grow well in waterlogged soil, and only *Phyllostachys heteroclada* and *Arundinaria gigantea* will survive these conditions. Although apparently healthy bamboos thrive on the banks of the Mekong River, a closer look reveals that these bamboos are planted above the water line.

Bamboos should not be planted in an area with salty soil, although *Phyllostachys iridecens* and *P. fimbriligula* have a higher tolerance to salty soil. Bamboo, however, will grow in poor-quality soil but the growth will be restricted.

The Practical Benefits of Bamboo

An all-purpose natural plant bamboo provides civilizations with wide varieties of benefits. In its adaptability to human needs, it has few competitors in the plant kingdom. It has the unique quality of being naturally pre-finished and ready-to-use.

Bamboo is a versatile plant with the following practical benefits:

1. Housing and Building: In countries like China, Japan and the ten Southeast Asian nations, bamboo is widely used for housing, although their designs vary. In Latin American countries, bamboo houses of up to several stories are common. These houses are made complete with bamboo fencing.

2. Famous musical instruments and dancing props made of bamboo are listed below:

- The world's first bamboo organ was built during the Spanish Regime (1521-1890) in Paranaque, Rizal, Philippines - still in good order to play liturgical music in the Catholic Church where it was installed.
- The Philippine national cultural dance, the 'Tinikling' could not be performed without two bamboo poles.
- In Bali, Indonesia, almost every village has a musical troupe and all instruments are made from bamboo, such as the giant flute, 'guntang' drum and xylophone.
- In Malaysia, the traditional cultural dances are accompanied by musical instruments made of bamboo, called the 'Angklung'.

3. Handicrafts, tools, household articles: Bamboo has been used traditionally in making these items.

4. Sturdy lightweight rafts and woven boats:

- Bamboo rafting is a common means of transportation in all Southeast Asian countries.
- In Vietnam, the woven bamboo boat is commonly used by fishermen.

5. Pigpen, chicken coop: All are made from bamboos.

6. Bamboo shoots: These are widely used as a vegetable throughout Asia.

7. High quality paper, rayon and calligraphers' brushes: These are nearly always made of bamboo.

8. Appliances: Bamboo match-stick curtain, paneling, parquet in-laid flooring are very common.

9. Herbal medicine: Bamboo leaves are used as herbal medicine.

10. As sharp knife: In many parts of Asia, traditional midwives use germ-free new sharp strip of bamboo to cut the newborn baby's umbilical cord.

Forest Rehabilitation by Replanting with Bamboo

Slash-and-burn farming practices and the overexploitation of timber resources have destroyed Southeast Asia's indigenous

forests, causing severe erosion and soil degradation.

As late as 21 March 2001, the Bangkok Post (Anon. 2001a) reported that large quantities of illegally cut logs were seized in the past five months in Thailand. "Among the contraband were 480 teak logs and 2,122 planks of processed teak. The timber came from illegal logging in Pong Nam Ron area on the fringe of Mae Yom National Park. A total of 30 suspected loggers were caught by Forestry official patrols". It went on to say, "In Chiang Mai, a ban was issued recently against bamboo rafting along the Mae Taeng Stream in Huai Nam Dang National Park. The ban was issued after officials found bamboos in the park were being secretly cut by trekking tour operators to be made into rafts".

Water and fire are also crucial factors that are affecting the survival of forests in Southeast Asia. In Kalimantan, Indonesia forest fires happen almost yearly, either man-made or from natural causes, i.e. due to lightning. This unfortunate event may last up to four months between March and June, especially if the forest is located on a peat swamp. Indonesia, being a poor country, lacks ability and money to fight extensive forest fires, sometimes occurring at different places. Many cities in neighboring countries, like in Malaysia and Singapore, suffer when covered with smoky haze throughout this event (Anon. 2001d).

Last year, also between March and June 2000, Phru To Daeng in Thailand, a peat swamp forest fire occurred, covering the town of Narathiwat with smoky haze (Achakulwisut 1998). Volunteers were unable to put out the fire. These forest fires were eventually extinguished by rainfall upon the onset of the rainy season, usually from the month of July.

Water in the peat swamp has its ebb and flow. If a structure is built to retain it, the water will be stagnant. The whole forest may turn rotten. This is as expressed in 1990 from a study by a team of consulting engineers from Thailand

The Head of the Princess Sirindhorn Peat Swamp Forest Research and Nature Study Center has this to say, "Due to the fragile condition of peat swamp forests it is nearly impossible for them to be rehabilitated after destruction. It would take up to 200 years for the charred forest to recover. Reforestation is necessary if we wish to return the swamp to its original, diversified condition" (Achakulwisut 1998).

For these devastated areas bamboo reforestation is recommended. These 'new forests' shall become sustainable sources of construction materials. They can also supply raw materials to manufacturers of quality paper and rayon fabric. The new forests will provide for naturists' conservation habitat for certain birds and wild animals, and also to maintain the balance of the ecosystem. The cutting and burning of trees releases huge amounts of carbon dioxide, helping trap heat, which many scientists believe is warming the earth through the greenhouse effect.

It will take only five years to grow a bamboo forest, but for a peat swamp forest devastated by fire will take 200 years to grow back near to its original diversified state (Crouzet 1998).

Asian countries should seek funding from the United Nations Environment Programme in their bid to reverse environmental degradation of the bamboo forests in Asia. Without restoring forest destroyed by yearly fires and overexploitation, there is risk from climate change, and increased soil erosion causing sedimentation to the coastal marine environment. The economic value of mangrove forests in preventing soil erosion and other environmental functions is estimated at US$ 19,000 per ha (Anon 2001c).

Obstacles to Bamboo Development

The major reasons why bamboos were not sustainably developed are listed below:

- Disparity on understanding global warming remains between urban and rural Asians.

An awareness drive should be organized to enable the population understand the 1997 Kyoto Protocol. According to this United Nations document (Anon. 2001d), the

methane in the atmosphere comes from domestic ruminants, forest fires, wetland rice cultivation and waste products.

Reforestation, e.g. with bamboo, is one positive way to lessen this continuing threat.

- Lack of interest and skill by entrepreneurs to develop high quality papers and rayon fabric.
- Some foreign countries which offered to train (local) civil-defence trainees from Asian countries were experts only in using modern methods and building materials for rapid mass housing. These were products exported from their own (foreign) countries and they were unfamiliar of the importance of bamboo as an alternative material (Manavinoon 1998).
- Unscrupulous individuals were able to obtain permission to develop newly deforested land for quick profit by converting swamp land into shrimp farms or resorts at the expense of the ecosystem (Kungsawanich 2001).
- Bamboo is cheap and is not recognized as a money earner.

The governments of the Asian countries should pay more attention to the sustainable development of bamboo. Bamboo should be used for reforestation purposes.

Bamboo Fodder for the Wild Pandas

According to conservationists, the giant panda once ranged from Myanmar through much of eastern China, but it was hunted by man so that the number declined to 1,200. The panda has become the symbol of all endangered species.

Pandas were known to feed almost exclusively on bamboo, and researchers in Sichuan, China found that they favored the leaves and young stems of the arrow bamboo.

First Framed Dome Made of Bamboo Structure

Concept: Traditional lattice wickerwork.

A bamboo-braced dome could be constructed on polygonal base where the apex touches a circumscribing circle. A moderate span dome of 20 up to 30 m could be made using bamboo stand alone as generated by scale model studies, considering all things are equal between steel, plastic and bamboo.

Braced domes are classified according to the way in which the surface is framed. The main types of spherical bamboo dome are applicable as follows:

a. *Ribbed Dome:* The ribs carry triangular loading and the dome can be designed as a series of two or three-pinned arches.
b. *Unique Grid Dome:* This type of dome is formed by a two- or three-way intersecting grid arcs. Where the arcs are great circles, the geodesic dome is one special case of the dome (Fuller 1983).

Construction

a. *Framing:* Hollow or solid bamboo sections may be used. Members are usually straight between nodes. Lattice domes, can be assembled on site using proprietary jointing system or specially cast joints.
b. *Proprietary Jointing Systems:* 'Mero' and Nippon NS 'Space Truss' joints are commercially available.
c. *Cladding:* Roof units made of transparent plastic, and canvas or fabric.
d. *Estimated Cost:* US$ 200 per sq.m. (excluding roof cladding and land ownership).

Bamboo Structural Stresses

The research program by Janssen (1982) has shown the rate between the mass per volume in kg/m^3 and the allowable stresses in N/mn^2 as shown in the following Table A.

Note: Dry bamboo has a moisture content of 12% when in equilibrium with air with a relative humidity of 70%.

It is well known that preservatives commonly used for woodwork as well for bamboo, from wood-borer insect protection and fire resistance, for instance using intumescent paint.

Conclusion

Governments, civil societies (non-governmental organizations), entrepreneurs, and conservationists alike are required to play a role to establish zones of protection of bamboo reforestation to deforested areas caused by forest fires or defoliated by man. Rhetoric aside, it is time for the experts to discuss whether and how they might give nature a helping hand and at what cost.

In Thailand, there are plans to set up a 'one-million-baht revolving fund for every village', and 'one-*Tambon*, one-product concept' for every sub-district in the country. However, in order to succeed, better cooperation between the community grassroots and the government are essential. A clear focus on how to manage the fund and bamboo products made by farmers borrowing from the scheme should be a priority. Also, it is vital to get the private sector on board.

Resilient but not breaking in the face of adversity, bamboo is lightweight and it attracts hardly any force bending and swaying with the typhoon or an earthquake (Janssen 1982). If grown abundantly, bamboo no doubt will be an immediate source of materials for shelter. This could avert a disaster after a catastrophe when developed countries are doing too little or too late to respond, e.g. preoccupied with humanitarian work elsewhere.

A single bamboo species can go over a hundred years without flowering. When it does a single plant is covered in thousands of flowers. The significance of the flowering *fait accompli* is death to the bamboo clones. However, one germinated seed is technically enough to ensure perpetuation.

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Table 1. Compression, bending and shear of dry and wet bamboos

Criteria	Compression (no buckling)	Bending	Shear
1. Dry bamboo (12% moisture content)	0.013	0.020	0.003
2. Wet bamboo (green bamboo)	0.011	0.015	-