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List of Participants

Bamboo in Latin America: Past, Present and the Future

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ABSTRACT

Almost 50% of world bamboo biodiversity is from America, with Brazil as the country with the largest national complement of species, with almost 134, followed by Venezuela with 68, Colombia 56 and Peru with 48.

The most important native genus in Latin America: *Guadua* sp. and *Chusquea* sp. Among the large sized bamboos, *Guadua angustifolia* is the most studied and used native species; due to the physical and mechanic characteristics of the 25-30 m high culms, appropriate for constructions and several other uses. Several exotic bamboo species, mainly from Asia are also present in the new world, among them several species of *Bambusa, Phyllostachys, Gigantochloa* and *Dendrocalamus.*

Bamboo was used mainly in constructions and tools for farming, music, weapons, among others. Bamboo housing components that are about 4500 years old have been found in Ecuador. During the colonial time "bahareque" technique was use for building old urban traditional houses mainly in Peru, Colombia and Ecuador, which after almost 500 years and several strong earthquakes are still in good state. In recent years, bamboo is use for urban and rural marginal housing, but also for complex architectural structures for houses, public buildings and bridges.

Even though, bamboo management, transformation and use in Latin America have not reach the traditional level as in Asia; however in recent years, socio economic development and environmental benefits, general interest on bamboo is increasing rapidly. Colombia and Ecuador have more tradition and experience for bamboo use in constructions, but others countries are also improving its use. New plantations and improved technology for management and transformation of native and exotic bamboo species are being implemented.

Key words: Bamboo Biodiversity, Bamboo Management, Transformation, Use

INTRODUCTION

"Bamboo: The Gift of the Gods[1]" was used in Latin America since ancient times, mainly for vessels, constructions, tools for farming, music, weapons, among others. During the colonial time "quincha" technique was widely use for urban traditional buildings, some of them still in

[1] Oscar Hidalgo, 2003.

good conditions after the impact of several strong earthquakes. With the development of the "bahareque" technique and other developments, it is increasingly being use for different types of urban and rural infrastructures, an initiative leaded by Colombian and Ecuadorian world known bamboo architects.

In a continent where most people live in the small islands of the Caribbean and Central America rather than in South America, where almost 50% of the world's tropical rain forest inhabits as well as most native bamboo species of this continent. This is also a region where still for some policy makers, only economic indicators are important, with little consideration to social and environmental ones, where concrete and brick are symbol of status and forest land is mean to be use for cropping rather than forest management; but it is also the land where bamboo development is experimenting important advances, specially in construction technology, but still much need to be done in other areas, specially for the development and implementation of national and regional policies for research, technology transfer and capacity building in bamboo forest management and sustainable integrated utilization/industrialization of bamboo.

This paper provides a brief review on bamboo diversity and uses in the past, present and an idea about its future in Latin America, based mainly on the information provided by several colleges[2]. Some information about bamboo development in some countries are not being mention in this paper and the presentation, without meaning they are not important, only because space and time limitations.

BAMBOO RESOURCES

Latin America, with approximately 18´692,000 Km^2, is the richest region of the continent in terms of diversity and number of woody bamboo species, 20 genera and 429 species distributed from 47°S in Chile to 27°N in Mexico, among them only one specie (*Arundinaria gigantea*) from North America is not found in Latin America. Therefore, of the 1110 species of woody bamboos of the world, 39% of the species and 31% of the genera are found in Latin America.

It is an estimate that around 11 millions hectares of Latin America are cover with bamboo[3]. Woody bamboos are found in almost all Latin American habitats with the exception of desert regions. They are distributed from the humid lowland forest at sea level, on the shores of the Pacific and Atlantic oceans, to the highlands in the Andes up to 4300 m in the "paramos" (Judziewicz et al. 1999). The highest variability of bamboos are present in the Andean Tropical Region, hot spots of biodiversity, most of then in increasing danger of extinction, due to intensive deforestation for agriculture expansion and intensive timber extraction.

In South America, Brazil has the greatest diversity with 137 species, followed by Colombia with 70 species and Venezuela with 60 species. The majority of species in Colombia and Venezuela belong to *Chusquea* genus (30% and 37% respectively), with the rest of the species belonging to the genera *Neurolepis, Arthrostylidium, Aulonemia, Elytrostachys, Merostachys, Rhipidocladum, Guadua* and *Otate.* Ecuador is the fourth in bamboo diversity with 42 species and 11 to be described. Among the 6 woody bamboo genera, *Chusquea* claims the vast majority

[2] Specially: Jorge Morán (Ecuador), Ximena Londoño (Colombia) and INBAR.
[3] Around 18 million has mix tropical forest, with variable percentage of bamboo in the south western Amazon region.

(41%) of the species. Following is Peru[4] with 36 species and 1 subspecie, the majority belongs to the genera *Chusquea* and *Guadua* (54% and 36% respectively) and Bolivia with 24 species and 2 sub species. The NE border of Bolivia, in an area with a similar ecosystem in Brazil and Peru, a natural forest of *G. sarcocarpa* and *G. superba* dominates a large extension of the Amazon jungle. The Guyanas (British and French Guyana and Surinam) have 13 species, mostly of the *Guadua* genus. Among countries of the south cone, bamboo is present in Argentina with 13 species, Paraguay with 5 species, Uruguay with 3 species, most of them of the genus *Chusquea* and *Guadua* and in Chile there are 10 species, all of them of the genus *Chusquea*.

Brazil is also the country with the highest percentage of endemic woody bamboos in Latin America (32% out of the total bamboo species) and 17 genera (85% out of the total bamboo genus). Among the world centers of bamboo woody and herbaceous diversity are the Atlantic forests of Brazil, which extend from the state of Paraiba to Rio Grande do Sul and include 22 genera and 62 species (Judziewicz et al. 1999).

The genus *Guadua*, with around 30 species is well represented in Venezuela and only Brazil has a greater number of these species diversity, not being naturally present only in Chile, the Caribbean and West Indies; but *G. angustifolia* was spread to the islands, probably from the Panama Canal Zone, where it was previously introduced from Ecuador in 1924.

In Central America, Costa Rica is the most diverse country, with 39 species, most of them from the genus *Chusquea*, Mexico with 35 species and 2 sub species, Panama with 21 species, Guatemala with 17 species Honduras and El Salvador with 11 species, Nicaragua with 9 species.

The native bamboo species in the Caribbean and West Indies are confined to small-sized bamboos less than 1 cm in diameter and are known to have 4 genera and 36 species of native woody bamboos, with the richest bamboo diversity being in Cuba.

Several exotic bamboo species have been introduced, to most Latin American countries, during the colonization and afterwards with the new settlers coming from Asia, Africa and Europe. These species are widely distributed around these countries and in many cases growing along with some natives ones. Among them, probably the genus *Bambusa, Dendrocalamus, Phyllostachys* and G*iganthochloa* are the most common ones, with *Bambusa vulgaris, B. vulgaris var. vittata, D.asper, D. strictus* and *P. aurea* widely distributed. In some countries like Venezuela and Brasil, *Guadua* and *Bambusa* are the most commonly use. The Caribbean countries, with not useful woody bamboo native diversity, plantations of several *Bambusa* species are being implemented for several purposes.

Some Latin America native bamboo species are in the UICN endangered species list, 6 of the genus *Chusquea*, 2 of *Cryptochloa*, 1 *Froesiochloa*, 1 *Guadua*, 2 *Olmeca*, 3 *Olyra*, 2 *Pariana*, 3 *Rhipidocladum* and 1 *Streptochaeta*. The last one *S. angustifolia* is already extinguished[5]

[4] This number can be much higher but more research is needed, specially in the tropical Andean forest. Some recent data shows around 40 species.
[5] www.uicnredlist.org

Pictures:

(1) *Guadua angustifolia* forest and (2) Colonial house made of "quincha" in Peru.

BAMBOO USED IN THE PAST

Probably the oldest bamboo specie (*Rhipidoclarum neumanni*) worked by a man, dated 8,640 BP was found in Catamarca (Argentina). Several pieces of bamboo mixed with clay from walls of the Late Valdivia and Machalilla cultures, dated to be 3,500 years BC was found in Milagro, province of Guayas (Ecuador). Ceramic vessels from the Jama Coaque culture (500 BC-500 AC) representing narrow bamboo boards (open bamboo pieces) secured with a fiber straw, are signals of bamboo importance and probably uses in ancient cultures.

On the arid Santa Elena Peninsula in Ecuador, Stothert K.E.(l985) reports about her findings about the Las Vegas culture, which was fully developed by l0,000 B. P. and earlier dates. The abundant hard labor of utilized but minimally retouched flakes and chunks suggests the manufacture of tools and equipment from wood, bamboo, reeds, and bark. The Las Vegas culture was similar to the Amotape and Siches in the northern coast of Peru, several places in the Colombian Valley like Magdalena and the Talamanca and Boquete phases at west of Panama. Therefore, bamboo was probably utilized in all these areas thousands years ago. In a place called Quebrada Chica in the central coast of Peru, an early circular trench made of bamboo, with the upper ends tided, with a shape like a beehive, was found by Donnan (1964). It may be similar to the ones found by Stotherts from the Early Las Vegas Phase, dated 8,000 to 10,000 years BP.

The Pre-Inca Mochica Culture (2000 B.P) funerary complex of the Sipan´s Lord, Lambayeque´s desert (Peru), shows that bamboo coffins were used for buried women and children, who accompanied their Lord in his travel to a new life. The Chan Chan complex, also from the Mochica Culture, located by the riverside of the Moche River in the coastal city of Trujillo, dated 850 B.P was built of adobe bricks using bamboo "caña guayaquil" in the walls

and inside the cliffs, as well for casts to produce adobe bricks. Machu Picchu, most known Inca´s city was protected from the Spanish conquerors, hidden by trees, moss and bushes of bamboo (*Aulonemia queko*), until it was discovered by Hiram Bingham in 1911[6].

According to the Norwegian explorer Thor Heyerdahl, pre-Columbian Peruvians went first to Polynesia using only native materials. He and with his crew, in the Kon-tiki (1947), a wood raft partially decked in spit bamboo, with the main sail on a yard of bamboo stems lashed together, a cabin (4.25m x 2.4m x 1.5m) made of plaited bamboo and transporting 250l of water inside bamboo canes, traveled about 6,980 km for 101 days from Callao (Peru) to Raroia Island (Polynesia) to prove his theory.

Bamboo houses, bamboo headed arrows carried in bamboo cartridges, musical instruments and cartridges for ornaments are still being use as their ancestors by the Aguarunas-Huambisas (neighboring Jivaroan groups), living in the Andean Tropical Forest of Peru and Ecuador, as well by others native groups, where the resource is more abundant.

These are a few examples of the ancient use of bamboo in the "New World" before was discovered by Columbus in 1492. With the Spanish, bamboo had many uses, as weapons in the wars for the independence; chair made of bamboo for carriers or freights mean to transport women, children or important people on their back, for water carriers (culms used as vessels) and many other uses recorded in paintings and drawings by artists of that period.

The "Peruvian quincha" is probably the most important traditional construction technique used in colonial time, specially the one called "Virrenial Quincha". The dome of the Santo Domingo Cathedral in Lima was the first made of wood, bamboo and lime. The complete Los Desamparados Cathedral (1669) was also built with "quincha". During the earthquake of 1687, the new buildings made of "quincha" were the only ones to stand without damage. After then, the system was used for new buildings and for refashioning or repairing old ones. After the very strong 1746 earthquake, most buildings were made of "quincha", because was not only sismic resistant, but also cheaper, rapid and adaptable to the symbolic conditions requested by any edification of that period. In the XVIII century an official norm obligated to use "quincha" in all high walls. Strong punish was impose to the ones who did not used this material. As far as is known, this was the first official legislation for seismic resistant construction in America.

In the humid tropical Andean region of Colombia, were bamboo "guadua" is abundant but also an area were strong seismic movements destroyed most houses around 1875, a new technology named "bahareque" was developed. The use of bamboo for beams and columns, with wood frames and a net of bamboo strips, like a basket that works as a seismic resistant structure, which is also very adaptable to the sloppy topography of the area. This new and unique technology allowed the rapid growth of harmonious cities, like Caldas, Quindio and Risalda, which stands until now after more than 50 years and several earthquakes.

[6] H. Bingham, 1911:The lost city of the Incas

Bamboo was also linked to traditional beliefs, like this: “master of the dead gives to the husband a piece of bamboo with the soul of his dead wife; husband opens it before time, wife flies away as a fly (Arguedas in Cipolletti 1980):

BAMBOO DEVELOPMENT FOR THE NEW MILLENIUM

With the advent of modern occidental architectural style and synthetic materials, bamboo and wood passed to be a secondary material or used only for rural constructions. National and local public organizations did not consider these materials in their legislation, with the correspondent exclusion from academic and financial programs and plans in most countries.

However, as mention before, Colombians and Ecuadorians architects, followed by Argentineans, Bolivians and Brazilians, just to mention some, are making the path and showing to the world what can be done with native bamboos and own technology for building almost any kind of infrastructure: popular social houses, hotels, churches, residential houses, schools, training centers, resort complexes, bridges, etc., some worked in other continents, like the Zeri pavilion in Hanover (Germany) and the ecotourism complex in Nankum Mountain National Park (China)[7].

As in most Latin American countries, developing of the cities is accompanied by a large immigration from rural areas. People do not have a home and takes over any piece of land in the out yards of a city, as in Guayaquil (Ecuador), were extremely poor people use canes for making a cover.

In this context, a catholic non profit organization created in 1973 a program named “Viviendas del Hogar de Cristo” - VHC[8], produced in less than 30 years over 150,000 pre-made bamboo houses for single mothers of the poorest areas of the city, a program developed with the technical advice of architect Jorge Morán Ubidia[9]. The beneficiary has to pay from US$ 522 ($21m^2$) to US$ 883 ($44m^2$) in three years. The extremely important social impact of this program was recognized by the Building and Social Housing Foundation of England, the United Nations Environmental Program News (2003) and the BBC of London.

In the same city, a new model bamboo house is ready to change the link of bamboo=poverty to bamboo=prosperity and make many more happy families, as the one of Mrs. Marelona, who moved from a VHC house, were she lived for 15 years, to a new bamboo house[10]. This new house brings new hopes for any one who wishes to have a good looking, comfortable and secure bamboo house.

The National Project of Bamboo established in Costa Rica in 1986 with the dual aim: to reduce deforestation by means of replacing timber with bamboo as primary building material and provide low cost housing for rural poor. A country with a high seismic risk, built 490 houses with a system of seft-construction and community supported work and was the key to promote the technology and construct thousands of houses in different areas of the country. The country

[7] Simón Velez Jaramillo (Colombia).
[8] Viviendas del Hogar de Cristo,Casilla Postal 09-01-4201, La Atarazana,Guayaquil,ECUADOR.
[9] J. Morán Ubidia (Ecuador) is a world known expert in low cost prefabricated bamboo housing.
[10] Morán, J. & Poppens, R. 2005.Vivir con la Guadúa. INBAR-UCSG.

suffered several earthquakes and bamboo houses behaved very satisfactory, people wanted bamboo houses (Quintans, K.N., 1998).

The Eje Cafetalero of Quindio (Córdoba, Colombia) after the earthquake of January 25th 1999 was almost completely devastated, particularly the cities of Armenia and Pereira, where more of 300,000 people were homeless. Houses constructed with "bahareque" were less affected by the seismic movement. Authorities, citizens and the international cooperation agencies (GTZ, FAO, UNDP), working together in a very dynamic process, supported the construction of a large number of new safe dwellings, using *G. angustifolia* as the principal element for the reconstruction.

Brasil, the country with the biggest bamboo diversity, does not have a very long experience on native bamboo use for large constructions, but is making rapid and important progresses. Several bamboo infrastructures are being constructed[11]. Cellulose and Paper of Pernambuco SA – CEPASA, member of the Joao Santos Group funded in 1972, is on of the largest company making paper and cartoon with bamboo cellulose from plantations of *B. vulgaris.* It has a modern infrastructure producing 150 TM/day and 90,000 TM/year, but ready to increase to 144,000 TM/year[12].

Colombia and Ecuador have started the industrialization of bamboo (*G. angustifolia*) for flooring and other laminated products, but final technical adjustments are needed to be competitive in the market dominated by China´s large bamboo flooring industry.

Peru has a very important native bamboo resources and a long history of use for different purposes as in constructions, however for many years, timber from Amazonian trees has displaced the used of bamboo. However, in the last 2 decades the use of bamboo is increasing, becoming the most important market of bamboo produced in Ecuador. The growing development of beach resorts for high to medium class people, with houses made of bamboo and timber, is changing the idea of bamboo as a low value resource, which in the past was the cause of its destruction from it natural habitats. Bamboo infrastructure for social services and housing program is under development by a join effort of the private sector with the government and international agencies. Therefore bamboo demand for internal and external market is growing very rapidly with an increasing non sustainable extraction of bamboo from their natural habitats. Bamboo furniture industry had improved, but using bamboo canes imported from Chile and lately from Costa Rica. Since this year, bamboo is a national priority natural resource for reforestation and rehabilitation of degraded tropical forest lands, poverty alleviation. Bamboo native forest is an important destiny for overseas "bird watchers", contributing to ecotourism and native communities' development.

Chile, where the timber sector has develop a strong industry, bamboo is intended to contribute to valorize more the forest and provide more working opportunities to small rural communities, specially those living only from small dairy or agricultural activities, looking forward to create small to medium size business for higher value bamboo products for local consumption and export. The government of Chile jointly with the private sector is implementing a program for

[11] Llerena, C., 2006. III Simposio Internacional de Bambú: INBAR-UCG- EU.
[12] Salgado & Borges, 2006, III Simposio Internacional de Bambú, INBAR-UCG- EU

bamboo development with the international cooperation. Research is being conducted in biological characterization, natural bamboo forest and plantations management, industrialization for housing, furniture, panels, pulp, energy generation, among others, mainly of *Ch. colihue*, the most important bamboo in Chile.

Argentina´s *G. chacoensis* is use mainly in rustic constructions, however in the last decade the University of Tucuman is leading a general research program on native bamboos characterization, development of new structural systems and procedures for seismic resistant constructions (H. Saleme,2006).

In Mexico, 42 uses had been identified for native species of bamboo, like *G. aculeate* "taro" used mainly for construction with the bahareque technology and the widely distributed *Otatea acuminate*, use for rural constructions and others diverse purposes. In the Dominican Republic (1987), a Chinese mission imported five bamboo species from Taiwan for reforestation of streams and rivers sides, installing the first propagation area in the Yaque River and in Villa Altagracia. In the year 1990 a Handicraft Bamboo Training Center was established for young people training and creation on new jobs opportunities. A similar experience is being developed in El Salvador, also with the technical cooperation from China´s Government, while in Cuba, a country with a shortage of timber, *B. vulgaris* from plantations was used before only for ornamental purposes, but now the government is interested for its use in industrial quantities. Since 1997, the Honduras´s Bamboo Project is planning a large plantation of *P. aurea* for energy generation, paper pulp and ethanol production.

Many uses for bamboo in daily life of rural people of Latin America countries have been recorded (Morán,J.,2001): rural dwellings, greenhouses, benches, windbreakers, tilts, stakes, nurseries, art works, craftsmanship, painting scaffold, hunting, kitchen accessories, soccer arch, fireworks castles, cockfight ring, equitation hurdles, fishing tools and even jewelry, are among many other uses of bamboo, especially in places where bamboo grows naturally, some unchanged over the years, but others becoming small family or community business, with improved quality and design.

New plantations and sustainable technology for management of native and exotic bamboo species are being implemented in some Latin American countries, like Chile, Colombia, Cuba and Ecuador.

The increasing deforestation, climate change, shortage of water and traditional sources of timber are affecting specially to the poorest rural people. Fortunately, many more are beginning to learn and recognized the socio economic and environmental value of bamboo. Direct and indirect short term impact of bamboo for the tropical rain forest rehabilitation and conservation is calling the attention of many more involved in sustainable development programs design and implementation.

These are some clear signals of Latin American countries capabilities and potential for the use of bamboo for sustainable environmental and socio economic development, the first steps are being taking in order to increase significantly its sustainable use and trade, but more international technical support is needed to fulfill the needs for its industrialization.

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Bamboo Development in Asia

Bamboo for Environmental Protection and Poverty Alleviation

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Bamboo grows in many areas of the world including Asia, Oceana & the Pacific, Africa and America. About 80% of the world bamboo resources are found in Asia. China is the leading country with 39 genera of bamboos with around 500 species and a plantation area of 5 million hectares. China is also the largest exporter of bamboo products ranging from food (shoots) and small daily products including chopsticks and toothpicks to handicraft, furniture and industrial products such as bamboo flooring, sheet products (plywood, MDF), textile, charcoal and vinegar.

India has the largest area (10 million hectares) classified as bamboo forest which are found mostly in the East and Northeast. An ambitious National Bamboo Mission announced by former Prime Minister Atal Behari Vajpayee in June 1999, to create sustainable livelihoods and boost income for the millions of families living in India's impoverished rural regions. The "All India Seminar on Bamboo Development" was organized by the Ministry of Environment and Forests and supported by UNDP, UNIDO and INBAR as well as other Indian government agencies including the Planning Commission, the Department of Science, Development Commission (Handicraft) on August 9-11, 1999.

UNDP funded the Cane & Bamboo Technological Upgradation and Networking Sub-Programme with the DST as executing agency and UNIDO as the implementing agency. The Cane and Bamboo Technology Centre (CBTC) was established in Guwahati, Assam in the Northeast in the same year as the Field Implementation Agency. The National Mission for Bamboo Applications (NMBA) was organized in 2004 to further bolster efforts on bamboo development.

India has not achieved the goals of the ambitious program and Indian exports of bamboo and bamboo products are still negligible up to the present.

The Philippine, although a small country with only about 50,000 hectares of bamboo plantations, is the No. 4 exporter of bamboo and rattan products especially furniture and handicrafts. Bamboo furniture exports from the Philippines have found a niche in the high-end market and are steadily growing.

Bamboo Industry Development in China

Bamboo has been used in China for centuries. Most of the industrial development on bamboo, however, occurred during the past two decades. The important factors that contributed to the fast growth in the bamboo industry are:

The farmer-enterprise linkage and involvement of all stakeholders includs technology providers and local government units.

a. A Policy Implementation Group, composed of representatives of the local Government (or local Forestry Bureau) and representatives of the local farmers, is organized.

b. The Group convenes the villagers and informs them about the environmental and economic values of B&R development, the related Land Utilization Policies, as well as the government policy of respecting to the villagers' free will regarding bamboo development.

c. A survey is carried (including population, education, income, land ownership (utilization), main crops, etc.) The villagers are also asked if they are willing to cultivate bamboo, how much secondary forest land would like to cultivate and what kind of support they would like to have (technology, funding, seedlings, etc.).

d. The Implementation Group then makes a land allocation scheme taking into consideration the results of the survey, the total area of the available state forest lands for the project and the real ability of each household.

e. The scheme is announced in the villagers' congress, discussed and approved.

f. Land Use Certificates are issued to each certified household after the lands are measured and allocated.

2. Well-organized technology extension system which is strictly participatory, provides the training needed by the farmers and their families.

a. Local governments, scientists and enterprises and farmers jointly participate in the technology extension;

b. Scientists sign technology service contracts with enterprises and local farmers;

3. Demonstration sites for bamboo plantations and enterprises are set up;

4. NGOs such as Bamboo Societies and Bamboo Industrial Associations are established to enhance the technology exchange activities including seminars/ training workshops and product exhibitions.

5. Implementation of policies and management systems that enhance the bamboo sector.

a. Local governments extend credit with paid interest to farmers and enterprises in support of

bamboo plantation and processing.

b. Local governments include bamboo in the Government Development Plan.

Community-based Bamboo Industry Development

A community-based bamboo development program for poverty alleviation, economic development and environmental protection must be strictly participatory with the involvement of all stakeholders: farmers and the community, local government, entrepreneurs and experts/technicians in all stages of the project. It must include access to the market through a global trading system. Participation of all stakeholders will be assured by conducting monitoring and periodic assessments.

The Philippines has started implementing such a development program in Quezon Province. This was spearheaded by the Philippine Bamboo Foundation and Congressman Proceso Alcala. Quezon was selected because there are a lot of bamboo in the area, the province is prone to flooding and other natural calamities (in fact, many people died in 2004 in the province because of mudslides brought about by a strong typhoon, there are organized groups/NGOs who are willing to participate and the local government, headed by Congressman Alcala strongly supports the project.

A meeting of all the stakeholders was held last month and it was immediately followed by training on bamboo stand rehabilitation and nursery establishment. Trainers from the Philippine Bamboo Foundation and the Department of Environment and Natural Resources (DENR) conducted lectures and demonstrations on how to clean and thin bamboo clumps in two towns in July. A nursery was established during the workshop. Local chapters of the Philippine Bamboo Foundation are now being organized so that monitoring and assessment will be done regularly.

A big group of Filipinos, including Congressman Alcala, Undersecretary Edgardo Manda, who is the Presidential Assistant for Region IV (where Quezon province is located) and other government and private sector representatives attended the International Training Workshop on Bamboo Industrial Processing Technologies and Machines, September 6-20, 2006, Zhejiang, P. R. China. This group will be involved in the implementation of the bamboo development program in their own towns and provinces.

A similar project was launched in Dumaguete City in Negros Oriental province where the 5th National Bamboo Congress will be held on Nov. 7 to 10. Training on bamboo stand rehabilitation, nursery and plantation establishment, management and harvesting techniques and bamboo shoot processing were held. Training workshops on furniture and handicraft making will be held in October and the products made during the workshops will be exhibited during the congress.

The network includes entrepreneurs who are putting up primary processing facilities, the first of which is being set-up in Quezon. Market linkage has been started with the local and global markets through industry associations like the Chamber of Furniture Industries of the Philippines, Philippine Chamber of Handicraft Industries and Philippine Exporters Confederation. It must be noted that prior to this project, furniture and handicraft manufacturers had a problem sourcing bamboo materials while the farmers do not have a market for their products. Now farmers and their families have been trained to make furniture components and woven handicrafts which they supply to exporters.

Bamboo and Rattan Trade Development in Ethiopia

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Summary

The basic business processes that relate to the economics of bamboo are production and marketing. While production deals with the provision of the products, marketing consists of the activities by which the products flow from the producer to the ultimate consumer. In this paper, processing is considered as an appendage of marketing because it converts the resource into marketable products. Processing and marketing together form the tools with which the raw materials are converted to appropriate products to meet market requirements. They create some of the uses of time, place and form: packaging, advertising, transportation, sorting and stockpiling. This paper basically deals with the processing and marketing of bamboo in Ethiopia.

Bamboo plays important roles in the daily life and well being of both rural and urban populations in Ethiopia. Rural and poor people depend on bamboo as major sources for food, medicines, fodder, fiber, household utensils, furniture, and fencing and construction materials. Bamboo products may also form valuable traded commodities at local, national, regional and international levels, providing employment and income opportunities at each level.

The major issue at stake is that the commercialization of most highly valued bamboo products has been identified to cause major impacts on the sustainability of raw material production. One reason suggests that the benefits of processing and marketing of bamboo products are small at the level of local producers. This hinders the ability of local producers to financially support sustainable production. Moreover, such poor local revenue capture can neither lead to an improvement in their income and livelihoods nor to the accumulation of capital for investment in the development of such products. Therefore, much of the revenue is earned at the processing end, usually located outside the raw material production areas. On this note, although not fully documented, the hypothesis guiding this paper is that the development of local processing techniques and better marketing arrangements can lead to higher incomes and improved livelihoods for the producers of highly valued bamboo products in Africa. To achieve this, better institutional arrangements including the influence of national and international organizations are considered instrumental.

1. Introduction

Bamboo as a non-timber forest product, support the livelihood of millions of local people in Ethiopia in small-scale cottage industries since time immemorial. The goods and services

gained from bamboo both at village and national are greatly essential in providing for basic human needs, such as; employment, fodder, food, shelter, and household materials. Bamboo is very important to Ethiopia, because of the fact that, high forest coverage is only 3.56% and still decreasing. Bamboo resources in the country is very rich, at present 67% of the African bamboo resources is found in Ethiopia, that means development of industrial Utilization of bamboo would help to solve problems of housing, furniture shortage and provide more job opportunities.

Apart from providing the above-mentioned wide range of uses, bamboo plays a crucial role in environmental protection. It arrests soil erosion, stabilizes riverbanks, improves environmental conditions, and most importantly, bamboo thrives both in wide range and marginal lands of the country. It is one the fastest growing and highest yielding renewable resource.

Naturally, only two bamboo species are growing in Ethiopia. These species are Yushania alpina k. Schum and Oxytenanthera abyssinica (A. Rich) Munro.

Ethiopia has over one million hectares of highland and lowland bamboo resources (Anonymous, 1997). The coverage of lowland bamboo is estimated to be 800,000 hectares while the highland bamboo is estimated to be 300,000 hectares (LUSO CONSULT, 1997). This means that 67% of the African bamboo resource is found in Ethiopia.

Recently bamboo products manufacturing workshops are expanding in big cities of the country. The regional governments and city councils micro, and small enterprises development bureaus as well as Forest Products utilization Research Center are now attempting to promote the development of small-scale enterprise such as bamboo, wood and metal sectors that does not require sophisticated technology.

2. Importance and industrial uses of Bamboo

Although bamboo is not an integral part of the economy of Ethiopia, it plays a very important role socially, economically and ecologically in areas where it occurs naturally and where it is planted. Both the highland and lowland bamboos are such a versatile type of resources that they can be used in many ways. Their paramount importance and multifaceted use in different parts of the country are reported.

Currently, many cottage industries in the capital, Addis Ababa, have largely started using highland bamboo to make furniture and other household materials. The development of bamboo entrepreneurship business in Ethiopia has a promising prospect in the future. Fore example In Addis Ababa within 10 years, the number of small-scale bamboo workshops had increased from 10 to 58.This shows that the perception of bamboo utilization is gradually changes when various bamboo products are available in the market. Currently in Addis Ababa and other big cities modern types of bamboo furniture such as sofa chairs, beds, tables, shelves, lampshades and fruit trays are available in the market.

2.1 Bamboo utilization and processing

The modern bamboo cottage industries, which produces new design of baskets, shelves, beds, tables, chairs and many other items, has witnessed the progressive development of a commercial dimension in both rural and urban areas.

Some of the rural harvesters return to their village with their bundles of bamboo culms (usually young men), where they are later processed or made into items for sale. Before processors can utilize the culms, they are dried in the sun by laying it in the ground to reduce the moisture content and to ward of insect attack and staining by fungi. Villagers and farmers manufacture bamboo products as a sideline activity, but in urban areas bamboo artisans work full time fashioning the culms in to various products for sale, often in small street side workshops.

2.2 Bamboo products production process

The processing of bamboo in most urban areas takes place in microstructures with the following general characteristics:

i. The average workforce per processing unit is 4.5 persons.
ii. The working capital and the average cost of equipment are US-$83 and US-$66 respectively.
iii. The tools used are simple, manual, rudimentary and limited to hammer, knife, driller, measuring tapes, gas for burning, brushes and metal saw.
iv. The infrastructure is not available. About majority of the bamboo processors work in the open and some in sheds or verandas. Over 50% of processing units operate in homes of craftsmen.

These characteristics are typical of an under developed processing sector with processing simplified to three discrete stages.

v. Preparations of material, during which the craftsmen scrape, dry, measure, cut, split and arch the bamboo;
vi. Assembly or setting, which comprises forming the basic framework, weaving and/or veneering and padding;
vii. Finishing, during which the craftsmen attach the blades, decorate and coat with varnish or paint.

This results in a number of customer products (baskets, trays, armchairs, tables, shelves, flower pots, hats, etc.) that are generally traded locally, with little export because of competition with exogenous models from South East Asia that are more refined because of higher level technology employed in the finishing of products.

2.3 Marketing of Bamboo

Trade in bamboo raw materials and products in East African countries are extremely limited and fluctuate greatly from year to year. UN COMTRADE statistics (that lump bamboo and rattan together) indicate that Kenya exports the greatest value of bamboo and rattan products in East Africa, averaging US-$1,463, 000 for the period 1989 to 2000 inclusive, but that after a peak of over 3 million dollars worth of exports in 1994 the figure has remained relatively steady at about US-$800,000 per annum. Ethiopia did not export bamboo or rattan products between 1989 and 2000, except for a surprisingly large US-$1.5 million dollars worth in 1998, all of which went to other East African nations.

Nowadays, the marketing of finished bamboo products by craftsmen is generally a short chain. Products are sold directly to consumers - to other villagers or passers - by in rural areas, or to city dwellers in the urban markets. As a result, middlemen are quite scarce. The market prices range from around US$ 2.00 for a small basket to US $ 240 a higher dining set. Nearly all the products are sold on the domestic market, with only a very small quantity going abroad by tourists and permanent residents. The export market remains largely unexplored but has a lot of potential given the international demand for bamboo and rattan products. Unfortunately rattan is not well explored and utilized in the country. There are some indications that rattan is found in some parts of the country in kaffa, Shaka, Bore and Jemjem areas. Consider the annexed chart about bamboo production process.

3. Socio - economic role of Bamboo

Bamboo is the most widely used plant in Ethiopia, especially by the economically disadvantaged, local poor groups/communities. Therefore, in the bamboo production villages, bamboo is of economic, social and cultural importance, ranking second only after agriculture in village production systems. In comparison with other forms of natural resources utilization, the bamboo sector is highly profitable and it requires from little to big capital investment and therefore, the monthly profit margins are relatively high. Moreover, bamboo harvesting and processing can form an important economic safety net for young men in situations of economic recession.

4. Institutional Issues

All forest lands and resources in the country belong to the state and private sector while local population are only allowed traditional user right from the state forest and their homestead plantations (farmers' bamboo). This provision has been enacted in various ordinances, laws, decrees produced by the government over the years. Improvements to these regulations were made with the introduction of the 1994 Forestry Act and its decree of application is up to now applicable. By this law, the exploitation of any Non-Wood Forest Products (NWFPs) requires that the exploiters obtain an approval and a permit. With these, the exploiter is supposed to pay a fee to the public treasury and also establish a way bill for the conveyance of the product.

With regard to product development, the Ethiopian government has recognized the promotion of NWFPs (Natural gum, Bamboo etc.) as a means to fight poverty in rural areas and to

generate revenue for the national economy. This was institutionalised with the creation of two departments under the Ministry of Agriculture and Rural Development (MOARD) for its development, promotion and marketing of NFWPs and other forest products.

Despite the current shortcomings, it is important to develop a national forestry policies recognize the need to support the development of the bamboo sector. Such policies dwell or:

- The creation of independent administrations for the NWFPs sector with in the Ministries in charge of forestry;
- The promotion of local community participation in all aspects of forest management and sharing of benefits derived from forest products;
- The decentralization of forest management responsibilities to communities in the light of community based natural resources development and the creation of community forests under well-defined legislation;
- The promotion of NWFPs as a vehicle for poverty alleviation and overall rural development;
- The need for greater research and capacity building in the development of NWFP sector;

5. Opportunities

- Resources available both wild and cultivated;
- Potential markets both local and International markets can be explored;
- Pre-studies on bamboo development, production and consumption system done by CFC, GTZ and INBAR;
- Little capital is needed to start up a bamboo cottage industry, meaning that little investment would suffice at national level to boost the bamboo industry;
- Strengthening producers and processors association could assist by fostering unity and good relations among members, controlling raw material prices, exchanging knowledge on marketing channels, capturing donor financial support, regulating and encouraging sustainable harvesting practices to protect existing wild stocks and promoting bamboo cultivation and plantations.
- The improvement of processing technologies in drying, preservation and oil curing of bamboo products may form a major development strategy for the bamboo sector in Ethiopia.

6. Constraints

- Poor infrastructure and continuous use of rudimentary tools results in poor finishing of products to meet the appeal of international markets.

- Producers and processors are poorly organized with weak horizontal linkages. Self-financing remains the only source of bamboo producers, perhaps because of poor worthiness of individuals.
- Weak institution lead to inadequate policy and regulatory measures and open access lead to unsustainable harvesting practices. Resource shortage within working distances has increased transportation cost by 10-25%.
- Lack of funding agencies, which assists training program to translate technical skill into income opportunity.
- Lack of dissemination of bamboo products information such as Monographs booklets. Leaflets and video films etc in Amharic language to concerned organizations and persons.
- Inadequate skill oriented training and research on bamboo production, processing, utilization and marketing.
- Modern technology has not been entered in this sector yet in Ethiopia in all aspects like production, processing and manufacturing of various products.
- Lack of knowledge among entrepreneurs about the marketing prospect of their products.
- Most of entrepreneurs are poor and cannot venture for commercial production and marketing.
- Very few studies have been carried out particularly on industrial uses of bamboo.
- Wastes derived from bamboo workshops are not converted to more value-added products.
- Lack of small machineries and tools to improve the quality of bamboo products.

7. Recommendations

Based on the above constraints and findings the following recommendations are forwarded:

- skill oriented courses should be given by micro small scale enterprise and Forestry research center on production ,processing ,utilization and marketing aspects of bamboo.
- Small machineries and tools should be provided to modern and traditional craftsmen and women so as to better organize the sector and improve the quality of the products.
- Processing techniques and use of simple machines have to be introduced and suitable technology for Ethiopian bamboo species should be transferred from other countries.
- Responsible agencies should prepare booklets, monographs video films and leaflets in Amharic language and disseminate to maximum number of people.
- Government and international fund giving agencies should support short-term training and research for over all development of bamboo sector (Research and development).
- Choosing the right marketing strategies and practices as well as getting financial and infrastructural support for processing and marketing of bamboo.

- To promote policy and institutional changes for bamboo development, more attention should be given by federal, zonal and district industry and trade bureau to improve local bamboo products markets.
- Good marketing infrastructure and reliable information system should be developed mainly to address the issue of lack of awareness on the part of consumers of price and competitiveness of bamboo products;
- There is a need to organize bamboo traders and craftsmen in groups such as production co-operatives to participate in the bamboo trade from a position of strength;
- Private sector initiatives should be aggressively supported by the Government and international funding agencies to find new markets and promote Ethiopian bamboo products, processing, utilization and marketing;
- Further training on the utilization of waste derived from the processing and manufacturing processes for furniture, parquetries, and panel boards is still required which also involves studies on their physical, mechanical and anatomical characteristics.
- Determining the suitable harvesting age of bamboo, and its relationship with the anatomical, chemical, physical, mechanical, and processing properties should also be given priority. These data are important as they help the harvester in selecting suitable material for various intended usage.

8. Conclusion

Bamboo related harvesting, processing and marketing activities have witnessed a significant increase in the last 10 years. The products have increasingly becoming fashionable in towns and cities as well as internationally. In addition, the rising cost of timber has also boosted demand for bamboo culms as a less expensive alternative. Therefore, the bamboo market has the potential to grow and provide a continuous source of revenue for participants; however, current harvesting techniques are inefficient, wasteful and detrimental to regeneration. This may hamper future supplies of raw material if the trend is not controlled and introduction of new species as well as artificial regeneration in bamboo plantations introduced to supplement wild stocks. Therefore, a sustainable harvesting of wild stocks, plantation establishment, increase availability of affordable sources of capital and standardization of quality products and grading rules are of a paramount importance.

As a result of the absence of intermediaries, most of the market prices of bamboo products are captured by producers. However, this seems to limit the scope of the markets to the local level, especially where the local producers are poorly organized. Intermediaries seem to have a better knowledge of regional and international markets than the local people, as well as some private investors on bamboo industry are now coming into the picture, which are capable of exploiting markets in and out of the region.

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Biodiversity Conservation and Sustainable Management of Bamboo Forest Ecosystems

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ABSTRACT

As output and economic value of woody bamboo forests is overemphasized, biodiversity conservation of bamboo forest ecosystem is ignored. Bamboo species and accompanying species of the cultivated bamboo forests are greatly decreasing, and structure of population is monocultured, which threaten stabilization of bamboo forest ecosystems and the sustainable management of the bamboo forests. Based on about 10 years' researches on biodiversity conservation and sustainable management of natural and cultivated bamboo forest ecosystems, four management practices are recommended to conserve biodiversity of bamboo ecosystems as follow: (1) select different geographical provenances of one bamboo species for plantation; (2) adopt multi-species to cultivate mixed bamboo forests; (3) mixing crops and medicinal plants with bamboo forests; (4) cultivating mixed bamboo forests with woody trees. We must attach importance to maintenance of the ecological functions of bamboo forests and keep balance between economic and social needs. Meanwhile, methods and technologies to conserve biodiversity and sustainable management of bamboo forest ecosystems are still to be further developed.

Key words: Bamboo Forests; Ecosystem; Biodiversity; Sustainable Management

Effect of *Dendrocalamus farinosus* Bamboo Plantation on Soil and Water Conservation in National Conversion Programme in Western China

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ABSTRACT

As an important bamboo species adopted in the China national Conversion Programme (converting slope farming lands to forests in western China), the economical outputs of the *Dendrocalamus farinosus* bamboo plantation are significantly recorded in the Programme in the region. However, few study on its quantified benefits for soil and water conservation is reported. In this study, based on field monitoring with scientifically-designed standard filed runoff plots with regular observations on 17 times rainfalls and 10 times soil and runoff processes occurring in heavy rainfalls in a year, the relation among the quantity of erosion, runoff quantity and rainfall factor is analyzed. The result shows that the throughfall rate in the bamboo plantation is 89.14%, average stem-flow rate is 1.57%, and canopy interception rainfall rate is 9.29%; and the capacity of water conservation in volume by the litters in the bamboo plantation is about 27.54t·hm^{-2}, which is equivalent to the contained water by 2.4~3.3 mm in depth in the total area of plots, being 14.46~19.88% of the total amount of the rainfall. As a result, average runoff quantity in the bamboo plantation compared to the sweet potato farming lands is reduced by 24.6%, average soil erosion quantity is reduced by 78.56%, and soil erosion quantity in the sweet potato land is about 4.7 times higher than in the bamboo plantation, which proves that the significant beneficial effect of the bamboo plantation for soil and water conservation is performed in the bamboo plantation.

Key words: *Dendrocalamus farinosus*; Interception of Canopy; Water Conservation in Litters; Ground Runoff; Soil Erosion; Conversion Programme

Diversity, Conservation and Improvement of Bamboos in Northeast India

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ABSTRACT

India has plenty of bamboo resources consisting of 24 genera and 138 species, of which, 3 genera are exotic and rests are indigenous. The country possesses world's largest bamboo reserves covering about 1, 00,300 km^2 of bamboo forests (15.67% of total forest cover) with 25% of the species found in the world and 43% of Asia. Bamboos found in all the states of the country. Northeast region is very rich in bamboo diversity with 63 species in 15 genera supporting 50% of the total species found in the country.

Out of the 138 species found in India, only 13 species are used commercially in various states mainly by the paper and pulp industries, which consume about 35% of the total production. The current demand of bamboo is estimated as 26.69 million tones as against the supply of 13.47 million tones. As such there is a wide gap between the demand and supply of bamboo. The main reasons for the gap are: low productivity of bamboo forests and plantations, inadequate supply of quality planting stock, poor stocking, over exploitation, faulty harvesting techniques and lack of scientific advancement in plantation technology.

The natural populations of various species in their wild habitat is depleting gradually due to various reasons in the Northeast region of India. To conserve bamboo genetic resources in the region a priority list (5 endemic species and 9 with restricted distribution) has been prepared for conservation after extensive surveys.

To enhance the productivity of commercially important species of bamboos, the criteria for selecting superior clumps have been standardized. The macro-propagation techniques of these species have also been developed for commercial multiplication of superior clumps to be used in plantation programmes. In addition the trials for selecting widely adaptable genotypes suiting the dynamic user's need in diverse climatic conditions are in progress.

Key words: Bamboo, Diversity, Conservation, Improvement, Clumps

Bamboo Sweet Riot

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ABSTRACT

Today's very real environmental threats, particularly pollution and global warming, require all of us to be proactive in our joint march to protect our delicate ecosystems. Amazingly, there exists one simple solution and that is bamboo. Bamboo is the fastest growing canopy for the re-greening of degraded and desert lands, and its stands releases 35% more oxygen than equivalent stands of trees. Some bamboo even sequester up to 12 tons of carbon dioxide from the air per hectare. Bamboo can also lower light intensity and protects against ultraviolet rays.

Bamboo is arguably the world's best sustainable resources with a growth rate of up to 3 feet or more per day. Unlike traditional hardwoods that can take up to 50-75 years to maturity, bamboo can be harvested in 4-5 years. It stabilizes the earth with its erosion preventing roots, and enhances the health and purity of the soils. Bamboo does not require pesticides, insecticides, or fertilizers, and does not involve the use of genetically modified organisms (GMOs). Bamboo fibers are eco-friendly unlike soil-damaging cotton and petroleum-based synthetic textile fibers. A 100% biodegradable paper and packaging product, it can dramatically revolutionize today's plastic pollution of ecologically endangered countryside. A non-timber forest product whose rate of biomass generation is unsurpassed by any other plants, it is the most important nature' substitute for the world's endangered rainforest hardwoods. It is a quick-growing, antibacterial, antifungal and antistatic fibrous plant suitable for bounteous end products/purposes. It is known to be an excellent natural raw material for manufacturing most of life's necessities. The versatility of bamboo outmatches all tree species. One fourth of the world's population relies on bamboo in some ways: it is the solution to providing a sure source of revenue to millions of women in most of the tropical countries. It is everyone's mission to raise awareness about "Bamboo, its use and benefits for the world, its People and its Environment" and to drive its trend upwards.

Key words: Bamboo, Environment Benefits, Utilization, Versatility

Carbon Storage and Spatial Distribution in *Phyllostachy pubescens* and Chinese fir Plantation Ecosystem

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ABSTRACT

Chinese fir (*Cunninghamia lanceolata* (Lamb.) Hook.) and Moso bamboo (*Phyllostachy pubescens)* are two native and major commercial tree species in South China. Because of their high quality in timber and their high commercial value, Chinese fir and Moso bamboo have been widely planted in the subtropical area of China. The plantation area of Chinese fir in China is more than 7×10^6 hm^2, accounting for approximately one fourth of total area of plantation forest in China and the area of Moso plantation is more than 3×10^6 hm^2, accounting for one third of the total area of global bamboo. In addition to their economic values, Moso bamboo and Chinese fir plantations are important to environmental protections in South China. Researches on the productivity of Moso bamboo and Chinese fir plantations have been conducted since the 1960s. However, the carbon storage and the different of carbon fixation of their plantations ecosystems haven't been studied until recently. In this paper, different carbon storage and spatial distribution and fixation of there two plantation ecosystems were reported. The results showed that, the mean carbon sequestrations of the two trees species was different, the total carbon sequestrations of Chinese fir was much more than that of Moso bamboo. The average carbon sequestrations in all organs of Chinese fir was in the following order: trunk (50.43%)>leaf (49.57%)>bark (48.84%)>branch (48.33%)>root (47.89%). The average carbon sequestrations in all organs of Moso bamboo was not correlate to their age and the carbon sequestrations as following order, sheath (49.91%) > branch (48.46%)> leaf (46.92%)>stem (46.68%) >rhizome (44.78%) > root (44.51%). The carbon sequestrations of soil (to 60cm) ranged from 0.746% to 2.763%, carbon sequestrations and storage of surface soil (0-20cm) was higher than the other layer. The total carbon storage of Chinese fir and Moso bamboo were 111.01$t.hm^{-2}$ and 99.83thm^{-2} respectively, of which the spatial distribution of carbon stocks was basically consistent, the value being greater in soil layer, followed by tree layer, understory and then litter layer. The average carbon storage in different layers in Moso bamboo was in the order as: soil (73.20%)> trees (25.63%) > litters (0.53%)> shrub and herb (0.63%).

The average carbon storage in different layers in Chinese fir was in the order as: soil (49.02%)>trees (46.98%)> standing litters (3.07%) >shrub and herb (0.94%). The carbon storage in tree layer was both highly correlated with the biomass, indicating the biomass of forest exerted a profound effect on ecosystem carbon storage. Annual carbon fixation of tree story in Moso bamboo was 9.94 $t.hm^{-2}.a^{-1}$, amounted CO_2 to 36.44 $t•hm^{-2}•a^{-1}$, its 1.1 times

to Chinese fir plantation. That is to say, Moso bamboo and Chinese fir plantation was important sink of atmospheric CO_2 and Moso bamboo annual carbon fixation more than Chinese fir plantation.

Key words: Chinese Fir Plantation, Moso bamboo Plantation, Carbon Distribution, Carbon Storage

A series of ecological environment problem caused by the atmospheric CO_2 density rise has become one of hot topic of the environmental science. The forest ecosystem will have the vital significance to the climatic change and the globe carbon balance because it is importante constituents of global climate system. The forest ecosystem has stored up 80% organic carbon of the land ecosystem aboveground parts and 40% underground parts [1] .Since the 1990s; many scientists have studied on the forest ecosystem carbon balance from the whole world, the region or the national criterion. Forest ecosystem carbon distribution and the carbon storage had been studied [2-10], but mostly limited to the natural forest, the plantation forest ecosystem has been studied a little.[10-12]. Along with Kyoto Protocol be implementated, correctly appraises the CO_2 fixed ability of forest in a smaller criterion such as some area, tree characteristic also appears extremely urgently.The Chinese fir and *Phyllostachy pubescens* are the important forest resources in southern China, but their plantation forest ecosystem carbon storage and distribution comparison research also rare report [13]. This paper study on the carbon storage and spatial distribution in *Phyllostachy pubescens* and Chinese fir plantation ecosystem, in order to provides the theory for the correct appraisal forest in the global carbon balance, simultaneously also provides the foundation data for estimate forest ecosystem carbon balance and the dynamic simulation, then also provides the theory for environmental protection policy of the government.

1 Site description

The experimental site was situated at Huitong country, Hu'nan Province (N 26°40′～27°09′ latitude and E109°26′～110°08′ longitude). It locates at the transition zone from the Yunnan Guizhou Plateau to the low mountains and hills of southern bank of Yangtz River at an altitude of 300～1100m above mean sea level and at the same time, this region has a humidmid subtropical monsoon climate with a mean annual precipitation of 1200～1400mm, most of the rain falling between April and August, and a mean temperature of 16.5 ℃, the extreme high temperature and the most low temperature respectively are 36.4 ℃ and -4.4 ℃,the yearly average relative humidity above 80%, The soil of the experimental field is red-yellow soil. Among them, the Chinese fir plantation is located in the Chinese Academy of Science (109º30´E , 26º48´N), elevation 200 ~ 500m. After a clear cutting of the first generation Chinese fir plantation forest in 1989, the pure Chinese fir stand was established in spring of 1990. The population density is 1,530trees/hm^2, the average tree DBH is 14.8cm, and the average tree high is 12.6m. The forest understory vegetation mainly by *Maesa japonica*, *Eurya muricata*, *Woodwardia japonica*, *and Dipcopterygium chinesis* and so on.

The *Phyllostachy pubescens* plantation is located in Lianshan town, Huitong County of Hu'nan Province （109º41´E，26º50´N）, the altitude is 300 ~ 400m. After a clear cutting of the first

generation Chinese fir plantation forest in 1993, the *Phyllostachy pubescens* plantation was established in spring of 1995 by transplants bamboo, initially planted density was 375 trees/hm2. Every year spring and the first month of summer remove the grass and bush in the land and fertilization in pre-dug holes urea 300 ~ 450g in the 3 years of afforestation. Except the small and weak bamboo shoots, the other bamboo shoots were kept in the land. Over 8-year-old bamboo was cut since 2003 and the forest land was scarified every year winter, the population existing density is 2,100 trees/hm^2, the forest understory vegetation mainly by *Digitaria sanguinalis*, *Paederia scandens*, *Houttuynia cordata*, *Ampelopsis aconitifolia* and so on.

2 Study methods

2.1 Biomass and net productivity of *Phyllostachy pubescens* and Chinese fir plantation

The Chinese fir biomass investigation combined the existing model with investigation the diameter at the breast height of stem (DBH) and height of every tree in the population at 2005.The net productivity of Chinese fir was the subtraction by 2 sequenced years net productivity.

The *Phyllostachy pubescens* aboveground biomass of the stand was estimated using DBH and height of every tree. Seleted 8 trees of the standard bamboo which present different age were cut at ground-level at 2005. Each sample was separated into stem, branch and leaf and the fresh and dry weights were measured. The underground biomass was investigation from 4 different gradient plot (1 m×1 m), digs out underground stem and underground trunk completely and the fresh and dry weights were measured.

Net productive of *Phyllostachy pubescens* was determinated by the following formula,

$$w=\sum ni(w_i - w_{i-1})$$

Where, w was the aboveground net productive. ni, was the individual trees of different age. i, was the age. wi, was the dry weight of the different age.

2.2 Understory layer biomass

The understory layer biomass was investigation from 5 different gradient plot (1 m×1 m), collected all plants in the plot completely and the fresh and dry weights were measured.

2.3 Litter biomass

Litter biomass was investigation from 5 collecter (1 m×1 m) in different gradient, collected the litter every month and the fresh and dry weights were measured.

2.4 Sample gathering and chemical analysis method

The sample which carbon content analysis was gathered during investigation biomass. Stem sample was gathered 10-20g every 2m, branch and leaf sample were gathered in 3 layers, and root sample was gathered in 3 grades (fine, middle, large). The soil samples of each site were taken at depths of 0-20, 20-40 and 40-60cm randomly sampled for three to four times, and mixed.

The carbon content was determined by a potassium dichromate-hydration heating method.

2.5 Carbon storage computation

The organ carbon storage equals to the product of organ content and its biomass. The annual carbon fixation was equal to the product of carbon content and net productive. The arbor carbon storage was sum of all organ carbon storage. The ecosystem carbon storage was sum of arbor, understory, litter and soil. Soil carbon storage was estimated as following[5],

Soil carbon storage = soil density × depth × carbon content×0.58×area

Where, 0.58 is the coefficient of reduction, refers to t organic content of soil granule less than 2mm.

3 Results and analysis

3.1 Carbon content and distribution of vegetation

3.1.1Carbon content of organ

The different organ carbon content was different, As shown in table 1, Chinese fir organs carbon content various in 47.15% ~ 50.82%, The average carbon concentrations in all organs of Chinese fir was in the following order: stem (50.43%)>leaf (49.57%)>bark (48.84%)>branch (48.33%)>root (47.89%).The stem carbon content is the highest, the bark and the leaf carbon content relatively low, mainly because the cellulose and lignin content higher in the trunk than the others.. *Phyllostachy pubescens* organs carbon concentrations undulation in 44.51% ~ 49.91%, and it was following the order, sheath (49.91%) > branch (48.46%)> leaf (46.92%)> stem (46.68%)> rhizome (44.78%) > root (44.51%). This result as same as the existing findings, that is to say , tree organs carbon content various in 45% ~ 55%, in spite of dirrerent tree or the same tree in different site and different age [14].

Chinese fir average carbon content was different was indicated in the different climatic zone or in different age at the identical site. Such as, Chinese fir organs average carbon content is 51% and 46.32% in 27-year-old tree of the southern Jiangsu area and in 23-year-old tree of the northern subtropics Xinyang region, respectively. In Huitong plantation, Hunan province Chinese fir organs average carbon content was 54.1%, 48.07%, 47.79% and 47.56% in the 20-year-old, 14-year-old, 11-year-old and 10-year-old , respectively [10,14]. That is to say, there were certain difference in carbon content of the identical forest type because of its locates geographical and age stage [14], but The average carbon content in all organs of *Phyllostachy*

pubescens was not correlate to their age which maybe correlate with *Phyllostachy pubescens* special biology characteristic and the growth rule.

Table 1 Carbon contration in different organs of *Phyllostachy pubescens* and Chinese fir (%)

Tree \ Organ	Age	Stem	Branch	Leaf	Root	Bark	Rhizome	Sheath	Average
Chinese fir	15	50.43	48.33	49.57	47.89	48.84			49.05
Phyllostachy	2	47.01	49.8	48.32	43.45		44.05	49.91	47.09
pubescens	4	46.36	46.84	46.34	45.86		43.76	49.91	46.51
	6	46.9	48.48	44.59	43.22		47.13	49.91	46.71
	8	46.45	48.7	48.44	45.52		44.16	49.91	47.2
Average		46.68	48.46	46.92	44.51		44.78	49.91	46.88

3.1.2 Carbon storage and distribution of vegetation

As shown in table 2, Chines fir plantation vegetation carbon storage was higher than the *Phyllostachy pubescens*. Chinese fir vegetation carbon storage was 57.03t.hm^{-2}, 2.13 times than *Phyllostachy pubescens*, approaches to forest vegetation average carbon storage of China (57.07 t .hm^{-2}). It is higher than that of the temperate zone forest (43.26 t .hm^{-2}) and coniferous forest of warm temperate zone (44.97 t .hm^{-2}), lower than that of coniferous forest in tropics and the subtropics (63.7 t .hm^{-2}) [5]. This mainly because that the age of Chinese fir was lower than the average age (20-30 years) of the above forest. *Phyllostachy pubescens* carbon storage was low than Chinese fir, because its management way was different with Chinese fir, usually was cut some old age *Phyllostachy pubescens* every year.

Table 2 Carbon storage of vegetation and its spatial distritution under different plantation ecosystem

Item	*Phyllostachy pubescens*				Chinese fir			
	Biomass (t.hm^{-2})	Percent (%)	C Storage (t.hm^{-2})	Percent (%)	Biomass (t.hm^{-2})	Percent (%)	C Storage (t.hm^{-2})	Percent (%)
Stem	26.29	45.71	12.27	45.88	59.60	51.27	30.05	52.57
Branch	3.68	6.40	1.78	6.67	8.70	7.48	4.20	7.35
Leaf	3.17	5.51	1.49	5.56	9.45	8.13	4.68	8.19
Root	7.66	13.32	3.41	12.75	18.69	16.08	8.95	15.66
Bark					9.54	8.21	4.66	8.15

Rhizome	5.56	9.67	2.49	9.31				
Sheath	8.31	14.45	4.15	15.51				
Sum	54.67	95.06	25.59	95.67	105.97	91.16	52.55	91.92
Understory	1.50	2.62	0.63	2.36	2.68	2.31	1.05	1.84
Litter	1.34	2.32	0.53	1.96	7.59	6.53	3.57	6.24
Total	57.51	100.00	26.75	100.00	116.24	100.00	57.17	100.00

Chinese fir plantation vegetation carbon storage spatial distribution was different from *Phyllostachy pubescens* but the layer of arbor was the main composing of vegetation carbon storage. The layer of arbor of Chinese fir and *Phyllostachy pubescens* was 52.55 $t*hm^{-2}$ and 25.59 $t.hm^{-2}$, accounts for the entire vegetation carbon storage 91.14% and 95.67%. Secondly, the litter carbon storage of Chinese fir accounts for the entire vegetation carbon storage 6.01%, more than 4.17% of the understory layer carbon storage. The understory layer carbon storage of *Phyllostachy pubescens* accounts for the entire vegetation carbon storage 2.36%, more than 0.4% of the litter carbon storage which possible corelated with the structure of *Phyllostachy pubescens*.

As shown in table 2, carbon distribution in organs of Chinese fir was in the following order; stem was the biggest, amount for 52. 7%, next is the root (15.69%), and then is in leaf (8.21%), the bark (8.17%) and the branch (7.37%); the order of *Phyllostachy pubescens* was stem (45.88%), the rhizome (15.51%), root (12.75%), branch (6.67%) and leaf (5.56%). Moreover, the carbon storage distribution of different organs basically correlation to their biomass, for example, stem biomass is the biggest, the carbon storage also the highest, that is to say, vegetation carbon storage mainly correlation to its biomass.

3.2 Soil carbon content and carbon storage

The forest litter was one of the important sources of soil organic carbon. The different level structure was formed in the forest land soil because of climate, biology function and its organic carbon content and the carbon storage also different along with the depth of soil. As shown in table 3, the hightest carbon content and carbon storage of *Phyllostachy pubescens* and Chinese fir plantation soil was 0-20cm layer, secondly in the 20-40cm, the lowest in the 40-60cm. Chinese fir plantation soil carbon storage was 54.84 $t*hm^{-2}$. The layer of 0-20cm was 24.95 $t*hm^{-2}$, accounts for the forest soil carbon storage 45.5%. It is 1.38 time and 2.12 times than that of 20-40cm and 40-60cm respectively. *Phyllostachy pubescens* plantation soil carbon storage was 73.08 $t*hm^{-2}$. The layer of 0-20cm was 38.16 $t*hm^{-2}$, accounts for the forest soil carbon storage 52.2%. It is 1.98 time and 2.44 times than that of 20-40cm and 40-60cm respectively. This maybe because biology returns land in 0-20cm soil is more than the others. In the forest soil organic carbon storage mainly distributes in the soil surface layer, but surface layer correlated with management, in particularly *Phyllostachy pubescens* forest land was scarified every year which certainly have the profound influence to soil carbon source/sink.

Table 3 Carbon concentration and carbon storage in soil

Forest	Chinese fir				*Phyllostachy pubescens*			
Soil depth (cm)	Density (g.cm^{-3})	Conc. (%)	Storage (t.hm^{-2})	Percent (%)	Density (g.cm^{-3})	Conc. (%)	Storage (t.hm^{-2})	Percent (%)
0-20	1.218	1.765	24.95	45.5	1.19	2.763	38.16	52.2
20-40	1.253	1.245	18.11	33.0	1.195	1.39	19.28	26.4
40-60	1.361	0.746	11.78	21.5	1.434	0.94	15.64	21.4
Total			54.84	100			73.08	100

Detwiler reported that the carbon storage in 0 ~ 40cm stores was 35%~80% of that of 0~100cm which average was 57% because of the land use change in the tropics and the subtropics area. Soil carbon storage in 0~ 40cm soil layer carbon storage were 78.5% and 78.6% of the total carbon storage in this area of Chinese fir and *Phyllostachy pubescens* forest, slightly higher than that of other areas. This may reflect this local planted forest soil is frailer than the other land and the soil carbon very easy lose by disturb [12]. Therefore, it is important that reduces forest disturbance by artificially and strengthens maintaining forest vegetation which would slow down CO_2 density in the atmospheric.

3.3 Carbon storage in each component of ecosystem

As shown in table 4, Chinese fir plantation ecosystem carbon storage was 111.87t .hm^{-2}. The soil layer carbon storage was 54.84 t .hm^{-2} which was the biggest in the ecosystem, accounts for 49.02%.The arbor layer carbon storage was the secondly amount of the ecosystem, accounts for 46.98%. The litter and the understory were another composing of the ecosystem carbon storage, account for 3.07% and 0.94%.The ratio of aboveground and underground (litter and soil) carbon storage of Chinese fir was 1:1.09. *Phyllostachy pubescens* plantation ecosystem carbon storage was 99.83t .hm^{-2}. The soil carbon storage was 73.08 t .hm^{-2} which was the biggest in the ecosystem, accounts for 73.2%.The arbor layer carbon storage was the secondly amount of the ecosystem, accounts for 25.59%. The litter and the understory were another compoising of the ecosystem carbon storage, account for 0.53% and 0.63%.The ratio of aboveground and underground (litter and soil) carbon storage ratio of *Phyllostachy pubescens* was 1:2.81. It was showing that forest land soil carbon storage was an enormous carbon pool.

Table 4 Carbon storage in each component of *Phyllostachy pubescens* and Chinese fir plantation ecosystem (t·hm^{-2}, %)

Forest	Tree layer	Understory	Litter	Soil	Total
Chinese fir	52.55	1.05	3.43	54.84	111.87
	(46.98)	(0.94)	(3.07)	(49.02)	(100)

Phyllostachy pubescens	25.59 (25.63)	0.63 (0.63)	0.53 (0.53)	73.08 (73.20)	99.83 (100)

3.4 Annual carbon storage in *Phyllostachy pubescens* and Chinese fir plantation

Table 5 The annual carbon storage in *Phyllostachy pubescens* and Chinese fir plantation ($t \cdot hm^{-2}$)

Forest	Layer	Standing Crop	Total C	Total CO2	Net production	Annual C accumulation	Annual CO2 accumulation
Chinese fir	Tree layer	105.97	52.55	192.68	10.72	5.32	19.51
	Litter	7.30	3.43	12.58	3.94	1.85	6.79
	Understory	2.68	1.05	3.85	2.13	1.83	6.71
	Total	115.95	57.03	209.11	16.79	9.00	33.01
Phyllostachy pubescens	Tree layer	57.51	25.59	93.84	17.68	8.29	30.39
	Litter	1.34	0.53	1.93	2.58	1.02	3.73
	Understory	1.50	0.63	2.32	1.50	0.63	2.32
	Total	60.35	26.75	98.08	21.76	9.94	36.44

The assimilates CO_2 ability of forest ecosystem was one of the contents of forest ecosystem productive .As shown in table 5, Chinese fir plantation carbon storage of forest vegetation was 57.03t.hm^{-2}, equal to assimilates CO_2 209.11 t.hm^{-2}. Chinese fir plantation annual carbon accumulation was 9 t*hm^{-2}, equal to assimilates CO_2 33.01t.hm^{-2}. *Phyllostachy pubescens* plantation carbon storage of forest vegetation was 26.75t.hm^{-2}, account for 46.79% of Chinese fir plantation. But *Phyllostachy pubescens* plantation annual carbon accumulation was 9.94 t*hm^{-2}, equal to assimilates CO_2 36.44t.hm^{-2} which was 1.1 times of Chinese fir. That is to say, the assimilates CO_2 ability of *Phyllostachy pubescens* plantation was more than Chinese fir. That is to say, Phyllostachy *pubescens* and Chinese fir plantation not only provide the lumber, also were an important CO_2 sink. There were much ecology significance for protects, restores and development forest.

4 Conclusions and discussion

15-year-old Chinese fir organs carbon content various in 47.15% ~ 50.82%, The average carbon content in all organs of Chinese fir was in the following order: stem (50.43%)> leaf (49.57%) > bark (48.84%) > branch (48.33%)> root (47.89%). *Phyllostachy pubescens* organs carbon content undulation in 44.51% ~ 49.91%, and it was following the order, sheath (49.91%) > branch (48.46%)> leaf (46.92%) > stem (46.68%) > rhizome (44.78%) > root (44.51%). The average carbon content in all organs of *Phyllostachy pubescens* did not correlate to their age. *Phyllostachy pubescens* and Chinese fir plantation soil (0-60cm deep) carbon content was 0.746% ~ 2.763%. The soil carbon content and the carbon storage of surface layer (0 ~ 20cm)

were the highest. Prevents surface soil erosion maybe effectively maintains soil carbon sink ability. Chinese fir and *Phyllostachy pubescens* plantation soil carbon storage were 54.84 t.hm^{-2} and 73.08t.hm^{-2}, respectively, accounts for 49.02% and 73.20% of their ecosystem. Soil average carbon storage of Chinese forest was 193.55t.hm^{-2}, approximately 3.4 times than vegetation carbon storage. In this paper, the soil and vegetation carbon storage of *Phyllostachy pubescens* and Chinese fir plantation were lower than the national average. This mainly explain as following, on the one hand the subtropics was advantageous to the vegetation grows, biomass accumulation by the better environment, on the other hand, soil carbon storage was lower because soil respiration in subtropics was bigger than other site and the vegetation absorb soil nutrient relatively speed. Moreover, except litter was the source of soil carbon, the root secretion was one of soil carbon important origins [15]. Liao Liping et al. reported that the fade root biomass in 13-year-old Chinese fir plantation was 497kg .hm^{-2}, account for 36.8% of litter, its carbon content was 525.4 g .kg^{-1}[16], that is to say, the root secretion and litter were important to soil carbon storage.

Chinese fir and *Phyllostachy pubescens* plantation ecosystem carbon storage were 111.87t .hm^{-2} and 99.83 t .hm^{-2}, respectively. Carbon storage spatial distribution pattern in the ecosystem basic consistent, soil was the main part, next is the arbor, understory vegetation and litter were very small. Among them, soil ,arbor, understory vegetation and litter carbon storage of Chinese fir plantation accounts for 49.02%, 46.98%, 0.94% and 3.07% of the ecosystem, respectively. soil ,arbor, understory vegetation and litter carbon storage of *Phyllostachy pubescens* plantation accounts for 73.2%, 25.6%, 0.63% and 0.53% of the ecosystem, respectively.Moreover, vegetation carbon storage mainly correlated to its biomass,for exsample, stem biomass is the biggest, the carbon storage also the highest. Chinese fir and *Phyllostachy pubescens* plantation stem carbon storage were 30.05 t .hm^{-2} and 12.27 t .hm^{-2}, respectively, account for 52.57% and 35.88% of vegetation carbon storage. The branch, leaf and root carbon storage account for 39.35% and 49.79%. *Phyllostachy pubescens* plantation vegetation carbon storage lower than Chinese fir, but *Phyllostachy pubescens* carries off carbon storage was more than Chinese fir. When cutting *Phyllostachy pubescens* stem, branch and leaf were carried off carbon storage 58.11% of vegetation carbin storage. Moreover the nature product carbon pool was made by *Phyllostachy pubescens* stem; branch would adjust the carbon turnover speed in the terrestrial environment. That is to say, *Phyllostachy pubescen* fixed carbon was retained long time than Chinese fir. Certainly, the different forest product use factor and nature retention time were different. In order to accurately judge the retention condition of fixed carbon we must do more thorough research.

Vegetation carbon storage of 15-year-old Chinese fir plantation was 57.03 t hm^{-2}, equal to assimilates CO_2 209.11 t*hm^{-2}. Chinese fir plantation annual carbon accumulation was 9t*hm^{-2}, equal to assimilates CO_2 33.01t.hm^{-2}. Vegetation carbon storage of *Phyllostachy pubescens* was 26.75 t .hm^{-2}, account for 46.79% of Chinese fir plantation, but *Phyllostachy pubescens* plantation annual carbon accumulation was 9.94 t*hm^{-2}, 1.1times of Chinese fir plantation. As to ecological environment protection *Phyllostachy pubescens* plantation better than Chinese fir in some degree because it's ability of fixtation CO_2 and resist soil erosion stronger than Chinese fir. But the management measure must be researched further because the intensivism

management of *Phyllostachy pubescens* would increase the vegetation carbon storage, in the same time it maybe reduce soil carbon storage.

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Fertility of Soil and its Capacity and Function on Water Conservation of Moso Bamboo Forests in Low Hill of Chaohu Lake Region

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ABSTRACT

Chaohu Lake is one of five famous lakes in China. But the pollution of water body and soil caused by soil erosion is serious in Chaohu Lake area. With the concerns of soil fertility and soil conservation and water protection, the soil of moso bamboo forest and other type forests in low hills of Chaohu Lake area were investigated. The results show that soil fertility of moso bamboo forest was better than that of masson pine forest. The water storage capacity of moso bamboo forest was more than that of masson pine forests and other forest types. It suggested that moso bamboo forest was more suitable for soil and water conservation in low hill of Chaohu Lake area.

Key words: Moso Bamboo Forest; Forest Soil; Soil Fertility; Soil and Water Conservation

Mapping Bamboo with UPM-APSB's Aisa Airborne Hyper spectral Sensor in Berangkat Forest Reserve, Malaysia

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ABSTRACT

Mapping of bamboo using satellite-based remote sensing in the Malaysian mountain forest has been neglected due to its poor mapping accuracy. However, an assessment of the distribution of bamboo resources in the Malaysian mountain forest is deemed necessary for its commercial utilization and development of bamboo product manufacturing. Bamboo is ranked second to rattan in economic importance in Peninsular Malaysia. The general objective of this study is to therefore to assess the capability of UPM-APSB's AISA airborne hyper spectral imaging sensor for bamboo mapping in the forest while the specific objectives are to identify, quantify and map out the distribution of natural bamboo growing areas in Berangkat F.R, Kelantan, Malaysia. A False Color Composite (FCC) airborne hyper spectral image of the study area was acquired in 2005 by flying over the study area with a Nomad G22B fixed-wing aircraft. Sobel filtering was used to enhance the image. Spectral Angle Mapper (SAM) was then used to classify the bamboo species among other vegetative species within the Berangkat F.R. A thematic map of bamboo distribution was produced and the bamboo species was identified as Gigantochloa scortechnii. The areal extent of bamboo acreage in the study area was 2.12 ha, with estimated bamboo culms of 4,009 at a mapping accuracy of 60%. Bamboo mapping using UPM-APSB's AISA airborne hyper spectral sensing has a great potential and should be integrated with a GIS-based decision support system to support future decision making, development and utilization of bamboo by Kompleks Perkayuan Kelantan management.

Key words: Bamboo, Mapping, Airborne Hyper spectral Sensing, *Gigantochloa scortechnii*

The Necessity and Feasibility on Development of Standards for Sustainable Bamboo Forest Management and Certification Scheme

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ABSTRACT

Forest certification, regarded as an effective tool to promote the sustainable forest management, is a market-based and volunteering process. At present, 7% global forest have been certified and labeled mainly are tropical and subtropical wood forest. Bamboo is a vital component of Non Timber Forest Products (NTFP) in international market where the importance for trade is greatly increasing. However, no standard for sustainable management of bamboo forest and certification scheme is developed yet to serve the sustainable management of bamboo forests and international trade of bamboo products.

The issues related to the necessity and feasibility of bamboo certification is discussed in this paper. It is suggested, in the immediate future, to take action on developing criteria and indicators for sustainable bamboo management and conduct a feasibility study of bamboo certification when needed. The actual practice of bamboo certification as a longer-term issue is subject to the interests and willingness of all stakeholders, including producers and consumers. As a first step, it was suggested that FSC, WWF China and INBAR, as well as other stakeholders, should jointly hold an international workshop on bamboo certification in the near future to hear various views on this issue and discuss concrete future actions.

It is also suggested that bamboo certification, like other certification schemes, should be a voluntary process that shall be market driven, participatory and transparent. During the consultation process, the roles of INBAR, FSC and WWF are to provide a forum for awareness raising, capacity building, communication and consultation among all stakeholders, and to develop sustainable management standards before implementation of any bamboo certification scheme. It was also agreed that the sectoral features of the bamboo sector and the interests of marginalized small and local stakeholders should be appropriately addressed if bamboo certification is going to happen.

Key words: Standard, Bamboo Certification Scheme, Multi-stakeholders, Marginalized Producer

Primary Report of Bamboo Introduction Experiment in Beijing Area

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1. The Management of Beijing Black Bamboo Park

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ABSTRACT

Bamboo is liked by Chinese people for thousands years. It is an important material for landscape plants because it is growth fast, easy to plantings and breeding. In Jin (1115-1234A.D.) and Yuan dynasty (1297-1368A.D.), bamboo had been planted in Beijing's gardens, but due to the climate, few bamboo species are used in this area. From 2004, 12 genera with 46 bamboo species (or cultivars) which are from Louguantai in Shanxi province are introduced in Beijing area. After 2-years observation, the results show: 1. In general, runners are hardier than mixed type bamboos. The former's branches could live through winter in safety, but the latter's branches and leaves are almost dead after winter that maybe because the thin culms of mixed type bamboos could not resistant cold temperature. 2. The growth types of runners and mixed type bamboos in spring are difference. The former renew its leaves and grow new shoots, the latter just grow many new shoots due to its culms and leaves are killed by cold temperature in winter. Then different planting techniques should be used to the 2 kinds of bamboo. 3. Dozen Species of bamboo, such as: *Phyllostachys iridescens, Phyllostachys bambusoides* f*. mixta, Phyllostachys incarnata, Sasa fortunei, Pleioblastus kongosanensis* f.*aureo-strlatus, Sasa argenteastriatus* etc., have relative high adaptability, so they have great chance to using in Beijing area. Some species just have normal adaptability, such as: *Phyllostachys praecox, Phyllostachys heteroclada* f. *solida*, *Phyllostachys arcana*, *Phyllostachys arcana* f. *luteosulcata, Sasa auricoma*, *Hibanobambus tranpuillans* f.*shiroshima* etc., more time is needed to observe them. 4. Beijing's cold temperature in winter and windy dry weather in spring are two important reasons which cause a lot of bamboo leaves becoming yellow and dry rot in spring. That impacts the decorative effects of bamboo badly.

Key words: Bamboo, Introduction experiment, Adaptability, Planting technique

Bamboo is liked by Chinese people for thousands years. It is an important material of landscape plants, because it is growth fast, easy to planting and breeding[1]. In Jin (1115-1234A.D.) and Yuan (1297-1368A.D.) dynasty, bamboo had been planted in Beijing's gardens. But due to climate, few bamboo species are planted in this area. In 2004, 12 genera with 46 bamboo species (or cultivars) which are from Louguantai in Shanxi province are introduced in Beijing , the aims are to know the adaptability of these bamboos, study planting and care techniques.

1. Materials and Methods

1.1 Materials

12 genera with 46 bamboo species (or cultivars) which are from Louguantai in Shanxi province, some of them are running type, some are mixed type.

1.2 Environmental situations about Beijing

Beijing is located approximately at latitude 40 ° north and longitude 116 ° east. It is in the zone of temperate continental climate. Summer is hot and moist, the hottest month in one year is July which average temperature is 26.1□ and the absolute highest temperature is 40 □. Winter is cold and dry, the coldest month is January that average temperature is -4.7□ and the absolute lowest temperature is -22.8□. The annual average rainfall is .695m and 74% of it is contributed by June, July and August. Only 10% of rainfall is in spring[2].

The experimental spot is located at Beijing Black Bamboo Park which is in center of the city. The spot which area is about 1200m^2 has full sunshine, mild wind and soil of PH 7-8.

1.3 The planting and care of experimental spot

The spot is divided into 46 planting bed and each bamboo species is planted in one bed. There are root barriers between each bed. The soil added with compound fertilizers is plow in depth of 400mm-500mm and cultivated for use. In April 2004, it takes about 36 hours to transplant the bamboos from Louguantai Shanxi province to Beijing. They are planted as soon as possible when they are arrived Beijing. At meanwhile, ample water is irrigated.

From November to March in 2004 and 2005, windscreens about 3m height were made at west and north of the experimental spot. In winter 2004, the ground of the spot was covered by 20-30mm depth saw dusts, but in 2005 not. No other special care for the bamboos except those mentioned above.

1.4 Standards and levels of adaptability

There are 3 senior standards: preservation rate in spring 2006, cold resistance and growth ability. Cold resistance includes 2 junior standards: leaf cold resistance and branches. Former means the proportion of dry leaf area to entire leaf, latter means whether the branches are alive after winter. Growth ability also include 2 junior standards, shoot rate and growth situation of young culms. For runners, shoot rate means the proportion of new culms in 2006 to old culms. For mixed type bamboo, shoot rate means judge the quantity of new culms directly. The growth situation of young culms means to judge the young culms according to its height and diameter. Each senior standards has a full score of 10, add up 3 senior standard scores, we finally get the adaptability score of each kind of bamboos. Evaluation standards are listed in table 1.

Table1 The judgment standards and scores of adaptability

Senior standards	Junior standards	grades	Standards	Scores
Preservation rate			Preservation rate in spring of 2006	Preservation rate×10
Stress resistance	Leaf resistance	1	Below 10%	5
		2	10 ~ 20%	4
		3	20 ~ 50%	3
		4	50 ~ 80%	2
		5	Above 80%	1
	Branch resistance	□	Almost no branches die	5
		□	Some branches die	3
		□	Almost all culms die	1
Growth ability	Shoot rate		runners mixed type bamboo	
		1	≥5 very many	5
		2	4 ~ 4.9 many	4
		3	3 ~ 3.9 normal	3
		4	2 ~ 2.9 few	2
		5	0.5 ~ 1.9 very few	1
	Growth situation of new culms	1	The height and diameter of new culms are better than old ones	5
		2	The height and diameter of new culms are not difference obviously with old ones	3
		3	The height and diameter of new culms are worse than old ones	1

2. Results and Analyses

The results of survival rate, stress resistance and growth ability of bamboos are listed in attached list 1.

2.1 Analyses of survival rate and preservation rate

Although the process of transplant bamboos is same, but the survival rates of different bamboos, even in one genra, are dissimilar. That maybe because: 1. Different bamboos have different ability to adapt transplantation; 2. Age, health situation, pest and disease of bamboos

are difference. 3. Quantity of some bamboo species is too few, so they are impacted more by accidental factors.

Bamboos in this experiment are divided for 4 groups according to change law of survival rate and preservation rate.

1. The survival rate and preservation rate are both very high. That means these bamboos adapt Beijing's environment. Such as *Phyllostachys iridescens, Phyllostachys mannii, Pleioblastus kongosanensis* f. *aureo-strlatus, Sasa pygmaea,* etc.

2. The survival rate is high in first year after transplantation, but the preservation rate decreases sharply during the next 2 years. That maybe because the cold temperature in winter and dry weather in spring. So prevent frost in winter and irrigation in time in spring is key factors to this group bamboos. Such as: *Phyllostachys heteroclada* f. *solida, Phyllostachys stimulosa, Phyllostachys bambusoides* f. *shouzhu, Phyllostachys heteroclada, Acidosasa venusta, Pleioblastus gozadakensis, Shibataea lanceifolia* etc.

3. The survival rate is not very high in first year after transplantation, but the preservation rate also does not decease sharply during next 2 years. So how to improve the survival rate to these bamboos is key point. Such as: *Phyllostachys bambusoides, Phyllostachys arcana* f. *luteosulcata, Pleioblastus chino* var. *hisauchii, Sasa auricoma, Hibanobambus tranpuillans* f.*shiroshima,* etc.

4. The survival rate is very low. Such as: *Phyllostachys dulcis, Phyllostachys nuda* f. *localis, Brachystachyum densiflorum,* etc.

2.2 The stress resistance of runners is better than mixed type bamboos'.

The runners' branches could live through the winter safely, they are able to grow new leaves in next spring, but the mixed type bamboos' couldn't. That maybe because that mixed type bamboos' branches is too thin. Leaves of all kinds of bamboo are dry rot badly in winter except *Phyllostachys incarnate, Phyllostachys iridescens, Phyllostachys glauca, and Indocalamus bashanensis.*

Most runners' leaf stress resistance are belong grade 3 or 4, but most mixed type bamboos' belong grade 5. Dry and yellow bamboo leaves impact their decorative effects badly.

2.3 The growth style of runners and mixed type bamboos is difference in spring

The runners grow new leaves from old branches and shoots in spring, but most mixed type bamboos have to grow new shoots only due to their culms have died in winter.

2.4 All kinds of bamboo in this experiment are divided for 3 groups according to their adaptability

（1）The adaptability score is 20 or above. That means these bamboos adapt Beijing's environment and could be used in this area. They could grow very well especially in the place where a good microclimate has.

Phyllostachys iridescens

Phyllostachys bambusoides f. *mixta*

Phyllostachys glauca

Phyllostachys incarnata

Phyllostachys rubromarginata

Phyllostachys mannii

Phyllostachys nidularia

Pleioblastus kongosanensis f. *aureo-strlatus*

Shibataea .chinensis

Sasa argenteastriatus

Sasa pygmaea

Sasa fortunei

Sasa pygmaea var.*disticha*

Indocalamus longiauritus

Indocalamus bashanensi

(2) The adaptability score is 15 or between15 to 19. These bamboos have normal adaptability in Beijing area. More time is needed to observe them.

Phyllostachys praecox

Phyllostachys heteroclada f. *solida*

Phyllostachys arcana

Phyllostachys bambusoides

Phyllostachys sulphurea'Houzeau'

Phyllostachys bambusoides var.*castillonis*

Phyllostachys arcana f. *luteosulcata*

Hibanobambus tranpuillans f.*shiroshima*

Monstruocalamus sichuanensis

Sasa auricoma

Shibataea lanceifolia

(3) The adaptability score of other kinds of bamboo is below 15, they do not adapt Beijing's environment in this experiment.

3. Discussion

3.1 Planting and care techniques for runners and mixed type bamboos

For runners and mixed type bamboos, different planting and care techniques should be taken because their growth type is dissimilar in spring. The new culms of most runners are often thin and marginal in early years after transplantation, so they sometimes look like grasses that decrease their decorative effects obviously. In the first year after transplantation, we could remain all new culms; it is good for photosynthesis of bamboos. In next few years, we could cut out some culms which are too small or too old.

For some mixed type bamboos, their branches and leaves above ground would all be dead in winter without cold proof. But in next spring, they still could grow many new culms, it almost dose not impacts its decorative effect. We could cut all mixed type bamboos' culms out in deep autumn, and cover them on ground. They could warm the earth, hold water in soil, and protect buds and rhizomes under ground to live through the winter.

3.2 The reasons that decrease decorative effect of bamboos in Beijing area

A lot of bamboo leaves become yellow and dry in winter and early spring. That, of course, partly because it is in period of change leaf. But more reasons may lead to that result.

(1) Bamboo's leaves are freezing injury during the winter. Freezing injury destroys cell wall of bamboo leaf, so the protoplasm lost its water. First, the leaves look like be scalded by hot water, then become yellow and dry little by little[3].

(2) Beijing's climate in spring, which is dry , windy, forceful sunshine and fast increasing of temperature, often leads to the result that bamboo leaves transpire more water than root absorb.

Attached list 1 The survival rate, shoot appearance rate and stress resistance of bamboos

Species	Planting numbers	survival rate	Preservation rate	Preservation rate	Stress resistance Score		Growing ability score		Adaptability
Investigation time	(culms)	2004.9	2005.4	2006.5	leaf	branch	shoot rate	Growing situation of new culms	Total score
Phyllostachys									
P.iridescens	5	100%	100%	100%	4	5	4	3	26.0
P.bambusoides f. *mixta*	3	100%	100%	100%	2	5	3	3	23.0
P.glauca	20	100%	90%	80%	4	5	4	1	22.0
P.incarnata	20	90%	85%	65%	5	5	2	3	21.5
P.rubromarginata	5	100%	100%	100%	1	5	4	1	21.0
P.mannii	30	97%	87%	87%	3	5	3	1	20.7
P.nidularia	30	100%	83%	73%	2	5	5	1	20.3
P.praecox	5	100%	80%	80%	1	5	1	3	18.0
P.heteroclada f. *solida*	10	90%	90%	40%	3	5	5	1	18.0
P.arcana	20	65%	55%	20%	2	5	5	3	17.0
P.bambusoides	20	70%	65%	55%	3	5	2	1	16.5
P.sulphurea‘Houzeau’	5	100%	80%	80%	1	5	1	1	16.0
P.bambusoides var.*castillonis*	5	80%	80%	60%	3	5	0	1	15.0
P.arcana f. *luteosulcata*	5	40%	40%	20%	1	5	4	3	15.0
P.stimulosa	20	85%	80%	55%	2	5	1	1	14.5
P.sulphurea	5	100%	100%	60%	1	5	0	1	13.0
P.bambusoides f. *shouzhu*	20	100%	85%	40%	2	5	1	1	13.0

P.nuda	20	25%	25%	5%	1	——	0	1	2.5
P.heteroclada	10	50%	30%	0%	——	——	——	——	0.0
P.vivax f. *aureocaulis*	10	40%	30%	0%	——	——	——	——	0.0
P.dulcis	5	20%	0%	0%	——	——	——	——	0.0
P.nuda f. *localis*	10	10%	10%	0%	——	——	——	——	0.0
P.sulphurea‘Viridis’	5	0%	0%	0%	——	——	——	——	0.0

Attached list 1 The survival rate, shoot appearance rate and stress resistance of bamboos

Species	Planting numbers	survival rate	Preservation rate	Preservation rate	Stress resistance Score		Growing ability score		Adaptability
Investigation time	(culms)	2004.9	2005.4	2006.5	leaf	branch	shoot rate	Growing situation of new culms	Total score
Brachystachyum									
B.densiflorum	20	30%	30%	5%	1	——	5	1	7.5
Acidosasa									
A.venusta	2	100%	100%	0%	——	——	——	——	0.0
Oligostachyum									
O.lubricum	5	0%	0%	0%	——	——	——	——	0.0
Pleioblastus									
P.kongosanensis f. aureo-strlatus	10	90%	90%	90%	1	3	4	5	22.0
P.chino var. hisauchii	30	63%	63%	63%	2	5	2	1	16.3
P.gozadakensis	20	75%	10%	0%	1	——	——	——	1.0
P.gramineus	5	20%	20%	0%	——	——	——	——	0.0
Shibataea									
S.chinensis	10	100%	100%	100%	3	5	2	1	21.0
S.chiangshanensis	3	67%	67%	0%	——	——	——	——	0.0
S.lanceifolia	5	80%	80%	0%	——	——	——	——	0.0
Pseudosasa									
P.japonica var.tsutsumiana Yanagita	3	100%	67%	67%	1	1	2	1	11.7
P.japonica	20	45%	40%	0%	3	1	——	——	4.0

Attached list 1 The survival rate, shoot appearance rate and stress resistance of bamboos

Species	Planting numbers	survival rate	Preservation rate	Preservation rate	Stress resistance Score		Growing ability score		Adaptability
Investigation time	(culm)	2004.9	2005.4	2006.5	leaf	branch	shoot rate	Growing situation of new culms	Total score
Sasa									
S.argenteastriatus	10	100%	100%	100%	2	3	4	5	24.0
S.pygmaea	20	100%	100%	100%	1	3	4	5	23.0
S.fortunei	10	100%	100%	100%	1	1	4	5	21.0
S.pygmaea var.*disticha*	10	90%	90%	90%	1	1	4	5	20.0
S.auricoma	5	60%	60%	60%	1	1	4	5	17.0
Indocalamus									
I.longiauritus	10	90%	90%	90%	2	5	4	3	23.0
I.bashanensis	10	100%	80%	80%	4	5	2	3	22.0
Hibanobambus									
H.tranpuillans f.*shiroshima*	10	60%	60%	60%	1	5	3	3	18.0
Monstruocalamus									
M.sichuanensis	10	100%	90%	90%	1	1	3	3	17.0
Qiongzhuea									
Q.communis	5	60%	0%	0%	——	——	——	——	0.0

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Study on the Hormonal Mechanism of Earlier Aging of Intensively Managed *Phyllostachys praecox* Stands Caused by Mulching Cultivation

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ABSTRACT

Determination was carried out on endogenous hormone content and ratio of rhizomes of *Phyllostachys praecox* stands treated with unmulching, 2 ~ 3, 4~5 and 6 ~ 7 year mulching for earlier aging rule. The result showed that from unmulching to 6 ~ 7 year mulching, ABA content increased markedly while that of GA_3, IAA, Zr, iPA decreased, but the one of Zr, iPA declined slightly, the above 5 hormones changed significantly from 4 ~ 5 year mulching to 6 ~ 7 year mulching. The ratio of GA_3/ABA, IAA/ABA, Zr/ABA and iPA/ABA declined from unmulching to 6 ~ 7 year mulching , particularly GA_3/ABA, IAA/ABA, GA_3 + IAA/ABA, and also decreased from 4 ~ 5 year mulching to 6 ~ 7 year mulching, the same as the aging year of rhizome. The earlier aging caused by mulching was not determined by less synthesis of CTK in root and its less supply to the above part of bamboo, but by the ratio value of GA_3/ABA, IAA/ABA, GA_3 + IAA/ABA, of which GA_3/ABA played the most important function, and IAA/ABA the second.

Key words: *Phyllostachys praecox*; Aging; Mulching Cultivation

Current Status of the Germplasm and its Conservation of *Dendrocalamus sinicus* in Yunnan, China

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ABSTRACT

Dendrocalamus sinicus is an endemic species in Southwestern Yunnan, China. It is the largest bamboo in the world, can grow to more than 30m in height and 30cm in diameter. The yield per unit area of its culm exceeds that of *Phyllostachys pubescens,* the most important economic bamboo species in China, by 5-8 times. It is one of the most important economic bamboo species in southern China and tropical and subtropical area of the world. On the basis of investigation on the biological characteristics and germplasm of the species, it is discussed in this paper on the limitations of its natural distribution, fragile growth and propagation, substantial content of culture. It is suggested that this species would be classified as one of wild plants of national priority for conservation; the monographic study for it should be funded by National Fund of Natural Science; and the nature reserve for its ecological and cultural systems should be considered with investment by the government.

Key words: *Dendrocalamus sinicus,* Biological Characteristics, Germplasm, Conservation and Development

The Impacts of Human's Disturbances on the Degradation of Clonal Population of *Qiongzhuea tumidinoda* Bamboo Forests

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ABSTRACT

This paper is studied from the impacts of forestry construction changing and overly harvesting of bamboo shoot to the degradation of the clonal population for *Qiongzhuea tumidinoda.* It aims at studying the relationship between human interference and population degradation, uncovering the regulation of degradation, groping for the major reasons of population degradation, establishing theorical and practical foundation for the studying of restoration ecology and the protection for *Qiongzhuea tumidinoda* resource. It was showed: (1) Human interference is the major impetus for the degradation of the clonal population of *Qiongzhuea tumidinoda*; (2) The most direct evidence for the degradation is that the dwarf-growth trend for the individual mortality growth of the clonal population for *Qiongzhuea tumidinoda*; (3) With the enlargement of human activity scope, the degradation of the clonal population of *Qiongzhuea tumidinoda* formed the gradient-distribution pattern of population interference, centered by villages; (4) In the natural distribution area of *Qiongzhuea tumidinoda* in Northeast Yunnan, the phenomenon of degradation of the clonal population of *Qiongzhuea tumidinoda* exists universally.

Key words: Human Interference; *Qiongzhuea tumidinoda*; Clonal; Degradation of Population

Disturbance phenomenon is generally exists in natural world. Relatively speaking, disturbance is the event of discontinuity. It ruins the ecosystem, structures of colon or species groups, changes the resources, the effeteness of nutrition or transforms the physical environment [1]. In the case of the wide-spread degeneration of *Qiongzhuea tumidinoda* in Northeastern Yunnan, artificial disturbance is the important cause [2], the main form of which is logging and ravaging collecting of bamboo shoot [3]. Dun to the disparity of disturbance form, intensity, scale, frequency, the impact on the arborous layer and brushwood layer of mountainous humid ever-green broad-leaves is different. Up until now, the research about the degeneration of clonal population of *Qiongzhuea tumidinoda* has only scattering generically description report [4]. This study would start emphatically from the effect on the degeneration of clonal population of *Qiongzhuea tumidinoda* due to the transformation of forestry structure and excessive bamboo shoot collecting, aiming to research the relationship between human disturbance and clonal degeneration, revealing the regulation of degeneration, exploring the leading element causing clonal degeneration, settling the theocratic and practical fundamental for restoration ecology study of *Qiongzhuea tumidinod* clonal population and resource preservation of this special.

1. Study area situation and study ways

1.1 General introduction of aimed area

The study is oriented in MuGang town DaGuan county and SangJisngkou's forestry in Yunnan center *Qiongzhuea tumidinoda* resource, and still doing researching in TongLouBa ShuiFu county natural protection area, XiSha village ShangShu town XiongXiang and GuangDou Hill Weixing county. The aim of the study is to get a clear idea about the degeneration situation of *Qiongzhuea tumidinoda* clonal population.

1.2 Study ways

1.2.1 The survey of different disturbance effect to *Qiongzhuea tumidinoda* clonal population.

(1)Collecting materials

Collecting about ZhaoTong city's history of forestry changes and *Qiongzhuea tumidinoda* resources exploit material; then carrying on analyzing, concluding and summing up.

(2)Modele field research

Using spatiotemporal replacing way, comparing the series of spatiotemporal that made of in different degeneration stages, explaining *Qiongzhuea tumidinoda* clonal population degeneration's tendency and speech from July 1999, at MuGang towm DaGuang county, SangJiangkou forestry center, according the different destroy degrees of middle hill's humid evergreen broad-leaved forest, we choose presentate level to design 4 quadrat about 10×10m, according the up arborous layer's make of and forestry spacial's situation. In every quadrate to two design 2×2m quadrant, we do survey on *Qiongzhuea tuminoda*'s high, DBH, clear bole height, age, number and other brushwood's special and hasty plants live situation.

According to the human activity frequency degrees, we chose different degeneration stage *Qiongzhuea tumidinoda* clonal population to carry on sample plot survey. In every four 2×2 quadrat, we measured *Qiongzhuea tumidinoda*'s height, DBH, clear bole height、age、number and so on. To gain some information about clonal population's degeneration, in October, 2002, we did research at ShuiFu, ZhengXiong, WeiXin *Qiongzhuea tumidinoda* natural distribute areas.

1.2.2 Date analysis

Analyse the growth features of the *Qiongzhuea tumidinoda* clonal population under different kinds of jamming, quantitatively analyse and compare its degradation complexion.

2. Result and analysis

2.1 The relation between degeneration of the clonal population of *Qiongzhuea tumidinod*a and human disturbance

2.1.1 The development and change of forest along with history and the change of *Qiongzhuea tumidinoda* resources

Humid evergreen broad-leaved forest in subtropical mountain is the primitive plant in northeastern Yunnan. *Castanopsis platyacantha* and *Lithocarpus cleistocarpus* are key species of tall tree. As a result, the increase and decrease of *Qiongzhuea tumidinoda* resource is closely related to the conservation and development of subtropical humid evergreen broad-leaved forest. According to some historical recordings such as ZhenXiongZhouzhi, YongShanZhiLue, YanJinZhiLue, SiChuanTongZhi, DianNanJiLue, during the three dynasties of Yuan, Ming and Qing, in the northern part of today's ZhongTong, there ever existed two large areas of forest, most of which is *Qiongzhuea tumidinoda*. One is at the conjunction of Zhenxiong, YiLiang and WeiXin counties, and the other is at the meeting part of Daguan, Yongshan and Suijiang counties. The splendid view of the *Qiongzhuea tumidinoda* forest was unique without no end of the forest sea [2]. With the increase of human population and the development of economics, the humid evergreem broad-leaved forest eliminates very sharply, and the distribution area of *Qiongzhuea tumidinoda* reduces. According to a report about industry in DaGuan county which is written by Zhang Chao-lang in 1936's Yunnan Shiyegonbao, in city area and along streets, all one can see are mountains and hills. However, districts like Sijia in Daguan, Hedong,Hexi and Baishui have large area of natural forests with big and tall trees [5]. Here we understand how seriously the forest had been destroyed.

Up to early 1950s, the two *Qiongzhuea tumidinoda* forests had been centered at SanJiangKou. At the early 1960s, the Forestry Department in ZhaoTong had an investigation about bamboo resources. It showed in places like MuGan, GaoQiao, about 100 square kilometers of the area still belongs to bamboo forest district. During the year 1953 and 1983, because of irregular cutting of the humid evergreen broad-leaved forest and deforestation, *Qiongzhuea tumidinoda* resources have been destroyed severely, the area of *Qiongzhuea tumidinoda* had fallen down to 17200hm^2. In the past 10 years or more, the forest area has been increasing due to the programs such as the Yangtze River Afforestation program, the improvement of small rivers, stopping planting crops for planting forests and protection of natural forests. But the trees for Afforestation mostly are *Cunninghamia lanceolata*, *Cryptomeria fortunei, Pinus armandii, Sassafras tzumu, Rhus chinese ,Phellodendron chinese , Juglans regia, Castanea mallissima,* and other protective forest, economical trees and mixed forest of *Bambusa pervariabilis ×Dendrocalamus*、 *Bambusa distegia*、 *Dendrocalamus catiflours*、*Dendrocalamus farinosus and Phyllostachs pubescens.* The area of human-made forest of *Qiongzhuea tumidinoda* is less than 2000hm^2. During that period of time, the flowering of *Qiongzhuea tumidinoda* increased, resulting in 1700hm^2 of *Qiongzhuea*'s death. The total area of *Qiongzhuea* has been decreased compared with that of 1990s.

The forest-cutting in order to get quality wood such as *Castanopsis platyacantha* and *Lithocarpus cleistocarpus* are a long and complex historical process from nearer to farer, lower to higher mountain. The result of it is the change of the whole eco-system because of the reduce of key tree species of tall tree. This indirectly affects the growth of *Qiongzhuea tumidinoda* and results in the degeneration of clonal population and the reduce of distribution area and the decrease of total resources.

2.1.2 Mining bamboo shoots indiscriminately and the *Qiongzhuea tumidinoda* resources quality

Qiongzhuea tumidinoda distributing over areas is a key species in mountainous region humid broad-leaved forest shrub level. In 1949, natural *Qiongzhuea tumidinoda* forest beyond the north humidity line in ZhaoTong city flowered and fruited in large areas. The forest didn't recover to normal until 1960 through natural updating. Since then people around the place began to pick and cut bamboo shoots one after another. The whole city's forest acreage decreased from 12.8% in 1953 to 6.6% in 1983. As the forest acreage is decreasing continually. While the intensity of picking bamboo shoots is increasing, the output of dried bamboo shoots, taking *Qiongzhuea tumidinoda* as the main role, increases rapidly since 1963. In 1983 the output of bamboo shoots was four times higher than in 1963(reference to chat 4-1). In 1993 , the percentage of forest cover returned to 8.7%, and in 2003 the percentage to 17.46%. Under the condition that the overall resources of *Qiongzhuea tumidinoda* is keeping steady except a bittle decreasing, the output of *Qiongzhuea tumidinoda* fresh bamboo shoots converted into dried bamboo shoots reached to 1641,8t, which was 11 times higher than the output in 1963, and 1.6 times in 1993. To maximize the benefit of bamboo shoots is the main driver of picking and cutting bamboo shoots activities. Each year, when the bamboo shoots begin to come out in March or April, thousands of people go to *Qiongzhuea tumidinoda* natural distribution to do "carpet" search from dawn to night. They pick and cut the bamboo shoots whenever these plants are met with, thus affect the bamboo shoots' growth and development severely. The height and breadth of *Qiongzhuea tumidinoda* decreases obviously, and the resources quality declines.

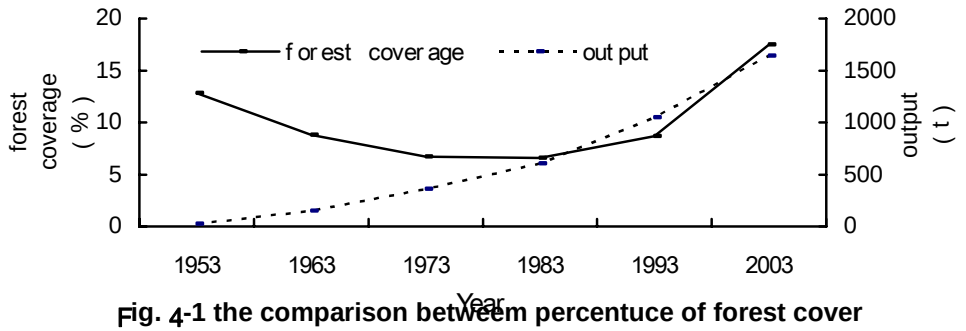

Fig. 4-1 the comparison betweem percentuce of forest cover and output change *Qiongzhuea tumidinoda* in 50 years

Mining bamboo shoots indiscriminately has a fatal effect on *Qiongzhuea tumidinoda* clonal population, for disordering and high intensity picking asexual plant disturb dynamic balance of population growth. The left bamboo shoots, coming out at the end of the growth are weak and can only be grown into thin and small. Their efficiency of photosynthesis and ability to absorb mineral substances are so low that they cannot keep normal development of the whole clonal population. If things continue this way, the *Qiongzhuea tumidinoda* clonal population will degenerate or even die out.

From the above analysis, forest picking and cutting result in the loss of *Qiongzhuea tumidinoda*'s ecological environment, thus make the *Qiongzhuea tumidinoda* clonal population degenerate indirectly. Mining bamboo shoots indiscriminately frequently the normal growth and development regulation of *Qiongzhuea tumidinoda* clonal population, so it has a direct effect on degeneration of *Qiongzhuea tumidinoda* clonal population. While human activity is the driven force of *Qiongzhuea tumidinoda* clonal population's degeneration.

2.2 The impact of human interference on the growing of the clonal population of *Qiongzhuea tumidinoda*

2.2.1 The impact of canopy densities on the growing of clonal population in upper high forest

For a long time, in order to obtain the precious wood species, such as *Castanopsis platgacantha*、*Lithocarpus omeiensis*，we have destructed the mountainous humid evergreen broad-leaved forest which deteriorates from near to far, low to high area. It reflects spatial distribution of the mountainous humid evergreen broad-leaved forest under human interference when we analyze the change of present upper tall tree canopy densities from the same area. According to table 4-1. Form lower elevation on to higher elevation, the canopy densities increase gradually. The constructive species of the humid evergreen broad-leaf forest on mountain become more various. The height sand the DBH of the ramets, which derive from the clonal population of *Qiongzhuea tumidinoda* in the forest increase. The ramet densities, however, deline dramatically. In the forest spatial whose canopy densities are 0.9, the average height of ramets is 1.5 times of that in the forest spatial whose canopy densities are 0.1, and the average DBH is 1.9 times of that in the latter, but ramet densities of the former are 14.75% of those of the latter. At the result, when the trees above the *Qiongzhuea tumidinoda* are destroyed, their apparently. Deriving more ramets to occupy more spaces of distribution is the strategy adopted by the clonal population of *Qiongzhuea tumidinoda* to adjust to the changed ecological environment and to sustain and develop its population. Meanwhile, the declining height and DBH of the ramets followin the declining canopy densities , reflect the tendency that the dividual ramet in *Qiongzhuea tumidinoda* clonal population grows ever smaller, which is the evidence of degeneration.

Tab. 4-1 the growing character of clonal population of *Qiongzhuea tumidinoda*

in different canopy densites

Types	Situs	Height Sand (m)	Superstratum arbor		Clonal Population of *Qiongzhuea tumidinoda*			
			Canopy Densities	Mostly Trees	Heigh (m)	Height (m)	DBH (cm)	Ramet Densities ($\times 10^4$plant·hm^{-2})
1	ZhongGeng	1750	0.9	*Castanopsis platyacantha*、*Lithocarpus cleistocarpus*、*Castanopsis platyacantha*	8-25	3.26	0.97	3.00
2	ZhongGeng	1640	0.8	*Castanopsis platyacantha*、*Lithocarpus cleistocarpus*、*Castanopsis platyacantha*	8-25	3.12	0.93	5.38
3	ZhongGeng	1550	0.7	*Davidiainvolucrata*、*Acer oliverianum*、*Prunus plurinervis*	6-18	2.91	0.86	6.37
4	ZhongGeng	1550	0.4	*Davidiainvolucrata*、*Osmanthus yunnanensis*、*Aralia chinensis*	6-15	2.50	0.61	10.50
5	BaiHuanWang YaKuo	1510	0.3	*Castanopsis platyacantha*、*Camellia grijsii*、*Aralia chinensis*	5-12	2.34	0.54	18.19
6	YiDaoHeBian	1500	0.1	*Aralia chinensis*、*Betula austro-sinensis*	5-10	2.18	0.51	20.34

2.2.2 The influence of various disturbance regimes on *Qiongzhuea tumidinoda* clonal population in the same area

Disturbance regimes are the sum of all the disturbance types, disturbance frequencies and disturbance intensities in a period of time. The properties of disturbance include its distribution、frequency、 period,、area、 intensity、severity(how severe is the influence on living things) and synergistic reaction(the influence that incurs other influence) ect. In matters of particular areas, the deterioration of eco-system is mainly determined by the four major properties of disturbance, namely, time, type, intensity and frequency.

Through researches to Qiongzhuea tumidinoda clonal population in the sample fields around DaLuoBa villiage, the following results (table 4-2) have been found. From the lower elevation ShiLi wan which is close to the village to the higher-height sand XiongZhaPing which is far from the village, the ramet densities of the *Qiongzhuea tumidinoda* clonal population reduce from 2.7×10^5 individual plant /hm^2 to 2.1×10^5individual plant/ hm^2 ramet height and DBH increase from 2.2m and 0.67cm respectively. The results have shown that the reactions of the clonal population towards man-made disturbance differ perceptibly both horizontally and vertically.

Table4-2 the situation of growing for clonal population of *Qiongzhuea tumidinoda* under different disturbance intensities and frequencies

Sites	Height Sand (m)	Distance (m)	Disturbance Regime				Clonal Population of *Qiongzhuea tumidinoda*		
			Type	Intensity	Frequency	Time	Ramet Densities ($\times10^4$plant·hm^{-2})	Height (m)	DBH (cm)
ShiLiwan (the food of slope)	1400	150	gather bamboo shoot、 browse	great	Height	Four seasons	27	2.20	0.67
XiongZhaPing (the middle of slope)	1490	1100	gather bamboo shoot 、 browse	middle	middle	Spring and summer	24	2.74	0.88
XiongZhaPing (the top of slope)	1560	1700	gather bamboo shoot	little	low	Spring	21	2.97	0.91

In order to save labor and shorten the transportation distance, the villages often carry out production activities in the *Qiongzhuea tumidinoda* forests around the village. These activities are far more complicated than those carried out on the far away mountains, in terms of disturbance

type、 intensity、frequency and time. In the lower elevation forest spatial which is close to the village, the disturbance type is a combined one of gathering bamboo shooting in the spring, collecting firewood all around the year and grazing livestocks in the spring、summer and autumn. The disturbance is intense. The disturbance frequency is high and the disturbance time span is long. As the elevation becomes higher and the distance to the village become farther, the disturbance type turns into gathering bamboo shooting only. The disturbance intensity is reduced. The frequency grows lower and the time span shorter. As a result, centered around radius of human activity increase.

2.2.3 The comparison of the growth of *Qiongzhuea tumidinoda* clonal population influenced by various disturbance regimes

The history of developing and utilizing *Qiongzhuea tumidinoda* is very long. At the border of Sichuan and Yunan province where YiBin city and ZhaoTong city lie, there is a saying that goes "The bamboo in YiBin and ZhaoTong can never be use up" [5]. In the eight counties north of the moisture lever in ZhaoTong city, the exploitation of *Qiongzhuea tumidinoda* bamboo shooting is common and has been practiced for long. Because the geographic locations, the levels of economic development and the ways that different ethnic groups make use of plants differ, the disturbance regimes are different. The analysis of the figures in table 4-3 shows that the *Qiongzhuea tumidinoda* clonal populations in the four researched sites have long been influence by the disturbance regimes of the particular areas and have shown obvious degeneration both in terms of height and DBH. Relatively speaking, DongJia Chayua is the experimental fields in ShuiFu county TongLuoBa reserve; we know that the degradation is very subtle. But in the densely populated ZhingXiong area, the average height and DBH of clonal population of *Qiongzhuea tumidinoda* is only 67% and 48% respectively compared to the dense water area. In prestige investigation area which has frequent activities, its degradation of *Qiongzhuea tumidinoda* is 1.84 times of the dense water area. But the average height and DBH is only 66% and 58% of the dense water area.

Table 4-3 the growing of area clonal population of *Qiongzhuea tumidinoda to* the reaction of different Disturbance Regime's affection

Sites	Height Sand(m)	Clonal Population of *Qiongzhuea tumidinoda*								Characteristic of forestry
		Ramet Densities ($\times10^4$plant·hm^{-2})	Ramet Densities in Different Age ($\times10^4$plant·hm^{-2})					Height (m)	DBH(cm)	
			1	2	3	4	5			
Dong's Tea Garden in TongLouBa Natural Reserve	1430	37	2	13	12	7	3	3.15	0.95	the abloom phenomenon in *Qiongzhuea tumidinoda*

GuanDuoShan in WieXin	1640	68	7	32	18	6	5	2.08	0.55	Canopy densities 0.1
YaoShan in ZhenXiong	1830	31	1	8	12	6	4	2.11	0.46	Canopy densities 0.3
SanJiangKou Forestry in DaGuan	1700	14	3	2	4	1	4	2.62	0.74	Canopy densities 0.3

3. Conclusion and discussion

3.1 The uncontrolled cutting mountains humid evergreen broad-leaved forest causes the lose of the *Qiongzhuea tumidinoda* ecological environment, which indirectly leads to the degradation of the clonal population of *Qiongzhuea tumidinod*a. The exploitation harvesting of bamboo shoot directly advances the speed of the degradation of clonal population of *Qiongzhuea tumidinod*a by frequently breaking down the normal clonal growing rule of *Qiongzhuea tumidinod*a. Human interference is the major impetus for the degradation of the clonal population of *Qiongzhuea tumidinoda.*

3.2 With the constantly decline of the high forest's canopy densities on the upper layer, the ramet height and DBH of *Qiongzhuea tumidinoda*'s individual mortality will decline too, which reflects that the dwarf-growth trend for the individual mortality growth of the clonal population of *Qiongzhuea tumidinoda* is the most direct evidence for the degradation of it.

3.3 With the distance between *Qiongzhuea tumidinoda* growing area and villages expending and its altitudes rising, the labor inputs of harvesting bamboo shoot and logs and other activities are also increased, which leads to the output of economical profit declining. From this view, the interference type will change from compound to single; the interference tension will change from big to small; the interference frequency will change from long to short; the individual mortality density of clonlal population will decline constantly and individual ramet height, DBH will constantly rising, as a result, the gradient-distribution pattern of human interference for the degradation of the clonal population of *Qiongzhuea tumidinoda* will be formed with the enlargement of human activity scope and the village as the activity center.

3.4 The comparison study to the existing of the clonal population of *Qiongzhuea tumidinoda* in some subjective areas proves that the degradation phenomenon obviously exists both in its height and wild growing process. In the natural distribution area of *Qiongzhuea tumidinoda* in Northeast Yunnan, the phenomenon of degradation of the clonal population of *Qiongzhuea tumidinod*a universal.

3.5 The reason that causes the degradation of the clonal population of *Qiongzhuea tumidinoda* is in much aspect. There are both historical reasons and reality problems, which involves policy, technology, traditional proactive and soon. It is only when the protection force to the left mountains humid evergreen broad-leaved forest is strengthened, the reform of the forestry right

system is quickened, the possession of *Qiongzhuea tumidinoda* problem under the collective is clarified by establishing local administrative lows and regulations, and the low output bamboo forestry transform is strengthened, manual inseminating scale is enlarged, the bamboo shoot is harvested regularly, then the recovery and sustainable developing of the clonal population of *Qiongzhuea tumidinoda* can become true.

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Environmental Benefits of Bamboo Forests and the Sustainable Development of Bamboo Industry in Western China

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ABSTRACT

Bamboo is a very important resource of forest, and its ecological environmental benefits are better remarkable than other tree and plant. Involved the ecological environmental benefits of bamboo, the forest resources conservation by "substituting bamboo for wood", the mountain region ecological environmental building, the engineering of "returning farmland to forests" and natural forest conservation, the sustainable development of bamboo industry, the documents about the bamboos diversity and its conservation are summarized in this paper.

Key Words: Bamboo Ecological Environmental Benefits, Substituting Bamboo for Wood, Returning Farmland to Forests, Pulp Industry, Sustainable Development

The bamboo resources in China are the most abundant throughout the world. Chinese began to cultivate and utilize bamboo in 6000 years ago. With the consciousness of environmental protection strengthening and facing a forests resource crisis aggravating an existing ecological crisis, the fine characteristic and development value of bamboo is being reconsidered. Now bamboo is playing an important role in the construction of environment and economy in mountainous regions. So developing China bamboo resources and exploiting the bamboo industry can promote environmental construction and economic sustainable development. Bamboo has so many characteristics and superiorities, compared with the other trees. Environmental problems, Poverty, as well as development of society can be solved gradually using bamboo in poor mountain-areas.

1 Bamboo has a remarkable beneficial impact in ecology and on the environment

Bamboo is playing an important role in the protection of ecological systems, reflected in two aspects. Broadly speaking, bamboo belongs to green plant. It can purify air and help regulate climate. Because of its growth habit it can also reduce water and soil erosion, conserve water resources while also protecting against wind and sand erosion and sand drift. In many ways, bamboo is superior to other trees and plants in the protection of ecological systems. (1) Compared with the other trees and plants, bamboo production cycle is shorter, and germination is quicker, ecological adaptation is better. It can renew forest vegetation rapidly, fix top-soil and reduce erosion of the water and soil. (2) Bamboo can maintain the water and soil effectively, due to its

huge rhizome-culm system. (3) Bamboo is a special plant, which can shoot and grow every year once be planted. Bamboo stand community structure is steady and can protect ecology sustainablely, even if it is harvested for several decades. (4) Bamboo can be used so extensively that it can even replace timber, in order to reduce timber consumption, control the over-exploitation to forest, and preserve forest vegetation and environment.

Bamboo has a flourishing root-system; the root is spiralling, forming net-shape. In the bamboo stand 1 ~ 10 cm top-soil of *Phyllostachys pubescens,* bamboo rhizome and root are abundance. Their volume is 51.26cm^3, weight is 24.62g, and length is 24.62m in every liter soil, representing 5.1% soil space. In turn, the root-system length of bamboo stand is 24.62km / hm^2 , living bamboo rhizome length of *Phyllostachys edulis* is 5~17×10^4 m / hm^2 , living bamboo rhizome length of *Phyllostachys bambusoides* is 9~25×10^4 m / hm^2 , living bamboo rhizome length of *Phyllostachys nigra* is 20~32×10^4 m / hm^2 . And this plays an important role in maintaining the water and soil. Sasa auricoma is undersized, but its bamboo rhizome and root-system is so flourishing that its anti-scouring index and anti-eroding index are 1.404 and 1.413 respectively. These are 40% and 34% separately higher than *Phyllostachys edulis* which has bigger diameter class. It shows that a *Phyllostachys edulis* can store 5kg water, the bamboo root can fix 4m^2 soils at least, and the saturation water storage capacity is 3750~4200 t / hm^2. At present, the land loss amount of Changjiang River upper area has reached 40 t / hm^2 every year. If a bamboo stand base about 3×10^4 hm^2 could be constructed, the soil loss amount could be reduced 9×10^5 t yearly, on the basis of 75% soil loss amount.

The precipitation is intercepted by bamboo crown and culms, for its huge canopy and dense branches and leaves. When rainfall passes staggered and overlapping crown, large area clums, raindrops change their descending directions and ways, thus lessen their descending speed. This process mitigate the splash erosion to soil by rainfall and the wash to soil by runoff, intercept the precipitation effectively, relax the rain-force, decrease erosion and scour to the forest-ground, also increasing effectiveness of permeation. Rainfall, (2mm intensity only), is absorbed mainly by bamboos root, leaves and culms. When bamboo density and leave-area index alter, effectiveness of interception is also change. For example, there are tow bamboo stands of *Phyllostachys pubescens*. One, bamboo density 2190 each hectare, average breast-diameter 8.123 cm, leave-area index 3.51, has a result, average interception capacity 0.95 mm, average interception rate 21.29%. The other, bamboo density 6720 each hectare, average breast-diameter 7.35 cm, leave-area index 10, gain a effect, average interception capacity 1.30 mm, average interception rate 31.3%.The latter is higher than the former, for 36.8% and 47% separately.

Bamboo stands are superior to a coniferous forest in preserving water resource. Bamboo rhizome distributing in upper soil, (depth ranging from 0 cm to 30 cm), constitute a total 70%~80%, very small amount of them reach 50 cm. Rhizome root distributing vertically in soil horizon, depth ranging from 10 cm to 40 cm constituting the majority, even can reach 60 cm. Bamboo root distributing in deep soil horizon, depth ranging from 20 cm to 40 cm, constitute total 70%, even

can reach 80 cm. In the space of upper soil, area about 1hm^2 , the distributing range of bamboo root ball, bamboo root, bamboo rhizome and rhizome root of *Phyllostachys pubescens* constitute more than space 70%, forming a pores network structure that the upper part is dense and the lower section is loose, fixing soil tightly. The network underground structure which is dense and pores has well the water permeability and the water retaining and soil fixing capacity. The fixing capacity of bamboo stand is 1.5 multiple than *Pinus massoniana*, the absorption precipitation capacity is 1.3 multiple than *Cunninghamia laceolate*, and the water resource containing capacity is higher than *Cunninghamia laceolate*, by 30% ~ 45%.

Bamboo stand is playing an important role in preventing pollution. The grove that the item plans to construct will improve environment greatly, especially in purifying air. The crop area about 1 mu can absorb CO_2 67 kg each day, SO_2 125 kg every moon, dust 60 t yearly. According to that, the bamboo stand area about 3×10^4 hm^2, will absorb 3.86×10^7 t waste-air every year.

Research indicates that, under the same circumstances, tree crown interception to rainfall of *Phyllostachys edulis* is 15.61%, which is higher than *Cunninghamia laceolate*, by 6.11%. Accumulation of stem runoff constitutes 9.16%, which is more than *Cunninghamia laceolate*, by 6.26%. Crop upland runoff capacity is 32.37m^3/a·hm^2, this is far superior to plantation. Generally speaking, the outside of bamboo leave is rough relatively. Dust absorption capacity of leaves is about 4.0 ~ 8.0g/m^2. When dust rising with wind has passed bamboo stand greenbelt, dust amount in the space could be reduced about half. Bamboo stand and bamboo grove are alike the other plants, they can weaken noise greatly, by free reflecting, absorbing and blocking sound wave. Test shows that, forest-belt which is about 40 m widely, can decrease noise 10-15 db.

There are many report researches on management methods and economic results of bamboo stand in and out of China, but few papers report the results and functions of bamboo stand ecological system and the hydrometric effect of bamboo stand. Furthermore, these studies mainly focus on *Phyllostachys pubescens* of China. Studies indicate that, pure stand of *Phyllostachys edulis* , density 3893 each hectare, average breast-diameter 9.1 cm, average height 14.6 m, its maximum water holding rate of forest crown surface is average about 22.10%, maximum water storage capacity is 0.84 mm. And the accumulation capacity of dead soil is 5.8 t / hm^2 , its maximum water holding rate is 231.54 %, maximum water storage capacity is 1.11 mm. The bamboo stand of *Dendrocalamus latiflorus* is a of forest types which have better ability to intercept precipitation, its precipitation interception capacity (upland runoff coefficient is 2.8 %) is better than *Cunninghamia laceolate* stand (upland runoff coefficient is 4.19 %), superior to *Eucalyptus* stand (upland runoff coefficient is 53.4 %) and bare land (upland runoff coefficient is 23.9 %). Average precipitation erosion rate (0.01037 t / km·mm) and average upland runoff erosion rate (0.37073 t / km^{-2}mm^{-1}) of bamboo stand of *Dendrocalamus latiflorus* are relatively lower, average precipitation erosion rate and average upland runoff erosion rate of mixed stand are 0.02114 t / km·mm and 0.62073 t / km·mm partly, average precipitation erosion rate and average upland runoff erosion rate of *Eucalyptus* stand are 0.93256 t / km^{-2}mm^{-1} and 1.7450 t / km·mm separately. This indicates that

bamboo stand of *Dendrocalamus latiflorus* not only has a better ecological benefit than mixed stand and *Eucalyptus* stand, but also has a clearer upland runoff than them.

Test by Luo Renxiang shows that, bamboo stand soil has a good ability to anti-scouring and anti-eroding. In the upper soil, depth ranging from 0 cm to 40 cm, soil anti-scouring index and soil anti-eroding index of *Phyllostachys edulis* are 0.998 and 1.051 separately, which are higher than *Robinia* (0.92 and 0.98), *Metasequia glyptostroboides* (0.93 and 0.52), 1 - 69 *Populus* (0.95 and 0.38).

2 "Using bamboo to replace timber" in order to protect forest resources

With practice on the timber emergency policy and the natural forest protection project of the nation, forest resources are further forced protect, lacking in timber supply certainly. Bamboo is bound to supplement (not replace) timber for the total timber supply will reduce about 2 hundred million m^3 / a in our country. At present, bamboo wood annual output converting into timber is 6.1×10^6 m^3, lacking 1.5 hundred million m^3 / a. Experts estimate in the coming ten year annual cutting volume reaches 1.8 hundred million m^3, and then the market will gain balance. So bamboo industry has deep-seated extension and potentiality, its market is broad and economic result is remarkable.

Bamboo is an important forest resource. And it comprises more than 70 genus and 1200 species all over the world, mainly distributing in the tropics and the subtropics. Bamboos can not only be planted for pure stand, but also be planted with the other trees to form mixed stand. Now, bamboo stand area is about 2.2×10^7 hm^2, bamboo timber annual output is 1.5×10^7 - 2.0×10^7 t in the world. It be estimated that bamboo stand area will reach 5×10^7 - 6×10^7 hm^2, bamboo timber annual output will reach 5×10^7 - 6×10^7 t in the end of 21 century. The bamboo resource of China is the most abundance throughout the world, more than 48 genus 500 species. Bamboo stand area is about 5.5026×10^6 hm^2, constitute 25% bamboo stand total area in the world. And the national bamboo stock is 1.51229×10^8 t, constitute 40% of the world. So bamboo is famous for the second forest. According to statistics, the harvesting rate of bamboo timber is about 9×10^6 t and the annual output value of bamboo industry is nearly 170 hundred million yuan.

The physical and mechanical properties of bamboo timber are superior to common wood. Its anti-tensile strength, anti-compression strength and anti-bending strength are 1~3 times of ordinary timber. Besides traditional utilization, many new materials made from bamboo have been used to replace wood materials, partly or totally, in the field of industrial production. Bamboo timber has longer fiber and bigger length-width rate, is a good paper-making material. So developing bamboo pulp industry is the most effective way of bamboo timber comprehensive utilization, for it utilizes fine properties and unique superiorities. The nation is lacking timber resources, especially for long fiber resources. The bamboo timber which is used for making paper is a very small part, even though our country abounds in bamboos. In order to solve the issue of lacking paper-making

material, the nation spends a lot of foreign exchange on importing paper, paper pulp and paper board every year. Consequently, using bamboo to replace timber, establishing new pulp bamboo grove base and developing bamboo pulp industry that possesses Chinese characteristic are top priorities.

In vast mountain-areas and countryside in western China, timber consumption for residence is a main reason that leads to destruction to forest resources. The author raises a plan which suggests using new buildings made of bamboo to replace old houses in 2001. Popularizing preserving environment type civil bamboo buildings in the minority nationality poor mountain-area of the south of Yunnan is particular entrance to bamboo industry, for this can promote big type sympodial bamboo resources industrial exploitation effectively. Furthermore, ecological problem (improving environment), economic problem (promoting the mass to get rid of poorness and become rich) and social problem (protecting national culture) could be addressed.

There are five goals to be realized:

(1) Promoting the exploitation of a modern bamboo industry thus quickening the pace about getting rid of poorness and becoming rich in the production area.

(2) Reducing the timber consumption to preserve forest resources, protecting environment to realize the sustainable development of society and economy in mountain-area.

(3) Carrying out secure living project, solving the living problem of the poor mountain-area, meeting the mass needs of material civilization and spiritual values.

(4) Preventing earthquakes and fighting natural calamities, reducing the loss of people lives and property in the area where the earthquakes happen frequently.

(5) Protecting the minority nationality cultural heritages to pour new vigour for tourist industry.

The fundamental transformation has taken place in our national forestry. Traditional productive forestry transforms into environmental forestry, modern forestry which put the timber production first transforms into contemporary forestry that pays attention to the exploitation of non-woody forest products and the utilization of non-consumption use value concerning forest resources. Today, seizing bamboo industry is equal to grasping the key link and the particular entrance of forest development.

Cultivating bamboo resources and developing bamboo industry can:

(1) Radiate and promote several related industries in the short term.

(2) Develop economy and help peasantry to get rid of poorness and become rich in the mountain-area.

(3) Give prominence to the environmental construction at the same time, basically changes forest passive aspect that only gazes at “big diameter class timber” over a long period of time.

(4) Combine the environmental construction and the industrial exploitation organically, and contribute to protecting forest resources and environment. And this is beneficial to quickening the pace about getting rid of poorness and becoming rich in the mountain-area, is also profitable to forming new economic increase point of “Green Economy” and realizing forest cutting across development, is as well as useful for preserving national culture and building new ecological tourist landscape.

3. The protection of ecological environment of west mountainous area in china

Compared with other woods, bamboo is much different. Mainly, bamboos propagate themselves by rhizomes. The bamboo class can grow up into grove in 3~5 years, and can sustain harvest for dozens of years, the vegetative cycle of bamboo is much shorter than other wood establishment period, 20-50 year. The grove can self-renewal year after year by springing new bamboo rhizomes, also it’s forest form and the function won’t be destroyed by the selection cutting way.

Fang Li Li (2000) pointed that, generally, the development of modern material civilization took the biodiversity reduction as a price, and the development of modern spiritual civilization took the cultural multiplicity reduction as a price. The invasion of the modern civilization brought a great impact on the west primary ecological culture. So, the thorny issues should be solved as soon as possible. In 1998, three river systems exploded rare and serious flood, until now, leaves a profound impression on people. Then, people clear even more that the flood is the result of the aggravation of ecology which caused by the destruction of forest vegetation on the upstream. Scientists said that the most effective way to prevent flood is forestation. Based on the fundamental realities of the country, our government decides to implement the “western china development” strategy which mainly arms to rebuild its ecological environment, to resume its beautiful scenery by constructing the infrastructural facilities, returning farmland to forest, and protesting the natural forest.

In china, mountainous area rich with bamboo resources, the sustainable development of modern bamboo industry lies in how to protect and use this multiplicity. The multiplicity includes three factors: the valuable and rare (heredity gene) bamboo species multiplicity, the bamboo community multiplicity, the ecosystem multiplicity and the resources utilization (bamboo culture) multiplicity. The bamboo multiplicity as an important component of the ecosphere is indispensable to bamboo area dweller’s life. It is impossible to implement protection of bamboo multiplicity and sustainable development of bamboo industry besides to deal well with the relationship between bamboo multiplicity and people’s demands. Mostly, people use the bamboo resources directly, regardless

its ecological utilization just like climate adjustment, soil and water conservation, maintain soil fertility and avoiding plant disease. It is a long-term and a tough work to protect the bamboo multiplicity; we should adopt the scientific management to get the direct and indirect benefits of the resources, and to protect its potential benefits to meet offspring's needs.

Therefore, it must to pay an equal attention to the ecological environment, economic efficiency and the ecology benefit for the protection of bamboo multiplicity and for the sustainable development of bamboo industry. As we can see bamboo industry will become pillar of the south economy in 21st century. In china, more than 80% bamboos cover the headstream and banks of the main river systems; play an important role in the water and soil conservation. It is necessary to intensify national consciousness of ecological protection. In order to make full use of the bamboo multi-purpose functions, it should integrate economic benefits with ecological benefits, and adopt the classification management on bamboo grove; it is not advisable to take the environment at price to get instant interests.

It is worth to notice that around the house, road and in valley bamboo grow as well as in farmland. While the bamboo grove used as shelterbelt, scenic forest and cash crops, it is keeping the ecological balance and getting economic benefits. It is necessary to build on the existing awareness and product a deeper understanding of the role bamboo grove play in the ecological development of the west mountainous area.

4. “Returning farmland to forest” and “natural forest conservation”

Natural forest mainly covers the west region, like Yunnan natural bamboo area, mostly belongs to drainage basin of the Lanchan River, Nujiang, and Yangtze River where there is serious ecological crisis. Once, people didn’t realize the bamboo’s effect to protect the ecological environment, the number of bamboo grove had been destroyed. People planted banana, pineapple, rubber and low output crops in the land which used to be the bamboo grove. As a result, while water and soil lost, more over, ecology losing its ability to redevelop.

In china, number of peasant population with limited farmland, there is great potential development in mountainous area. However, the economy of mountainous area develops so slowly because of all kinds of difficulty. In south region, the poor mostly live in the mountainous area; the primary task of Aid-the-poor-Program is how to help people shake off poverty. The government forbids cultivating on mountain, and claims that 25% or more sloping land should return farmland to forest. If only more people understood how economic prospects and ecology stability of the mountainous area are tied into the care and protection of the bamboo resources, decision-makers and consumers might take different priorities when it comes to bamboo industry. It has succeeded greatly in south region, “Depends on bamboo to escape from poverty”, and “rich by bamboo” opens a new way and brings a bright future to people in the mountainous area. Therefore, bamboo

is the best choice to speed up the development of mountainous area since it short vegetative cycle, high rate germination, versatility, economic value and so on.

Now, “returning farmland to forest” project has been implemented comprehensively. Since 1999, October, Sichuan province has obtained the remarkable achievement in the improvement of the ecological environment and increase peasant's income; and returned farmland 193,000 hectares; they plan to return farmland 996,100 hectares from 2001 to 2010. But it is still a question whether this project work or not in a short time, and what the farmland return for? Bamboo is a key link and breakthrough point. The total output value of natural bamboo grove or extensive management bamboo is only hundred Yuan or less each acre annual, but the intensive management bamboo grove’s amount to several thousand Yuan, even up to ten thousand Yuan.

5 The sustainable development of bamboo industry

In 20th century, with the rapid industry developing, world’s forest encountering unprecedented destruction, In the past 50 years, he percentage of forest dropped from 25% to 17%, there are 1.246 billion hm^2 woods disappeared, it means that there are 2 249 hm^2 woods disappeared every year. Ultimately, we all depend on the forest, yet if we do nothing, the world’s forest will be gone in just one hundred year on this speed, and then all the organisms, including humans will evolve in this crises. So, it’s high time to play a policy of sustainable development of forest recourses.

What, in fact, is sustainable development of bamboo industry? It takes scientific technology to use and conserve the bamboo resources, to meet both present humanity and descendant needs. According to the practice in the Hunan province, Taojiang, Yang Chufan (2000) regards that the sustainable development policy of bamboo industry has three principal aims: to raise the total output by scientific cultivation; to increase farmer’s income by diversified business methods and comprehensive utilization; and to keep nice survival environment by reasonable use and protect the bamboo resources.

Development is essential, but it will only succeed if it maintains the productivity, resilience and variety of the biosphere. On the other hand, conservation will provide lasting benefits only when it integrated with the right kind of development, which is sustainable development. Don’t kill the goose that lays the golden egg.

Hui Chaomao (2001) proposed to establish a safeguard system and dynamic monitor system of bamboo resources and environment. In a sense, the production process of bamboo could effect on the ecology, in addition, bamboo grove itself is the guardian of ecology. Therefore, with the two systems, the economical growth and even the environmental protection are not only possible but also inevitable. The systems work when it is integrated with the development plan, national consciousness of environmental protection and legally. Combining the development of bamboo industry with the protection of nature, with the government for ecology of river basin and the

improvement of local economy; combining the cultivation and production of bamboo with the poverty alleviation program, development of scenic–tourist, transformation of microenvironment and the adjustment of industrial structure.

6. Future

Nowadays, the bamboo products are too simple, the bamboo use factor below 30%, even only about 10%. It is high time to develop bamboo products with high value by effective technology, it is the key to the comprehensive development of bamboo industry, also is essential to cultivation and the positive cycle of resources. According to the theory and practice, to develop the bamboo pulp industry is the most effective way to raise the utilization of bamboo; it may lead a comprehensive development of bamboo industry and display ecological function of bamboo very well.

Bamboo is both decorative and useful. In many parts of the world it is food, fodder, the primary construction material and is used for making great variety of useful objects from kitchen tools, to paper to dinnerware. Therefore, to develop bamboo industry is the best choice to achieve the “West Development” and the “returning farmland to forest”. The bamboo industry development is not only the “ecology construction project” but also the “poverty alleviation program”; it is not only the “green economical project” but also the “national culture project”; it is not only the “modern forestry project” but also the “development project of mountainous area”.

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Magic Bamboo Charcoal Products in Protecting Human being's Health

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ABSTRACT

Production process, properties and microstructure of bamboo charcoal are briefly introduced. The shape of microstructure of bamboo charcoal likes a spreading carbon nanometer tube figure, which results from a lot of special functions that wood charcoal has not. The relations between specific surface area, resistance, and adsorption of bamboo charcoal and terminal carbonization temperature are described. Methanal, benzene, methylbenzene, ammonia, and chloroform adsorption ratio of bamboo charcoal are tested and shown in tables and figures .Used in cleaning water, bamboo charcoal is able to improve COD, i.e. Chemical oxygen demand, chroma, and turbidity and remove total nitrogen and residual chlorine in polluted water efficiently. In order to eliminate the phenomenon of adsorption saturation of bamboo charcoal during use process, a nanometer photo catalyst was loaded into the pores of bamboo charcoal to form a modified bamboo charcoal with the properties of photo catalyst, sorbent, and sterilizer. By this way, two natures of two materials are perfectly combined. Finally, the treatment of living sewage in town and an example are introduced, showing development potential in future.

Key words: Bamboo Charcoal, Production Process, Properties, Microstructure

Sustainable Livelihoods for Reducing Poverty

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ABSTRACT

Bamboo, which abounds in many areas in the world, is still a very much neglected resource. Farmers, who are usually dependent on one crop like rice, live below the poverty line, are not aware of the benefits they can get from bamboo. Bamboo is a versatile material and all its parts can be used for over 1,500 recorded uses and is, therefore, a good vehicle for attaining Millenneum Development Goal No. 1, Eradicate Poverty and Extreme Hunger.

Many existing bamboo stands have become less productive after years of neglect. Rehabilitation of these bamboo stands by cleaning, thinning and fertilization will improve their productivity and give immediate economic benefits to the farmers.

Bamboo shoots have been widely known as good source of food because of their tastes and nutritional and medicinal values. Farmers and their families can harvest and process bamboo shoots for their own consumption and for income generation. There is a big demand for bamboo shoots both in local and export markets especially Japan.

Bamboo has gained acceptance as a good material for construction and bamboo buildings survive even strong earthquakes. The Philippines exports bamboo cottages and gazebos which are used in beach resorts, gardens and as exhibit stands in trade shows. There is a growing demand for bamboo furniture and handicraft including baskets.

All the bamboo wastes can be made into charcoal. Village level charcoal making can be established with simple equipment. The charcoal will be used mainly for fuel. This will help conserve fast depleting forest resources because villagers no longer have to cut scant wood resources for fuel.

Key words: Rehabilitation, Bamboo Shoots, Bamboo Furniture and Handicraft, Fuel

Bamboo Eco Housing:
Approach for Sustainable Livelihoods of Mukta Kamainyas

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ABSTRACT

Bamboo Eco-housing Project aimed to facilitate better accommodation condition of recently freed bonded labor – *Kamainya*, by introducing the low cost bamboo housing technology. Government of Nepal announced to abolish the bonded labor existing in some part (western terai) of the country for decades named *Kamainya* system on 17 July 2000. *Kamainya* enjoyed that day with mirth and merriment but question of livelihood, in absence of "food, shelter and cloth" is still alarming to them. The project implemented as a package program for the livelihood enhancement of *Kamainyas* by promoting the versatile use of bamboo and developing bamboo based enterprises. The project implemented in Bani Mukta *Kamainyas* Camp of Krishnapur Village Development Committee. Global Environment Facility/Small Grants Program of UNDP and International Network for Bamboo and Rattan were the partners. The goal of the project was develop a bamboo based livelihood option for the poor *Kamainyas*. Design and research, Promotion of bamboo cultivation and conservation, Construction of bamboo houses, Nursery establishment and seedling production, bamboo plantation, construction of toilets, biogas installation, Improved Cooking Stoves installation, agroforestry model, Capacity building, Institutional development and Dissemination of research outputs and experience sharing were the major activities. Skill and knowledge of the local people were enhanced through different trainings. Local CBOs and NGOs were supported to implement activities to enhance their institutional capacity. Local level and national level workshop were conducted and Bamboo Update a quarterly news letter has been published for wider dissemination. The major positive aspects of the Bamboo Eco-Housing Project were extension of Bamboo resource and its diverse use in western Nepal. The project was successful to create opportunities to the local communities. Construction of bamboo houses not only decrease the pressure on timber consumption but also promote the bamboo cultivation in rural areas which ultimately benefits the local farmers. The bamboo planted in the community forest will be used to construct bamboo houses in future and the Bamboo trust fund will be utilized as a local bank for the community development.

Key words: Livelihood, *Kamainyas*, Eco-housing, Resources, Mitigation

Introduction

Bamboo is an important source of income and sustaining livelihoods especially for the socially and economically challenged community. Bamboo reaches structural maturity within three years and generates a crop every year. Mature culms are used in Nepal in more than 300 ways. Bamboo is a good substitute of wood. It is also a good raw material for paper factory and building truck bodies. Fresh as well as fermented bamboo shoot is used for soup, curry and pickle. Bamboo based small enterprise provides employment and income for rural people so it can be an effective means to improve the livelihoods of rural poor people.

Bamboo is one of the Earth's oldest and most precious construction materials. In Asia, traditional houses of the low-income group use bamboo for supporting the structure. Due to the global shortage of housing materials the importance of bamboo as a construction material has received a greater attention in recent years. Low cost bamboo houses are a cheap and safe alternative to the shelters. Fast rotation period and excellent strength properties make bamboo a sensible alternative construction material. Bamboo houses are not only economical but these form earthquake proof structures and disaster relief solutions. The mechanical properties of bamboo have been justified for the construction of bamboo houses. This paper highlights the major activities and the results obtained by RES-Nepal in course of implementing the Bamboo Eco Housing Project, 2004-2005.

Project Area

The project implemented in the Bani *Mukta Kamainya* Camp of Krishnapur VDC, Kanchanpur district of Western Nepal. The region is lies in the tropical zone. The Camp is 30 km towards east from the Mahendranagar, the district headquarter of Kanchanpur district. The total house holds of Kamainya is 548. Government of Nepal has classified *Kamainyas* in two groups namely "Ka Barga" (class A) and "Kha Barga" (class B). 486 household are categorized as "A class" and 62 household are categorized as "B Class". Government of Nepal has distributed 5 Katha (0.16 hectare) to the each household of the class A group and 4 Katha (0.13 ha) to the class B group. Out of 548 household of *Kamainyas*, 468 families (85.4%) are literate whereas 80 families are illiterate.

Approach

The project adopted a participatory mode of implementation. A project implementation unit (PIU) established which worked as a core unit. Related line agencies and stakeholders were involved directly or indirectly at different level. Regular coordination with funding agencies, sharing about process and outcomes and incorporation of their valuable inputs provided a better guidance at central level. At district level, coordination established with District Forest Office, District Land Reform Office, District Development Committee, District Agriculture Office and District Education Offices. At the field level, Community Based Organizations, local Non Government Organizations, Forest User Groups and target beneficiaries were the implementing partners.

Genesis Of Kamainya System

The synthesis of *Kamainya* system indicates that *Tharu* people migrated to different parts of Western Terai from Dang district of Rapti Zone. After the Malaria eradication efforts in Nepal, people from hills started to migrate down in search of fertile and plain lands and occupy them. As *Tharu* were already there as an untouchable People, hill migrants established good relation with them.

Tharus were culturally fond of drinking and merrymaking therefore concept of private property had not been deep rooted in them. Also at that time, when there was no competition for land due to the large tracks of unsettled lands, the need for ownership was not of much concern to them. In-migrants, often were of high class Brahmin and Chettri and were thought to be clever due to education and learning. They lent money to Tharus, mortgaged their land and eventually confiscated in time. This process continued for some generation and ultimately those losers had to migrate, somewhere else to find a living as agricultural laborers.

Decision of Nepal Government concerning freeing the *Kamainyas*

Government of Nepal abolished the bonded labor existing in some part of Country for decades in the name of *Kamainya* system effective from 17 July 2000. *Kamainya* enjoyed that day with mirth and merriment but question of livelihood, in absence of "food, shelter and cloth" is still alarming to them. Landless settler's problem resolution commission has identified total no. of *Kamainya*s as around 7,000 out of which 58% are found to be living under the open-sky.

Many INGOs including ILO, Action AID, and dozen of the NGOs are working in this humanitarian issue. As a usual fashion, their concentration is on education and awareness activities targeted basically to children of *Kamainya*s. Such activities however cannot make any quick effect unless problems of place and cloth mitigates. Even to support the education of *Kamainya* children, a means to answer the question of healthy living and some form of income generation that could be self reliant - was of immediate need – which was the focus of the Bamboo Eco Housing Project

Table 1 Demography of *Kamainya* in Kanchanpur district

Description	**District**	***Kamainya***
Population	375465	2300
Literacy	52.06	4.4
Human development index	0.3	.
Per household land holding *(ha)*	0.72	0.18

Source: Ministry of Population and environment Government of Nepal, 2003

Major Achievements

Construction of Bamboo Eco houses

A new model of bamboo house was introduced in project site to enhance the use of bamboo in construction. INBAR provided an in-house training regarding pre-fabricated bamboo house construction at the premise of Himalayan Bamboo Pvt. Ltd, a sub-contractor of RES Nepal. The house consists of 9 panels. Each panel is made with flattened bamboo in wooden frame. Flattened bamboos are woven to the both sides of wooden frame in such way that the inner parts of the bamboo are exposed towards the exterior of the wall. The prefabricated panels are then assembled in the light concrete foundation made with stone and concrete with about 40-cm depth.

Figure 1 Bamboo house constructed for the *Mukta Kamainya*

After the assembly of the panels in the foundations, all the walls are plastered with cement mortar. The roof consists of Zinc tins that were secured with bamboo trusses. All the bamboos and woods were treated with vacuum pressure method using Chromated Copper Arsenate for wood and 3% Boron solution for bamboo poles and flattened bamboo. Per square feet construction cost is NRs 300 (US $ 4). The total area of a house is about 300 sq. ft. The houses are taken as earthquake proof, low cost and its duration is more than 30 years. Low cost bamboos toilet were also constructed. To reduce the pressure on the natural forests some alternative energy activities e. g. installation of biogas plants and Improved Cooking Stoves were also carried in the project area.

I Extension of Bamboo Resources

Participatory Learning and Action Women's group established a community Nursery to produce bamboo seedling. All together 30 hectares bamboo plantation was carried out in community forest, public and private land and also along the riverside. A demonstration plot of bamboo, covering one hectare area, was also established in the community forest. The objective of establishment of the demonstration plot was to monitor the growth performance of different species of bamboo in that locality.

Table 2 Growth Performance of Bamboo in Demonstration Plot

Plot	Name of the Bamboo species	Method of Propagation	Initial ht (m)	After 1 Year (m)	After 1.5 Year (m)	New shoots
1	*Dedrocalsmus hamiltonii*	seed	0.61	2.0	6.5	21
2	*Bambusa balcooa*	seed	0.57	1.9	6 m	18
3	*Dendrocalmus giganteus*	single node cutting	0.80	3.4	7.5 m	12
4	*Bambusa nutans*	seed	0.46	2.1	7 m	25

Source: Field Report BEHP, 2005

Human Resource Development

Trainings and support program were organized to develop the capacity of local people. All together nine training, both knowledge and skill based, were conducted and 205 local people were benefited directly.

Table 3 Training and Beneficiaries

SN	Name of the Training	Beneficiaries		
		Male	Female	Total
1	Nursery Management and Bamboo Propagation	12	14	26
2	Improved Cooking stove	1	25	26
3	Saving and Credit Management	22	4	26

4	Bamboo Trust Fund Mobilization and Management	12	6	17
5	Bamboo Craftsmanship	25	0	25
6	Agroforestry Management	21	4	25
7	Bamboo and Rattan furniture making	25	0	25
8	Bamboo Eco housing Construction	10	0	10
9	Bamboo craftsmanship refreshment	25	0	25
Total		**152**	**53**	**205**

Institutional strengthening program

Twenty two saving and credit groups formed during the project period have been running quite smoothly. Eco Club formation, arboretum establishment, celebration of environment day was organized under support program whereas plantation and environmental *Dauda* (culture dance) competition, women's cultural program for conservation were organized under Non Government ns support program. A resource outlet established for selling the bamboo handicrafts and furniture. Different agroforestry models were implemented in the project site.

Bamboo Trust Fund

Fifty five nec d from the Bamboo Trust Fund. The trust fund management committee is responsible for the trust mobilization. 33% of the members are women, including the treasurer. The Bamboo Trust Fund had registered in Krishnapur Village Development Committee. The ceiling of the loan for a person has been fixed as Nepalese Rupees 5,000, whereas it is 15,000 for a saving and credit group. The member are getting loan in eight percent interest. The payment system is trim griculture followed by twenty two percent in establishing a small scale enterprise.

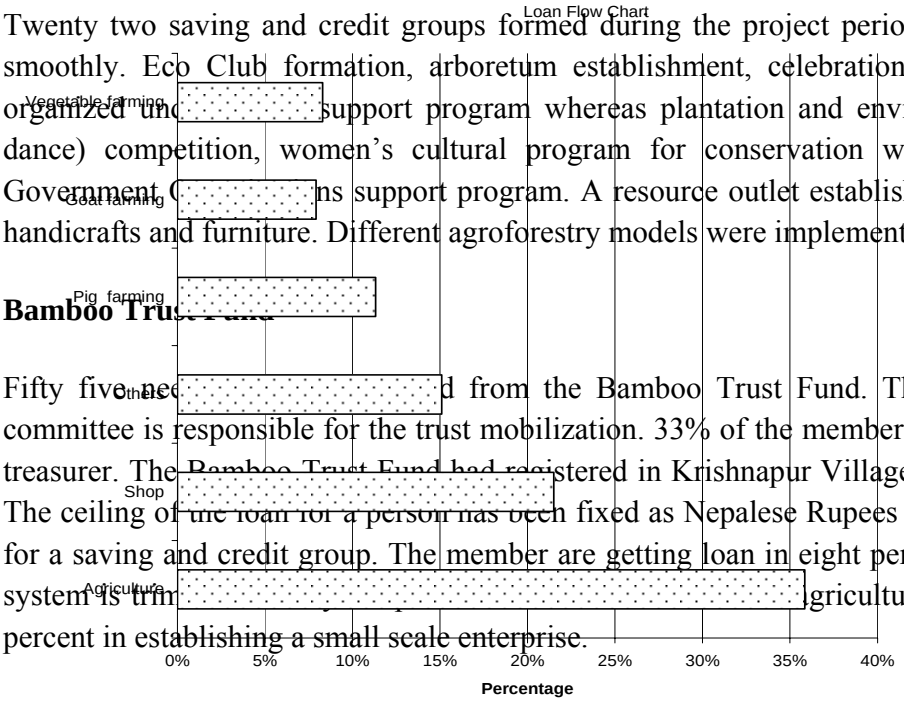

Figure 2 Distribution of loan in different sectors

Communication and outreach Program

The project activities were published regularly in Bamboo Update, a quarterly News Letter. The news letter was disseminated through both printed and electronic copy to various GOs and I/NGOs. District level and National level seminar were organized and the bamboo handicrafts and furniture

also exhibited through a four days exhibition in Kathmandu. All the reports and the learning of the BEHP also aired through www.res.org.np

Figure 3 Exhibition of bamboo products

Conclusion

The positive aspect of the Bamboo Eco-Housing Project is extension of Bamboo resource and its versatile use in western Nepal. The project activities have created opportunities at the local level. It is assumed that the project could be replicated to other area of the country especially in the community having socially deprived groups. Construction of bamboo houses not only decrease the pressure on timber consumption but also increase the demand of bamboo in rural areas which provide support to the rural livelihood and conservation of biodiversity. It is also planned that the bamboo planted in the community forest will be used by the communities to construct bamboo houses and make bamboo handicrafts and furniture. The Bamboo trust fund has served as a local bank for the community.

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Gender, Bamboo Sector Development and Rural Livelihoods in Southwest Yunnan of China

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ABSTRACT

This paper is the outcome of a gender assessment study (GAS) on bamboo-based rural industries in Southwest Yunnan of China carried out from March to July 2003. The study findings highlight the following key gender issues in the bamboo sector and rural livelihoods:

1) Women play a crucial role in the means of ensuring livelihood security for families and communities.

2) Women predominate as unpaid family workers and expect to carry multiple household chores, which limits women's full participation in bamboo-based productive activities and reduces their opportunities for contributing to economic development.

3) Women and men have different access to bamboo resources, especially the land under bamboo forests. A woman's access to land and other natural resources is partially determined by her marital status. Women lose their land use rights after they got married and left the parents' homes. Men have more access to a wide range of resources relating to productive activities.

4) Cultural values tend to disadvantage women in terms of their participation in politics and decision-making processes. Men are normally the head of households and make final decisions related to the family.

5) Women have limitations in mobility and traditional customs do not encourage them to leave home to work for meeting and training far away from the village.

6) There are gender obstacles in both the villages and in the government departments as there is low awareness and limited understanding of gender concepts and process for gender mainstreaming among its staff.

Key words: Gender, Rural Bamboo Industry, Rural Livelihoods, Division of Labor, Decision Making

Diversification of Household Livelihood Strategies for Tobacco Small-holder Farmers:

A Case Study of Introducing Bamboo in the South Nyanza Region, Kenya

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ABSTRACT

Most of the tobacco production in Kenya is taking place in the Southern Nyanza Region, western Kenya. The land under tobacco has continued to grow rapidly at the expense of traditional food crops and livestock activities, with high demands on wood-fuel, serious health issues, and demanding in terms of the farmer's time. All these tobacco issues have led to increased poverty levels in the region. This kind of scenario calls for research that can solve a multiple of problems, i.e. economic and political problems, socio-cultural and gender issues, food insecurity concerns, occupational and environmental health hazards, and environmental concerns. This paper outlines the vision of the on-going 3-year research project on how tobacco production can be controlled through the diversification of household livelihood strategies among tobacco small-holder farmers. The study in particular is investigating on the existing potential of introducing Bamboo as an alternative and viable crop in the region. The other major task being undertaken is the analysis and ranking of the local household livelihood strategies used by tobacco and non-tobacco farmers in the study area. The study will also involve a detailed assessment of marketing dynamics on bamboo products as a feedback to investment in the tobacco industry. The research methodology being adopted involves the review of relevant literatures, field experimentations/demonstrations, local community household surveys and Participatory Rural Appraisal (PRAs) with stakeholder identification and analysis, and focused group discussions for meeting the data requirements of the research project. The vision of the project is to turn-around the dependence of local livelihoods on tobacco to bamboo cultivation in the long term through implementation of an action plan to be developed.

Key words: Tobacco, Poverty, Bamboo, Sustainable Livelihood, Action Plan

1.0 Background to the Study

Most of the tobacco production in Kenya is taking place in the Southern Nyanza region mainly in Suba, Kuria, Homa Bay and Migori Districts (GOK, 2002a; 2002b; 2002c; 2002d; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d). Despite the global policies aimed at reducing world

tobacco productions and use, the Kenya Government's policies aimed at poverty reduction, are encouraging more tobacco production and crop diversification in this region (GOK, 2002a; 2002b; 2002c; 2002d; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d). This is evidenced by the current plans of the British American Tobacco Company (BAT) expanding its activities to other districts in the Nyanza Region, i.e. in Bondo and Siaya in the Central Nyanza region (GOK, 2001). It is also estimated that the number of farmers contracted by tobacco companies in Kenya increased by 67% in the period 1972 to 1991, and by 36% from 1991 to 2000. Alongside, the land under tobacco grew rapidly at the expense of food crops because more farmers are shifting to tobacco production (GOK, 2001; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d).

A 2-day workshop recently (27^{th} –28^{th} October, 2005) held in Migori town in Kenya funded by IDRC on the Diversification of Household Livelihood Strategies for Tobacco Small-holder Farmers in South Nyanza Region, Kenya indicated that the tobacco sector in this region is facing a multiple of economic and political problems, socio-cultural and gender issues, food insecurity concerns, occupational and environmental health hazards, and environmental concerns (Kibwage et al., 2005).

Some of the key economic and political problems associated with tobacco production in the region are outlined here: -

- Most farmers are attracted and trapped into tobacco production due to the belief that the crop has more and quick cash returns than other crops. Farmers are initially induced and trapped by tobacco companies to grow the crop by being given inputs for free initially and later on credit.
- The tobacco farming occupation requires and demands a lot of labour and it is a very tedious activity compared to its returns/ profits. The farmers indicated that the cost of producing tobacco is very high and when loans are deducted from total sales, they are left with very little earnings as compared to the high labour and time inputs. Furthermore, they have no control on prices of inputs and output.
- Tobacco farmers also face serious harassment, cheating, and exploitation during the leaf weighing process and recovery of input loans. Furthermore, tobacco companies have monopolized certain areas leaving farmers with no options of selecting a company of their choice. This has further enhanced exploitation of the farmers' ignorance, which is openly practiced by recruitment of new tobacco farmers mainly targeting the illiterate and the poor in their society.
- The local tobacco cultivation activities are not insured against natural calamities like hailstones, disease and fire outbreaks, etc. Bamboo farming has less risk associated with natural calamities like hailstones, diseases and fire outbreaks.

- Tobacco Companies indirectly use local political leaders to promote the crop in their constituencies, which has been a big blow to production of other crops like maize, sorghum, millet, etc. in the region.
- Finally, it became evident during this workshop that the Kenyan Government has no clear policy on tobacco production control. While the Ministry of Agriculture is promoting the growing of the crop, the Ministry of Health is seriously campaigning against the crop and smoking in particular.

The key socio-cultural and gender issues in this region include:-

- High child labour among the tobacco growing families especially during the harvesting and curing period to avoid crop damage and losses from climatic changes when it has matured. Bamboo harvesting will be a continuous activity and there will be no "period of panic" due to climatic changes.

- Exploitation of children and women by men and tobacco growing companies.
- The youths who have been trapped into tobacco farming have no time for social and community development activities.
- Increased HIV/AIDS cases in the region due to high levels of poverty.
- Increased cases of suicide among tobacco farmers especially associated with frustrations due to high debts, damages caused by hailstones, pests and diseases.
- Farmers' frustrations by companies is also the major factor responsible for the high reported cases of societal vices like mugging, robberies with violence, theft and cattle rustling in the region Farmers' frustrations by companies arise from high debts from farm input loans, and crop damage caused by hailstones, pests and diseases. The tobacco companies don't take any responsibility in such cases. Some of the affected farmers resort to these social vices for economic survival.

  Tobacco has also led to food insecurity concerns in the region in several ways: -

- The region is facing food shortages because of tobacco production since farmers spend most of their time in tobacco farming at the expense of food crops, which they eventually buy from surrounding districts at very high prices. Kuria district, for example, which used to produce and supply maize to most parts of Kenya, is currently categorized by the Kenyan Government as one of the areas that require and receive relief food aid every year.
- The land under tobacco is on the rise, at the expense of food crops.
- Tobacco is known to extract several mineral nutrients from the soil leaving it almost barren. Other crops like maize, cassava, millet, passion fruits, Soya beans, sunflower, tomatoes, cotton

and sweet potatoes no longer perform well in the region, a scenario which farmers suspect tobacco cultivation, its associated diseases and its nutrient demands to be the root causes. Introduction of bamboo as a crop is normally associated with a lot of manure/ compost from the decomposing leaves. This will act as a long term strategy to rehabilitate the soil needs.

- Livestock activities have also drastically gone down. The major constraint to agricultural activities/ diversification in the region is generally the lack of market for the local produce.

Since the introduction of Tobacco in the region, health status of the local people in the region has also drastically deteriorated. For instance, the Workshop participants alleged that 60% of the medical cases in Kuria district are tobacco production and processing related. There is generally lack of protective devices required during the production and preliminary processing of tobacco leaves. These include, gum boots, nose masks, overall coats, gloves, etc. During the harvesting and curing period, there is also serious shortage of storage facilities. Most farmers use their own houses to store the leaves, an act which is very hazardous to their health. Children and women are more vulnerable than men to tobacco-related health risks since they spend most of their time in the occupation.

Finally, tobacco farming in the region has raised several environmental concerns. The type of tobacco grown in the proposed study area is fire-cured. The curing process demands a lot of wood-fuel. Consequently, a lot of indigenous trees are felled for use causing deforestation. Soil erosion is rampant in these areas. In most instances, the eucalyptus tree seedlings are provided by tobacco companies to farmers for public relations. Scientific research has shown that this type of trees put a lot of demand on water and nutrients resulting to loss of soil fertility and low water table. Farmers at the moment are forced to buy firewood for cooking. This has even led to further reduction in food crop production, hence, increased poverty levels in the area. Rainfall patterns and amounts are no longer predictable by farmers in the region due to extreme deforestation to obtain firewood for curing. The availability of firewood for tobacco curing and domestic use is currently critical. The distance covered and time in firewood collection by women and children has been increasing from season to season and year after year.

The growing of tobacco along riverbanks and general use of fertilizers and pesticides has also caused the death of some valuable fish species in the local streams and rivers. The fish and aquatic life that used to be common in rivers and other water bodies have disappeared since the introduction of tobacco in the region. This is supported by recent studies in the region, e.g. Kibwage, et al, (2003). Some farmers attributed the emergence of the Striga weed in the region to tobacco farming. Environmental pollution due to poor disposal of wastes (expired fertilizers, chemicals, uncollected tobacco) by the tobacco companies was also reported to be high.

This kind of scenario calls for research that can solve a multiple of problems facing tobacco farmers in the region, i.e. *economic and political issues, socio-cultural* and *gender issues, food*

insecurity concerns, occupational and *environmental health hazards,* and *environmental concerns*. This proposed research project is based on this rationale and it fits very well with other on-going or recent research interests as indicated below.

1.1 Research Problem

Various research initiatives are currently being carried out to address poverty issues in the Lake Victoria Basin. The Swedish International Development Agency (SIDA) is currently funding about 50 regional research projects in the areas of wetland resources management and land use planning to alleviate the high levels of poverty in the region. The World Agroforestry Center (ICRAF) is planning to initiate a bamboo research project in the Lake Victoria basin as a possible solution to water pollution. The project being funded by the Swedish International Development Co-operation Agency aims at developing an ecological wastewater treatment that would serve the dual function of filtration and purification of polluted Lake Victoria Waters (World Agroforestry Center (ICRAF), 2005). The development comes in the wake of reports by the World-Bank funded Lake Victoria Environmental Management Project (LVEMP) that Lake Victoria's pollution had reached alarming levels.

The tobacco-related issues in the South Nyanza region, which is within the Lake Victoria Basin, have been prioritized in the current Development Plans of the South Nyanza tobacco growing Districts (GOK, 2000a; 2000b; 2000c; 2000d). To address these issues, the Government policy encourages crop diversification as the long-term solution. To address the current problems in the region, this study intends to examine the current and traditional household livelihood strategies used by tobacco farmers in comparison to non-tobacco farmers. The study will experiment on the cultivation of two bamboo species (**Giant Bamboo** and **Bambusa Vulgaris)**, as an alternative crop and source of livelihood for tobacco-growing communities. This study is mainly based on facts obtained during the above-mentioned workshop, which concluded that all small-holder tobacco farmers are willing to shift to other viable alternative agricultural crops. Since farmers are keen on the market dynamics, this study will undertake a market research on bamboo products in the Lake Victoria Basin and Kenya in general. The research vision is that the tobacco industry in the region may to a large extent be replaced in the long run with the bamboo industry to address the tobacco-related issues outlined earlier.

1.2 Rationale for Selecting Bamboo as an Alternative Crop to Tobacco

There are nearly 1,200 species of Bamboo in the world. Kenya has about 150,000 hectares of bamboo forests, partly pure and partly in mixture with trees and shrubs. The bamboo resources in Kenya consist of indigenous *Arundinaria alpina K. Schum* and introduced (exotic) species. The indigenous bamboo species is mainly found in gazetted indigenous forests and small proportions are in farmlands.

Bamboo has been selected for experimentation because of its economic productivity which can reach up to an annual yield of 20-40 tons per hectare on a managed plantation. This has been documented very well in Asian countries. Due to its lightweight, high elasticity and great resistance to rapture, bamboo is ideal for numerous construction uses. It can also be used in the production of pulp and paper, handcrafts, household goods, rehabilitation and stabilization of gullies and riverbeds and recycling and filtration of domestic and industrial wastewater. Bamboo shoots are also a good source of human food, while the leaves have been widely used for animal fodder. With a growth rate that is three times faster than eucalyptus, bamboo usually mature in about 3-5 years (depending on different environmental field conditions), after which harvests are possible for up to 80-120 years.

In Asia, over 1,500 uses of bamboo have been recorded! (RELMA, 2003; Madhab, 2003, National Mission on Bamboo Applications, 2004). But in Africa, largely due to lack of awareness, bamboo's great potential is rarely exploited. Bamboo in Kenya plays a very important role in fencing, house construction, water harvesting, cottage industries dealing with matchsticks, baskets, tooth-picks, and various other handicrafts and, in agricultural farming especially for supporting horticultural crops. Kenya has so far recorded up to 48 local bamboo uses (Ongugo et al, 2000).

With the numerous problems associated with tobacco farming in Kenya as earlier outlined, tobacco is so far used only for cigarette manufacture. Farmers have no any other local alternative use of the crop produce as compared to bamboo which has a multiple of uses.

1.3 Literature review

Studies that have been carried out on tobacco indicate that, tobacco is the root cause of high poverty levels among the affected farmers (World Health Organization, 2004; Chacha, 2000; Panchamukhi, 2000). However, a recent study indicates that tobacco is the only viable livelihood in some regions in Kenya due to general climatic and soil conditions (Nyangito, 2000). He indicates that tobacco is also preferred because of its ready market and demand. However, the author recommends for research on alternative crops due to the major threats to the sector, especially the proposed Tobacco Bill in Kenya and international unstable prices.

The application of bamboo in enhancing the economic and ecological well being of resource-dependent communities in Asia has been extensive and well documented. Systematic studies of the potential of bamboo, previous and current uses, and the social, cultural and political perspectives of these resources have been invaluable in promoting development through innovative and sustainable use of bamboo (Bamtek and Kleinhardt-FGI Pty Ltd, 2002). The International Network for Bamboo and Rattan (INBAR), initiated by IDRC, has played a pivotal role in advancing the bamboo sector in the Asian and African regions. INBAR has facilitated and coordinated research (including action-research) on biodiversity and genetic conservation, production systems, processing and utilization and socio-economics and policy, while promoting capacity building at

the national level. A number of rural development programs are being implemented in the region. INBAR has also been instrumental in promoting technology transfer and information exchange between network partners (Kigomo, 2000; Ongugo *et al*, 2000).

The replicability in Latin America and Africa of the success stories from South and South-east Asia is yet to be assessed, despite the immense interest from the private sector, non-governmental organizations and government institutions in using bamboo to fuel rural development in the region. The dearth of information on the bamboo sector has been the main constraint to the development of systematic and sustainable development programs. This is the gap that the proposed study intends to fill.

Literature review indicates that over 20 exotic bamboo species have been introduced into Kenya during the last two decades using demonstration plots established at various ecological zones as part of bamboo promotion strategy, largely through the support of IDRC. These species are yet to be widely planted by farmers (Kigomo, 2000, Ongugo *et al*). These studies concluded that some of the species introduced (*Bambusa brandisii, B. vulgaris var. striata, B. bambos, B. tulda, Dendrocalamus membranaceous, D. strictus, D. brandisii, Gigantochloa aspera, Oxytenanthera abyssinica, Phyllostachys pubescens and Thyrsostachys siamensis*) are successfully growing in the field and on-farms in western, central and coastal parts of Kenya. However, farmers are not aware of their cultivation methods, market potential and processing.

As indicated earlier, Kenya has so far recorded up to 48 local bamboo uses (Ongugo et at, 2000). The main uses are in fencing, construction, props in the flower industry, bamboo shoots, and toothpicks and skewers. The other products produced from bamboo are incense sticks, baskets and handicrafts (Kigomo, 2000; Ongugo, et al., 2000). Furniture making using bamboo is not a specialization in Kenya but the potential is there (Ongugo, et al., 2000). Toothpick production is one other enterprise that is growing very fast in Kenya but it uses very small quantities of bamboo. On commercial scale, bamboo has increasingly gained importance in flower farming industry where it has been used for support purposes. Its use in horticulture does not also involve any substantial processing. To a large scale, but less documented, is the use of bamboo by farmers in the highlands to support pea farming. Ongugo, et al. (2000), noted that many local people who live in urban, peri-urban and rural areas derive their income from the various activities of the bamboo production to consumption system. These activities include harvesting and assembling, transportation, processing, packaging and marketing.

Most of the raw materials are obtained from natural forests which are currently restricted by the Government. A major constraint to the development of the bamboo sector in Kenya is the short supply of bamboo from state forests as a result of this government ban on the utilization of the resource. Other problems are the poor infrastructure, poor processing technology, poorly developed marketing structures and lack of alternative sources (Kigomo, 2000; Ongugo, et al., 2000). All these factors have affected the effective utilization of bamboo in the country because harvesting

from Government forests is presently illegal. The research team will work at every project phase with government policy makers and implementers to address the problems of poor infrastructure, processing technology and marketing structures.

To develop and sustain a vibrant bamboo sector in the country, this on-going study is experimenting on the growing of bamboo on private farms which have previously been or not been used for tobacco farming. The findings of this study will be used to promote the development of on-farm bamboo plantations in replacement of tobacco in the region and other parts of Kenya. Results from the study will therefore form the basis for policy recommendations and local community action plans with strategies for sustainable and improved livelihoods among tobacco farmers.

1.4 A conceptual framework for analysis of rural livelihoods

The research will utilize the Sustainable Livelihoods Approach (SLA) as a framework for micro policy analysis of rural livelihoods in addressing the research objectives. This 'household assets – mediating processes-activities–outcomes' approach has been used in analysis of poverty-environment interaction, e.g. (DFID, 2001) livelihoods systems approach to gender analysis; and in research on sustainable rural livelihoods and natural resource management, (Ellis, 2000; Scoones, 1998; Bebbington, 1999). The framework analyses the main factors that affect people's livelihoods and relations between them. It can be used in both planning new development activities and assessing the contribution to livelihood sustainability made by existing activities (DFID, 2001).

In the context of this study, the framework will be used to analyze the relationships between tobacco and non-tobacco farming -based livelihood strategies/activities and outcomes to community household assets (natural, physical, human, financial, and social capital) modified by social relations (gender, age and ethnicity), and institutions; as well as demographic and policy trends and environmental shocks (drought, floods, diseases, civil war, etc.). The findings of the study are expected to lead to development of sustainable livelihood strategies that lead to income security and conservation of natural resources.

2.0 Research Objectives

The overall research goal is to investigate the sustainability of traditional and modern household livelihood strategies of tobacco farmers and how they would be diversified through the introduction of Bamboo as an alternative crop to reduce tobacco production in the South Nyanza region.

Specific research objectives of the study are:-

1. To examine the current and historical changes in household livelihood strategies used by tobacco farmers in comparison to non-tobacco farmers.
2. To experiment on the potential and people's attitudes of adapting Bamboo as an alternative crop or source of livelihood to tobacco farming in the region.
3. To undertake an assessment of marketing dynamics as a feedback to investment in the bamboo industry in the region and Kenya.
4. To develop community action plans to ensure a reduction of tobacco production in the region through livelihood diversification/ poverty alleviation strategies.

3.0 Research Methodology

The research methodology will involve qualitative and quantitative tools used in both social and scientific research analysis. These will include relevant literature reviews, field experimentations/ demonstrations, local community household surveys and Participatory Rural Appraisal (PRAs) with stakeholder identification and analysis, and focused group discussions for meeting the data requirements of the stated research objectives. This research project will basically be done in a period of 3 years (April 2006-April 2009). Below is a detailed description of the study area, key research tasks, study population/ sampling methods/ procedures, data collection and analysis methods.

3.1 Demographic profile and socio-economic activities within the study area

Kenya's economy is basically dependent on agricultural production. The study area of this project as indicated earlier is the South Nyanza region (see the map below), which comprises four Districts (Kuria, Migori, Homa Bay and Suba). By 1995, all these districts were under one district officially referred to as South Nyanza District. Due to population increase and internal Kenyan politics, they are currently 4 administrative districts.

The study area's brief profile is as outlined below:-

Geography: South Nyanza region is located in the south-western Kenya, along Lake Victoria and covers an area of about 7,778 sq. km. (5,714 sq. km. Land area and 2,064 sq. km. Water) which is 48% of the Nyanza Province's land area. From the lake shoreline, the study area's altitude ranges between 1,163m to 2000m above sea level (GOK, 1989).

Ecology and Water Resources: The region has basically an inland equatorial climate, modified by the effects of altitude, relief and the influence of Lake Victoria waters. The normal temperatures range between 17°C to 30°C. Rainfall occurs almost throughout the year with a maximum in April to May. December to February is usually a dry season. The main perennial Rivers are Kuja, Migori, Awach Tende and Awach Kibuon (GOK, 1989; GOK, 2000a; 2000b; 2000c; 2000d).

Soils and Land-use patterns: The region has a variety of soils, most of which are highly localized. The lowlands striding along the shores of Lake Victoria, have rich alluvial soils in most parts and sandy loam soils in other areas. The medium potential zone has patches of loam and grey soils. The high potential zone is dominated by loam soils and brown clay soils. Tobacco growing is currently being practiced in high, medium and even low potential zones (GOK, 1989; GOK, 2000a; 2000b; 2000c; 2000d).

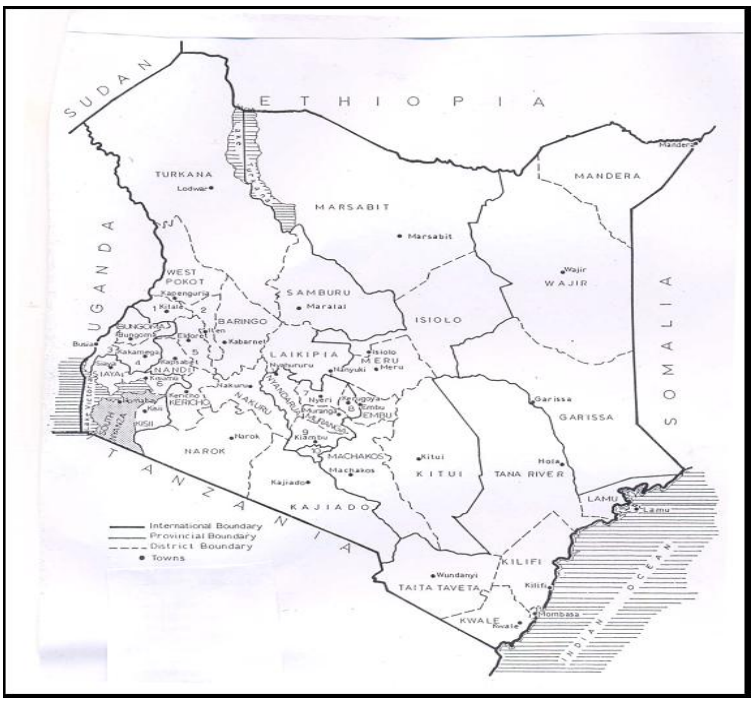

Figure 1: The location of the South Nyanza Region (Study area) in Kenya

Population and Natural Resource Base: The study area is estimated to have about 2.0million people at present. Apart from agricultural land, other major natural resources in the region are the Lake Victoria waters, Fish from the Lake, unexploited mineral resources and wildlife resources (GOK, 1989).

3.2 Research Tasks, sampling, data collection and analysis methods

With reference to the specific objectives of this study, there are 4 research tasks to be achieved in this project, namely:-

Task one: *To study and rank the household livelihood strategies used by tobacco and non-tobacco farmers in the South Nyanza region.* The task is being under taken in the first year of the study. The key research questions to be answered here include:-

- What are the basic tobacco cultivation requirements (inputs required and sources, farming procedures and standards, rules and regulations)?
- Have there been any changes in land tenure system and physical area under tobacco?
- What crops have been replaced by tobacco at the household level?
- What are the agricultural input-output functions for tobacco and other local cash crops?
- Why are the farmers undertaking tobacco farming?
- Why have certain farmers abandoned or never engaged tobacco farming?
- Are farmers willing to shift from tobacco farming to bamboo farming if the latter proves to be a viable investment in the region?
- Are there any other local uses of tobacco?
- What is the local price elasticity of tobacco?
- What are the economic and political issues related to tobacco?
- What are the socio-cultural and gender issues related to tobacco?
- What role do men, women and children play in the production of tobacco?
- Is food still grown by the farmers and, if so, who is responsible for that?
- Does tobacco production interfere with the schooling of the children?
- Is tobacco production responsible for food insecurity at the household level of tobacco farmers and, if so, how?"
- What are the occupational and environmental health hazards associated with tobacco at the household level?
- Are there environmental concerns related to tobacco production?
- What are the expected socio-economic, cultural and environmental implications of introducing bamboo at the household level?
- What impact will the introduction of bamboo have on women, children, youths and men?

The general hypothesis guiding this objective is that: ***farmers in the region have been changing their household livelihood strategies over time in response to increasing poverty levels caused mainly by tobacco cultivation.***

This task is being carried out in the four (4) Southern Nyanza Districts of Migori, Suba, Kuria and Homa Bay. A multi-stage and stratified random sampling procedure was used to select households for the study. One administrative location with the highest concentration of tobacco farmers was selected from each district for the study. Farmers were then be stratified into three (3) groups, i.e. *contracted tobacco farmers, non-contracted tobacco farmers and non-tobacco farmers.* The socio-

economic data on livelihood strategies, diversity and their vulnerability in selected households was done using a standard questionnaire with both structured and non-structured questions relevant to the study. The questionnaire was developed and tested within the first two months of the study.

An average representative random sample of 40 farmers in each category listed above was selected from the 4 Districts. This minimal sample size will allow statistical conclusions for each of the three categories, i.e. *contracted tobacco farmers, non-contracted tobacco farmers and non-tobacco farmers* for every district. This means that a total of 120 farmers are being studied in each district. This gives the total sample size of the study to be 480 farmers from the region. The interviews will be supplemented with participatory methodologies, group discussions and participant observations to cover all the study objectives in detail. Kiswahili, which is the National language in Kenya, will be used during all the PRAs. Four PRAs-Focussed Group Discussions (i.e. one for each district) will be organized accordingly. All PRAs will be gender sensitive by including adult men and women, and youths during all meetings and household surveys to be carried out during all phases of the study. The PRA tools to be used and their purposes are as outlined below: -

1. *Construction of community social and resource maps:* To indicate the community geographical boundaries, major resources, and social features. This will show the strong environmental and social inter-relationships that exist. The community members will take a lead in this through guidance by the PRA team.
2. *Historical time lines:* Groups of old members of the community will assist to trace the significant events in the region. This will give us a background of a heritage of experience and knowledge that influences present attitudes and behaviour in the community with special reference to historical tobacco farming practices. This tool will document the major events, which have influenced the community life since the introduction of tobacco, the kind of interventions tried in the past and their present impact, both positive and negative on the lives of the community.
3. *Seasonal calendars:* This will involve everybody in the community to establish cycles or patterns of farming activities and occurrences over a year. These yearly cycles will be important to determine, for example, labour productivity, timing for project activity, potential absorptive capacity for new activities, times of disease and food shortages, and variations of cash flow, etc.
4. *Historical resource analyses:* This tool will show the availability of key resources to the community over time from the past, current and future. It will also indicate the reason in changes of these resources. This will be an important planning tool because it will indicate to the community the changes on the resources on which their developmental action plan will be based on as required in the last objective of this study.
5. *Farm sketches:* This will show individual farm practices, and will enable the PRA team to compare facilities and strategies in the micro-zones. It will also portray, on relative basis, the

socio-economic status within the community, in terms of farm management, standards of resource management, productivity and income levels. Farm sketches of different households may reveal variations in terms of farm sizes, crops cultivated, planting strategies, and other variables of household resource use.

6. *Resource flow matrix*: This tool will be used to indicate visually the flow of the resources to and from the communities. It will show where the community resources are exported to and imported from. The tool will also show in what form (raw or processed) the resources are exported or imported by the local community. This tool is expected to indicate to what extent the communities depend on tobacco cash to pay for some resources imported.
7. *Livelihood mapping*: This will basically be the process of identifying the basic resources used by the community. It will involve identification of all the basic life support resources of the community and what they consider as important to their livelihood. This tool will also be useful in ranking of community resource problems and opportunities. In particular, the local traditional crops like cassava, sweet potatoes, groundnuts, maize, beans, sorghum, finger millet, onions, tomatoes, pepper and kales (*Sukuma wiki*) will be prioritised using this PRA tool.
8. *Institutional and stakeholders analysis*: This tool will assist in identifying the activities of various groups and organisations within the community as expeditiously as possible. It will also be used to examine the community perception on the existing institutions (rules of the tobacco production and processing game) and organisations and understanding their importance.
9. *Gender analysis and daily calendars*: This tool will be utilised by the PRA team to determine the roles and problems of women, men, young and old in the tobacco industry. Daily calendars for each gender group will be established for comparison purposes and further analysis.

On the other hand, the data obtained from the 480 respondents will be coded and clustered for subsequent statistical analysis using SPSS computer program. The analysis will generate summary statistics for background variables as well as test relationships between hypotheses variables in order to meet the research objectives. Descriptive statistics and regression will be used at the univariate, bivariate and multivariate levels of the analysis, respectively. The results will be presented by use of text, frequency tables, charts and tables presenting results of significance of relationships between statistical test variables.

Task two: *Experimentation on the potential and people's attitudes of adapting the Bamboo species as an alternative crop or source of livelihood to tobacco farming in the region.* The setting of the field farms has been done in first year (October, 2006) during the short rains, but monitoring and evaluation of the performance of the bamboo plantings will be carried throughout the project period. The key research questions/ issues to be answered or investigated include:-

- What are the bamboo establishment costs per hectare?

- What will be the advantages and disadvantages of bamboo cultivation as compared to tobacco and other crops grown in the region?
- What are the gross and net income margins of tobacco, other local cash crops as compared to bamboo products?
- Growth rates of bamboo plantings, i.e., per month, culm diameter, height.
- Survival rates and general health of the plantings under different environmental conditions, e.g. agro-ecological zones,
- Tillering rates, i.e. number of shoots per clump of bamboo.
- Number of culms per clump.
- Number of culms (poles) harvested for timber.
- General observation on response to fertilizer/ compost application.
- Time taken to maturity/ harvesting for various products.
- Farmers' willingness and attitude to bamboo farming.

The general hypothesis guiding this objective is that: ***Bamboo cultivation will have more advantages and economic benefits than tobacco farming.***

To obtain information on the above research questions and issues, a manageable and representative number of experimental farms (averagely 30 farms from each district each approximately ¼acre) were selected with the consent of 15 tobacco and 15 non-tobacco farmers, on formerly tobacco and non-tobacco farms, respectively. This gave a total of 120 sites/farms to planted with Bamboo plantings in the whole region. Each experimental farm site has averagely 20 plantings (i.e 10 Giant bamboo and 10 Bambusa vulgaris). A total of 2,429 bamboo plantings have been planted and this is expected to have a major impact of the project in the region in the long term.

Selection of farms was flexible and representative depending on diversified land characteristics. The bamboo was planted around the perimeters of the fields, homesteads, near riverbanks and any other free land abandoned after used to grow tobacco or other crops (since tobacco companies only accept virgin land for tobacco farming from season to season). Availability of land for bamboo experimentation was not an issue in the region. In principle, the project is avoiding competing for land with tobacco farming and other crops at this experimentation stage.

With reference to accepted bamboo growing practices (National Mission on Bamboo Applications, 2004; China National Bamboo Research Center, 2001), these farms were planted with Bamboo plantings at spacing of about 5m X 5m.

The plantings raised through culm cuttings were obtained from Thika town (60Km from Nairobi City and about 600km from the study area, South Nyanza). Planting of young bamboos was done at the beginning of short rains, i.e. October 2006. This was important and critical to the project in order to avoid high watering expenses and increasing the survival rate of the young bamboo trees. Daily and monthly monitoring on the performance of bamboo trees will be carried out by farmers, and the research team, respectively. A calendar of field days has been developed to fit the farmers' operations.

The experimental farms will also act as farmer training and demonstration centres. Trainings on livelihood diversification and the need to reduce tobacco production will be carried alongside the training on planting and care of bamboo plantings. The livelihood diversification trainings will target both tobacco and non-tobacco farmers at the community level.

The plantings are expected to take a period of about 3-5 years to mature. Some products like shoots, compost from bamboo leaves, fodder for animals will be realized within 3 years. However, the culms will require another 2 years to harden for a variety of products. Forecasting on the production of other products will be done at that stage.

Management of the plantings, evaluation and monitoring will be done in collaboration with the farmers to ensure success of the research project. The second and third years will also be dedicated to market research on bamboo poles and other products. Further trainings will also be carried out on harvesting techniques, use and marketing of bamboos and the products. Change of attitudes and willingness to adopt the new livelihood strategy under experiment will be a continuous process during the project period.

Task Three: *The assessment of marketing dynamics on bamboo products as a feedback to investment in the tobacco industry.* This will give special reference to the Lake Victoria Basin and Kenya in general. This will be carried out in the second year of study. However, a reconnaissance survey and a pilot study of the task will be carried out towards the end of the first year in preparation for the second year of study. The key research questions to be answered here include:-

- What are the forecasted yields and profit margins of bamboo in comparison to tobacco and a range of local cash crops grown?
- What are the local existing bamboo product markets?
- What will be the target bamboo product markets?
- Who are the bamboo customers and potential customers in Kenya?
- What kind of people are they, and where do they live?
- Can and will they buy new bamboo products?

- Are the bamboo retailers offering the kinds of goods or services wanted at the best place, at the best time, and in the right amounts?
- Are the current prices consistent with what buyers view as the product's value?
- Are there any local bamboo promotional programs and are they working?
- What do customers think of bamboo products business?
- How does the bamboo business compare with other similar product competitors?
- What are the expected market entry obstacles (tariffs, regulations, policies) within these markets?
- What are the preferred product types? Why are those products preferred?
- Who are the local and international competitors currently supplying target markets?
- What are the projected product prices?
- How easy will it be for farmers to get their crop to the market?
- How long will it take to get paid for their product?
- What distribution strategies will bamboo growers prefer?
- Who are the potential partners to farmers in the bamboo industry sector?
- What is the existing potential for setting up village level bamboo processing enterprises?
- Is the present infrastructure in the Nyanza region allow easy and reliable supply of raw materials to existing processors or whether new factories will need to be set up in the region?

The general hypothesis guiding this objective is that: ***Bamboo materials and products have a high market potential in the Lake Victoria Basin and Kenya in general due to their diversified and unique characteristics.*** Using the data obtained in *Tasks two* and *three*, a trade-off model between Tobacco and Bamboo will be worked out. Different costs of production and market demand assumptions will be tested for a rational decision to be made.

This objective of the study will not be limited to the South Nyanza or Lake Victoria region. It will be carried out in areas where bamboo production, processing and utilization are common. These are Mt. Kenya, and the surrounding towns of Nyeri and Nanyuki; and the Aberdare mountain ranges including Nairobi and Naivasha towns. Other study centers will include the Mau mountain ranges, the Cheranganyi hills, Mt. Elgon, Nakuru, Kitale, Malindi and Mombasa. In the Lake Victoria region, the study will focus on urban Centres within the study area and region, e.g. Homa Bay, Migori, Mbita, Kehacha, and Kisumu City.

The parameters for data collection at the primary and secondary levels will be undertaken. The primary data will be collected from field surveys and informal interviews with a selected sample of

raw bamboo producers, collectors, processors, retailers, importers/traders and consumers. A semi-structured questionnaire will be designed for the study. The research team will administer the questionnaire. Interviews will involve several visits to host villages and collection centers and major processing, manufacturing and market centers in Kenya. Secondary data will be gathered from literature on previous work on bamboo, especially at Kenya Forestry Research Institute Centers and ICRAF.

To understand the consumption / utilization, analysis of the product range, pricing and mode of payments will be undertaken. Other parameters to be considered include volume of sales income and profits of handicraft operators, supermarkets, projected sales and future outlook, and trade restrictions, royalties, taxes, and other fiscal and regulatory measures. The Nakumatt chain of Supermarkets in Kenya who currently sell over 30 bamboo products will be of major focus by the study.

A quota sampling technique will be used to select the bamboo collectors and processors in all the study sites. Harvesting, collection, and processing individuals in rural and urban towns will be selected based on relative distribution patterns of target stakeholders in the various parts of country. Since the precise distribution of all bamboo collectors and processors is unknown beforehand, the actual survey will be done following the initial interviews with key informants in urban areas and forest stations.

In brief, the following categories will be interviewed to obtain information on existing and potential bamboo market in the Lake Victoria Basin, Kenya and beyond: Bamboo producers/farmers, bamboo collectors/harvesters, primary processors, retailers and consumers (market centers in urban towns/cities), policy making institutions, and other stakeholders. In the Lake Victoria region, PRAs and field visits will be used to assess the potential market of bamboo products like firewood for the fish, tea and sugar industries; charcoal; construction materials; etc in the region. Four PRAs (i.e. one for each district) will be organized accordingly. In brief, bamboo marketing research task will focus and organize marketing information in Kenya. It will ensure that such information will permit bamboo entrepreneurs to:

- Reduce business risks
- Spot current and upcoming problems in the bamboo market
- Identify market/ sales opportunities
- Develop plans of action

Data analyses will be done using SPSS and Excel computer packages. Descriptive statistics will mainly be used in the analysis. Frequency tabulation will be used to present the collected information on the various aspects of the bamboo sector. Where appropriate, the distributions will be summarized, using the statistical central measures of tendency such as mean, mode and median.

Percentages will be used to compare frequencies and to express qualitative variables in a numerical format.

Task Four: *Development of four (i.e. one for each district) Community Action Plans (CAPs) aimed at reducing tobacco production in the short, medium and long terms.* This is planned to be carried out in the third and last year of study. The CAPs will act as a record on each District's bamboo cultivation and development priorities and the potential/ willingness in reducing tobacco production in the region. They (CAPs) will act as the basis for addressing tobacco-related issues in the region. This task will basically be achieved by running district-based PRAs. To ensure reliability of the CAPs, multiple goal linear programming will be used in the analysis for determining what livelihood strategy will be best against poverty and environmental objectives.. Since different actors will use the CAPs to extract sectoral projects for funding, the PRAs will ensure that they include all stakeholders and local change agents (tobacco farmers, non-tobacco farmers, relevant government line Ministries, NGOs, local leaders, donors, etc) will all participate. The CAPs will also capture other local livelihood strategies (based on other local cash crops) prioritised by the community in Year I of the study.

Four PRAs (i.e. one for each district) will be organized accordingly. However, the farmers will take a lead in developing the CAPs. The research team and other project collaborators will act as facilitators, and make technical information available to the community to help them come to rational decisions. It will be preferable to involve the NGOs and donor agencies in this activity because in many cases, external input, especially funds, technical support, and training, may be critical for success of the CAPs implementation process. Implementation and monitoring of the CAPs will mainly be the responsibility of the community.

4.0 Capacity Building

Capacity building to ensure long term and sustainable livelihoods will be of priority. This will be achieved in the following ways: -

- Training of tobacco and non-tobacco farmers on the benefits of livelihood diversification and reduction of tobacco production.
- Training of farmers on how to produce bamboo plantings and seedlings and their care, harvesting, processing technology, uses and market networks.
- Two Maseno University Masters-level students will work on full-time basis as research assistants in this project and will receive on the job training on bamboo production. They will be expected to develop their PhD research proposals by the Mid-2007 on Bamboo production and processing/ tobacco production control. They will have the capacity to handle future strategic research works aimed at tobacco production control.

- The development of such manpower and institutional capacity at Maseno University will lead to establishment of a regional Bamboo Promotion and Tobacco Control Research Centre (BPTCC) before the end of project period.

5.0 Users and Beneficiaries

The tobacco farmers are the main target as users and beneficiaries of the research project results. However, other non-tobacco farmers in the region are expected to adopt bamboo farming to diversify their livelihoods too to ensure sustainability of household income portfolios. However, all participating farmers in the bamboo farming experimentation will have to give formal consent to use their land for bamboo experimentation to avoid any unforeseen land use conflicts later. The tobacco-affected women, children and youths are expected to be the major beneficiaries. The results will also benefit other tobacco farmers in other parts of Kenya and the East African region in general. At the policy level, government officers at all levels (local, regional and national) in the country will use the results to promote the growing of bamboo as an alternative cash crop, because farmers are always willing to switch to any crop that has a ready and diversified market as indicated during the Project Planning meeting with various stakeholders.

The research is expected to attract young researchers in studying several aspects on bamboo as a crop and tobacco control aspects in the region. At present, there is a lot of research going on in the Lake Victoria Basin focusing on poverty alleviation. Maseno University is the only University in the region and one of the leading research Centres on various issues.

The research project anticipates a lot of interest from various tobacco farming stakeholders. The tobacco companies and their agents may try to campaign against bamboo production using weak points like period of maturity (3-5years), but the fact remains that tobacco farmers are in serious search for livelihood alternatives to tobacco farming. The research team is prepared to counter such diversions through the trainings/ workshops planned as part of this research project. The research project is banking on the support of small-holder tobacco farmers for the success of the project.

6.0 Dissemination of Results/ Outputs

Several outputs expected can be summarized as:-

- Ranking of local livelihood strategies among the tobacco and non-tobacco farmers.
- Create awareness on the cultural, socio-economic and environmental impacts associated with tobacco production.
- Obtain information on bamboo market structure and performance in the region.
- Development of new and sustainable partnerships with various stakeholders in order to reduce tobacco production, rural poverty and environmental degradation.

- Development of Community Action plans to reduce tobacco production through livelihood diversification.
- Research capacity building through trainings and publication of results.
- Development of policy documents based on diversified and sustainable livelihood portfolios.

As outlined above, trainings on livelihood diversification by tobacco farmers on traditional food and cash crops (i.e. cassava, sweet potatoes, groundnuts, maize, beans, sorghum, finger millet, onions, tomatoes, pepper and kales (*Sukumawiki*)) and specifically bamboo growing, harvesting, use and marketing will be undertaken at the community level using *barazas* (chief's meetings), seminars, group discussions and field demonstrations. This will be communicated through local languages (Dholuo, Suba, Kuria). Quarterly reports and policy briefs will be sent to relevant stakeholders and to RITC for further dissemination through their website. Hard copies of *Policy Briefs* will be published and distributed. The policy makers will be convinced to read them since they will be part of the research process, and because they will participate in key project meetings during the data collection exercises. Two (2) papers will also be published in peer-reviewed international journals on every objective of the study (i.e. 2 papers in Year I, 3 Papers in Year II and 3 Papers in Year III). This amounts to eight (8) publications in 3 years.

7.0 Monitoring and Evaluation

Monitoring of the research project will be a continuous process throughout the project period. Progress reports will be submitted to IDRC and Maseno University every six months. Evaluation of the project will be required at the end of the every year to ensure that the project direction or vision is maintained in the long term. The evaluation will be done both internally by the research team and externally by IDRC. The key indicators for first year include: the number of households interviewed, the ranking of household livelihood strategies, number and status of bamboo experimental farms, number of PRA meetings, number and quality of trainings held, etc. The second year evaluation indicators include, the bamboo performance monitoring reports, status of bamboo experimental farms, the attitudes of farmers towards the project, the bamboo market information, number of policy briefs, papers for publication, number and quality of trainings, etc. At the end of the third year, the policy briefs, papers for publication, number and quality of trainings and CAPs developed will form the key evaluation indicators. The farmers, researchers and other stakeholders will form the source of information for the evaluation team(s). Annual evaluation/ progress reports will be submitted to IDRC, Maseno University and other relevant stakeholders. Comments from the evaluation reports will be used to improve further the performance of the research project.

8.0 Collaboration

Maseno University is the research institution leading in this project. To realize tangible outcomes from this study, collaboration/partnerships has not only been established with the farmers, but also with other stakeholders. The research team has already developed direct research links with the Ministry of Agriculture, the World Agroforestry Center (ICRAF) which is currently promoting the cultivation of bamboo in some degraded areas to control water pollution, relevant NGOs e.g. (Social Needs Network and Community Livelihoods Development Forum-COLIDEF), Kenya Forestry Research Institute (KEFRI). All these are being consulted for information and participation during the project data collection meetings/ data validation workshops/ seminars. NGOs and other organizations against tobacco farming are being utilized in mobilization of farmers to attend workshops/ training field days, etc. These links have been useful especially in farmers' selection and their mobilization to accept the experiment and adoption of new alternative livelihood strategies. It will also be ethical to share information during the project period among the collaborators and relevant stakeholders.

The research team has also developed linkages with the International Network for Bamboo and Rattan (INBAR) in conducting of short farmer/ student trainings. INBAR is also assisting in the area of literature on Bamboo production, processing, marketing and utilization.

9.0 Timetable

Expected duration of the research project is three (3) years **(1st April 2006-31st March 2009).** The activities to be carried out and those being carried out have already been outlined in detail under the Activities/Methodology section of this proposal. Below is summary of proposed time-table of principal phased activities:-

KEY ACTIVITY/PHASE	PERIOD		
	April 2006-March 2007	**April 2007-March 2008**	**April 2008-March 2009**
• To study the household livelihood strategies used by tobacco and non-tobacco farmers in the South Nyanza region			
• Setting up of field experimentation of Bamboo in the 4 Districts			
• Monitoring and evaluation of the performance of the bamboo plantings			

• Assessment of marketing dynamics on bamboo products as a feedback to investment in the tobacco industry in Lake Victoria Basin and Kenya in general.			
• Development of four (i.e. one for each district) Community Action Plans (CAPs)			

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Development Strategies of Follow-up Industry after Converting Slope Farming Lands to Bamboo Forestry in Suijiang County

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ABSTRACT

The Follow-up industry of has been developed since implementing returning land for farming to forest engineering .Based on investigating bamboo resources of returning land for farming to bamboo forestry and status of processing enterprise ,the article analyzed present problems of bamboo industry for development in Suijiang county ,the countermeasures for the development industry are proposed.

Key words: Follow-up Industry; Status; Countermeasures, Suijiang

Cultivating and developing Follow-up industry of returning land for farming to bamboo forest are to properly adjust economic structure of mountainous area, exploit the effective way of employment , tamp the basis of socialism new countryside and develop leading enterprise ,expand industrial chain, drive the development for second ,third industry .Suijiang has implemented returning land for farming to forest engineering since 2002,it has important play in effectively controlling soil and water loss ,rising the forest coverage ,again constructing beautiful landscape and building lakeside eco- tourism area. Through inverstigation , area of bamboo forest amounts to 8449.3 hm2inSuijiang,ecological benefit ,economic benefit and social benefit for bamboo are very obvious ,but lack of scientific exploitation and utilization resulted in the developmental lag of bamboo industry .

1. The status quo of Follow-up industry for development in Suijiang

1.1 The status quo of bamboo resources

Suijiang is located on between east longitude 103°46′46.8″ ~ 104°16′35.8″,north latitude28°21′2.9″ ~ 28°40′21.3″,the south is high and north low. Altitude is between 290m-2054m. Mountain range belongs to Wumeng mountain system, is transitional zone that border of Sichuan basin is transient to Yunnan-Guizhou Plateau and monsoon marine climate dry and moist is distinct, monsoon climate being characteristic of more cloudy day ,less sunshine, heavy rain and moist, annual average temperature is 17.8□,annual total sunshine is 1053.7h, average temperature of the coldest

month is 8.2□, frost-free is 326d,annual rainfall is 943.7m,relative humidity is 79%.Becauseof the complex landforms and physiognomy ,proper climate ,these make Suijiang one county of having abundant bamboo resource in Zhaotong city .According to the guideline of acts as circumstances, practicing Survival of the fittest, returning land for farming to forestry engineering has been started since 2002,the whole county including four towns and one village in the place where slope is more than 25 implement returning land for farming to forestry engineering , the area of afforestation is 3040.36 hm^2, the area of 15°— 25°is 249.2 hm^2,the area of less than is 23.8 hm^2(Table 2).By the end of 2005,the whole county finished 3313.36 hm^2,which the area of growing to full stand is 1546.9 hm^2,accounting for 60% of the whole area ,main bamboo species are as follow:

Bambusa*pervariabilis*×*Dendrocalaopsisgrandis pyllostachyspubescens, Neosinocalamusffinia, Dendrocalamus latiflorus, Dendrocalamus giganteus*, in which the plantation area of *Bambusa pervariabilis* ×*Dendrocala mopsis grandis* is 1410.4 hm^2 , composed of 43% of total area of returning land for farming to forestry (Table 1).

Table1 The statistics for area of returning land for farming to forest from2002 to 2005 in Suijiang county (Unit: hm^2)

villages and towns	B□D	*Ph.pubescens*	*Ne.affinia*	*De.latiflorus*	*De.gianteus*	Total
Huivi town	445.61	208.00	170.33	13.87	/	837.81
Zhongcheng town	262.60	/	51.34	/	/	313.94
Banli village	156.55	48.53	260.00	/	/	465.08
Nanan town	133.87	/	33.33	/	36.73	203.93
Xintan town	278.07	202.40	/	/	/	480.47
Tianba town	133.70	/	146.67	/	/	280.37
Total	1410.40	458.93	661.67	13.87	36.73	2581.6

The secondary are *Neosinocalamus affinia* and *Phyllostachys pubescens*, the least is *Dendrocalamus latiflorus*, only accounting for 0.5% of the total area.

Table2 The statistic for area of utilization of returning land for farming to bamboo forest (Unit: hm^2)

Villages and Towns	Area of growing to full stand	Area of non-growing to full stand	Total
Huivi town	527.80	310.00	837.8
Zhongcheng town	242.60	71.34	313.94
Banli village	205.08	260.00	465.08

Nanan town	170.60	33.34	203.94
Xintan town	267.13	213.34	480.48
Tianba town	133.69	146.67	167.06
Total	1546.9	1034.69	2581.60

The development of bamboo industry in Suijiang depends on abundant natural bamboo forest, besides bamboo forest of returning land for farming to forest, its area sums to 6023.03 hm^2(Table3),occupied 46.5% of present bamboo forest, totally having bamboo 21species of 10genera,in which monopodail bamboos are as follows : *Phyllostachys pubescens ,Ph. bamsoides flacrima-deae*、*Ph. Heteroclata*、*Ph. Sulphure* and so on .Sympodial bamboos: *Neosinocalamus affinis*、*Bambusa rigida , Dendrocalamus latiflorus*,etc. Mixed bamboo species: *Qiongzhuea tumidinoda*、*Pleioblastus amaras*、*Yushania suijiangensis, ect.*

Table3 The statistic of area of natural bamboo forest in Suijiang(Unit: hm^2)

villages	*Ne.a*	C.*q*	*De.g*	*Qiongzhue*	*De.l*	*Ph.p*	*Ph. h*	*Ba.r rigida*	*Ph. b*	*Ph. s*	*Pl.a*	Total
Huiyi	90.60	/	/	33.54	64.0	286.2	116.94	25.40	3.87	20.87	10.4	651.89
Zhongch	115.74	/	2.14	38.00	/	35.47	343.47	115.20	/	/	/	650.02
Banli	205.00	512	/	2053.34	/	284.14	/	/	/	/	/	3054.48
Nanan	57.60	/	31.80	231.74	1.34	/	/	48.34	/	/	/	370.82
Xintan	67.33	1.54	/	106.94	/	179.33	/	41.00	6.27	/	3.40	405.81
Tianba	241.67	/	/	454.6	/	93.20	46.00	32.33	7.34	13.47	1.40	890.01
Total	777.94	513.55	33.94	2918.00	65.4	878.34	506.00	262.00	17.50	34.34	15.20	6023.03

1.2 The current condition of processing enterprise

Whether the processing and utilization are done well will influence directly whether or not can transform the advantage of bamboo resources into economic superiority and relate to prospect of the bamboo industry for development. Processing enterprise for bamboo still lays in bud phase , only owning a enterprise that engages in making bamboo pulp and paper, namely Zhongxin paper L.com., total assets is 12,150,000 Yuan, profit payments and tax turnover 1,260,000 Yuan ,having 106 employees, and mainly manage cultivation, research and development, processing of product of bamboo, and the production of bamboo pulp and paper; its products are craft paper made of bamboo pulp ,paper used as envelope and neutral craft paper etc, whose products market east, north , central ,north and west in China and so on ,but there is no other bamboo processing factory.

In present period, the exploitation and utilization for bamboo are following traditional utilization such as making “Tuzhi”, bamboo -pulp paper-making and bamboo weaving and so on and don’t

further exploit .In order to cater to international situation of economic globalization and district economic integration and carry out “Develop characteristic economy, cultivate quickly and advance mainstay industry”, during 11th- five-year-plan, Suijiang will build up bamboo pulp industry annually producing 30,000t , bamboo template factory that will annually produce bamboo flake board yearly 30,000 m^3 , bamboo plywood annually 10,000 m^3, bamboo mat plywood yearly 5000 m^3, bamboo-timber complex structure material for environment-protecting 5000m^3 and processing factory for bamboo handicrafts yearly produce 10,000 pieces.

2. Existing problems of developing Follow-up industry

2.1 Lack of understanding for forestry department and support policy

The advance of returning land for farming to bamboo forest is closely related to forestry department. Although the cultivation of bamboo for pulp forest has obtained remarkable results , Follow-up industry for development is to starting phase .Idea of part of villages -towns and forestry departments in Suijiang is not unified during the construction of Follow-up industry, understanding not comprehensive and lack of support policy, meanwhile ,benefit between farmers and enterprises is not considered ,which don’t lead to situation “Frying the same dish ,sitting down together to eat” ,seriously reduce farmers’ enthusiasm and affect the development of basic work

2.2 Extensive management for bamboo forest, single planting mode

90% villagers inverstigated were only educated to primary school. It’s hard for them to get to the latest information around the world. Many bamboo peasants who are dominated by the traditional ideas believe that bamboo is a limitless resource feeding on mud and drinking dew, without paying more attention how to care bamboo. Furthermore, the city or province forestry of technology dissemination departments had not conducted a series of training course and lectures to villagers on bamboo-cultivation.

Most bamboo peasants didn’t timely loosen the soil, hoe up weeds and plough soil, so the bamboo-shoot grows unsatisfactory. Even worse, the disease causing by the insect pests is so serious which effects the natural growth of bamboo forestry. Those factors lead to the degrade of the bamboo’s quality.

Because the geography is complex, the altitude grades are very huge, and the growing places conditions are very different, about the reverting farmland to bamboo forestry, here people failed to think about the biology and biology characters. at present, peasants still mainly grow hybrid bamboo *Neosinocalamus affinis*、*Phyllostachys pubescens* and Chimonbambusa quadrangularis and have not cultivated native bamboos ,such as *Qiongzhuea tumidinoda*, *Ph. heteroclata*. The planting pattern is single and the development of bamboo resource is no enough.

2.3 The small scale of enterprise ，products with low technology

The leading enterprises processing play a leading role in accelerating the development bamboo industry. However, Suijiang County has no enough enterprises to process bamboo crafts, bamboo carbon, bamboo shoot and other bamboo products. Only Zhongxin pulp paper factory is processing bamboo. Besides, there is no enterprise to establish product-research department to make good use of the features of bamboo, paying little attention to the product development. Therefore, the kind of product is single, technology- containing is low and the profit is too small.

2.4 The stagnant traffic and marketing net no perfect

The natural condition is too bad in Suijiang County, the altitude is too high and the main roads are muddy. One or two roads are too muddy to go forward when it is raining. Under such condition, bamboo peasants transporting bamboo to the purchasing area should spend more time, material and human resources. Therefore, the stagnant infrastructure affects the relative development of bamboo industry.

With the further development and the openness of the bamboo market economy, the system of the related industry marketing net is becoming more and more important. the shortcomings are embodied in the following aspects: the bureau of the county were not aware of the situation and the didn't popularize too much. ，as a result, the companies and peasants know little information about the bamboo market, they perform without exact directions, more worse, until now, an integrated bamboo industry exchange market has not been established with certain scale and radiation. The processing and utilization of bamboo and bamboo shoot can't be well combined with other items for these reasons, it still has a long way to go before an ideal system of bamboo industry including the processing trade of it came into being. Bamboo products, processing and utilization for bamboo and construction of market and base building didn't combine organically. There is a long distance between the phenomenon and the aim of industrialization development pattern of integration for trade, processing and forestry.

3. Countermeasures

3.1Establish policies, coordinate interests among related industry

The development of bamboo industry depends on harmonious development among hundreds of thousands of farmers , processing enterprises and marketing business .Because management of bamboo is of dispersibility and complexity, which require establishment and implement of policies for bamboo industry need consider interest body, through constructing preferential policies to activate their enthusiasm and critical and ordered relationship between government and managers for bamboo .To building up the concept of human oriented and seriously implement taxation and fee reform system from governments, stop all illogical fees that are collected from farmers and

processing business for shoot-bamboo product , truly relieve the burden on farmers and processing enterprises , keep their interests . For example , for FDI attracting , to carry out preferential policies among land expropriation, taxation and fee , hydropower, loan etc ,and create easy climate for foreign businessman who develop bamboo industry in Suijiang ,for the development of local firms , to simple procedure of working ,financially support and guide for government and reduce taxation and fee in initial stage of operation for business and provide superior condition for the uprise of local enterprises.

3.2 Integrate resource; expand clustering way for bamboo industry

Clustering for bamboo industry is referred to be special aggregate, centralizing certain region a bamboo industry, enterprises that have cooperative relationship and different scale class and all kinds of resources related to its development closely associate with by interlaced network. The development pattern of clustering for bamboo industry inSuijiang is that science and technology resource, enterprises resources, and tourism resource etc are integrated to exploit clustering way for bamboo industry of characterizing Suiiang. In the course of development , government should scientifically plan bamboo resources ,directive cultivation in order to form new pattern of three-Dimensional mode of planting inside bamboo forest , engage bamboo experts in the scientific institutions to guide farmers to tend bamboo forest punctually and scientifically , periodically operate technical training about Follow-up industry , practically transform achievements in scientific into productive forces .Cultivating leading enterprise is a significant Key Point that Suijiang will recognize integration for Bamboo pulp paper and a tie that connect hundreds of and thousands of farmers with changeable markets .So,Zhongxin industrial limited company is acted as leading enterprise in Suijiang , quicken the construction of operating model “Company+Base+farmers” , and make the best use of driven action that leading enterprises develop in producing ,processing , marketing etc, to have integration for bamboo pulp paper engineering develop stably ,harmoniously, healthfully and guide the development for other small-medium enterprises. I t becomes pillar industry, which products bamboo pulp paper up to thirty thousand ton in 2010.

3.3 Intensive management promoting the process of the bamboo ecological

To make industry management more intensive and ecological is the process of harmonious development between human being and nature. It is also the new industry mode to realize sound circulation and the senior form of industry development. Coordinating the first, the second and the third industries relationship of bamboo is the foundation of bamboo industry’s development. The first, the second and the third industries are related closely with each other. They depend on and promote each other. The first industry is the base of the second industry, while the development of the second industry accelerates the extensive breeding of the first industry. vice versa, the acceleration of the first and the second industries promotes the marketing of the third industry to standardization, internationalization and marketization. Suijiang people should make efforts to

cultivate the resources of bamboo kinds so as to form own leading products with distinguishing characters. with further exploration of bamboo-processing, the leading enterprise should make full use of the brand-new effect of the good products .By implementing preferential policy to the expenses of taxation, the bamboo peasants and processing enterprise will have great motive to promote marketing. Besides that, it promotes the sound circulation of the producing, processing and sale of bamboo and realizes the mutual-benefit among the bamboo peasants, the corporations and the nation, as well as forming a new environment of a perfect bamboo market and the production becoming more ecological.

3.4 Construct famous brand, perfect marketing network system of bamboo industry

Following advance of production, market integration, it's important to strengthen marketing network system. Implementing the strategy for famous brand is useful to expand market share, improve products quality to recognize Industrialized management and participate in international competition .Suijiang should build up information platform on processing enterprises for shoot-bamboo, industrial market, trade centre and construct data base on condition for processing enterprises for shoot-bamboo and industrial market .Every functional department in Suijiang together deliberate the development of bamboo industry, establish association for the primary industry, the secondary and tertiary industry, increase advertisement force , perfect information network for product , promote product quality, and expand influence to form characteristic market for shoot-bamboo in Suijiang at home .Based on domestic market , starting to construct famous brand and information network to broadcast advertisement at prime time of international channel ,which punctually provide information to service , build international marketing network and advance healthy development for bamboo industry .

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Enhancing Bamboo Production and Utilization in Rwanda

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1. INTRODUCTION

There are some 1,200 species of bamboo species belonging to 70 genera in various parts of the world. They are mainly distributed in the tropical and subtropical regions where they are estimated to cover area of some 22 million hectares. As components of forest vegetation, they are mainly understorey species in mixed forest stands. However, with disappearance of upper storey tree species, they occupy the main storey of forests in some cases. In some regions like the highlands of Eastern Africa, bamboo is naturally regenerated in pure stands and are dominant forest vegetation at certain altitudinal zones.

As compared to the situation in the neighboring countries, Rwanda has very limited natural bamboo resources. There are two indigenous species – *Arundinaria alpina* which is predominantly found in the north eastern region around Parc de Volcans and *Bambusa vulgaris* which is predominantly found in the forests of Cret-Zaire-Nil region of the country.

Besides arboretum planting and research trials, bamboo has not been widely cultivated in Rwanda. Rwanda did not participate in the bamboo and rattan initiative in neighboring countries (supported by IDRC) about a decade ago. Thus, it has not benefited from trials of exotic species. However, more recently, there has been renewed interest in good quality bamboos in the country. For example, ICRAF has recently facilitated introduction of giant bamboo species. These are being propagated at Ruhande arboretum in Butare but survival is so far very poor.

So far, there has been very little work on processing and utilization of bamboo in Rwanda. Typically bamboo stems are used for fencing and construction of light structures. There is little processing beyond cutting and drying before use. Although bamboos are valued for fencing, the market for this has remained low and poorly developed since people prefer live fences (hedges). May be the market has also been constrained by limits in supply as the government has enforced bans on cutting of bamboo and other tree species. So far, bamboos are not very important on local economy. In few cases when it is traded in local markets, it has low value (currently, a pole of *B. vulgaris* fetches about US $ 0.20 in the main urban areas).

Due to the growing threat on existing bamboo resources, the Government of Rwanda (GoR) has recently imposed ban bamboo cutting. Furthermore, GoR has called upon ISAR and other agencies to engage in research and development aimed at enhancing production and utilization of bamboo in the country. It is in this background that GoR recently nominated one ISAR scientist to attend two months bamboo technology training course in China. This proposal is a direct response to this call.

2 TRENDS IN BAMBOO UTILIZATION

Bamboo has been used in building houses, making bamboo watercrafts and appliance for production, living and culture entertainment taking shelter from the wind and improving residential environment and using its shoots for food by people of bamboo-producing counties such as Asia, Africa and South American since as early as the beginning of mankind activities. Mankind's food, clothes, house and means of transportation have close relation with bamboo.

2.1 Bamboo in construction works

More than 70% of the annual bamboo wood produced in the world has been used for countryside buildings, agricultural production and people's daily life and less than 30% in modern industry raw material.

2.2 Bamboo in pulp and paper production

The properties of bamboo wood such as long and thin fiber, good plasticity are ideal for making different kinds of high-quality paper pulp, artificial silk and glass paper.Bamboo has many advantages like fast growth, high yield, growing into full size in short time and highly renewable, therefore, it can be used sustaintdly. Bamboo culms generally contain higher and better fiber than many hardwoods. Bamboo forest's per unit area annual fiber production is 1-2 time higher than that of coniferous or hardwood forest. Bamboo fiber content is 40-60%, with big density and without stripping, and its cooking quantity increases by 10-20% than that of timber or grass.

2.3 Bamboo Shoot Production

Edible bamboo shoots contain sugar, protein, cellulose and a great variety of mineral nutrition elements, vitamin A, B, C, and So on; they are considered to be natural health food promoting digest and excretion and reducing harmful substances and the occurring rate of toxication disease and bowel cancer.

2.4 Bamboo Wood processing

In spite of its clear advantages in physical, mechanical properties, the use of bamboo has been largely limited due to its size, form and fistular culm. Bamboos are mainly used in building houses, making furniture, farm tools and daily necessaries in bamboo.

2.5 Use in Making Bamboo Production and in Construction

China occupies the first place in the world in fine bamboo weaving, bamboo carving, bamboo handicraft articles, rattan products and bamboo articles of everyday use. Bamboo is also one of the oldest and most versatile building materials with many applications in the field of construction.

2.6 Bamboo Stands Play a Positive Role in Natural Environment

Since bamboos are evergreen, beautiful, tall and straight, fearless of cold, simple, clear and dancing in branches and leaves, they receive people's like and are praised highly.

Bamboo plays a positive role in conserving soil and water and regulating and controlling natural environment and climate. So bamboos can be planted at the upper reaches of or along the river, lake and reservoir in order to stabilize and protect bank or dyke against water's pounding.

3. PROJECT JUSTIFICATION

The rural population of Rwanda are menaced by serious problems of malnutrition and poverty due often to soil infertility which has become degraded by erosion. However, if we had planted and sustainable used bamboos on gradient lands, we would have been able to fight erosion and poverty, at the same time find out multiple bamboos products. So, once the project is implemented we will be lucky to get some products from bamboo serving as food and consumed a diet rich in vitamins, proteins and calories and the bamboos will be sold by farmers expensively to the transformation factories.

The rural population will be quickly sensitized about protecting the soil and it will be simple to get their comprehension because of their awareness that markets for their products are available, the old bamboos of the Volcano National Park which get decomposed because of being unused will be with great utility.

4. PROJECT GOAL AND PURPOSE

4.1 Project Objective (Goal)

The major objective of this project is to improve rural incomes, household food security and livelihoods of communities, while increasing the quality and productive potential of the natural and planted forests in the country. This is in line with the overall goal of GoR policy of improving rural livelihoods, increase food security and enhance sustainable management of natural resources..

4.2. Project Purpose

The purpose of the proposed project is to enhance profitable and sustainable bamboo production and utilization in the country. The project will stimulate investment in bamboo production and processing technology. The hypothesis is that improved productivity and profitability of bamboo production and processing will reduce pressure on the threatened existing bamboo resources. To achieve the purpose stated above the project will conduct a comprehensive inventory of existing bamboo resources and implement its improved management and protection. The project will introduce processing technologies for profitable enterprises, particularly in the areas of weaving, furniture production and charcoal production. The project will also introduce higher yielding and better quality bamboo species and varieties from other countries for testing in Rwanda.

5. PROJECT RESULTS (OUTPUTS)

The main results (outputs) of the project will be:

(i) Area covered, management status and productivity of existing bamboo forests and agroforests **inventoried and documented;**

(ii) Proven technologies for processing bamboo for charcoal production **tested, adopted** and **promoted**

(iii) Proven technologies for processing bamboo for furniture, brooms, woven mats and medicine **tested, adopted** and **promoted;**

(iv) Farmers and entrepreneurs capacity to exploit different market niches **improved;**

(v) Faster growing and better quality bamboo species and varieties **tested and promoted;**

(vi) Institutional and policy options for integrated bamboo production and utilization **identified and promoted**

6. PROJECT ACTIVITIES

Result 1 will be achieved through inventory of all existing forests and agroforests. Collected information will be analysed, documented and fed back to target communities.

Specific activities to achieve this result will include:

(i) Technical assistance (inventory expert for 3 months)

(ii) Purchase of maps and satellite imageries

(iii) Field surveys and ground truthing

(iv) Publication of results

Result 2 will be achieved through compression of sawdust and other wastes into briquettes for carbonization in improved kilns.

Specific activities to achieve this result will include:

- Purchase of briquetting equipment
- Equipment maintenance and operation
- Employment of 1 technician

Result 3 will be achieved through testing and adoption of technologies for bamboo furniture, bamboo mats, brooms and medicines.

Specific activities to achieve this result will include:

- Purchase of bamboo processing equipments
- Equipment maintenance and operation

- Employment of 1 technician

To achieve Result 4 markets for new bamboo products will be identified, entrepreneurs and farmer groups will be trained in processing bamboo products and linked to markets.

Specific activities to achieve this will include:

- Market surveys and identification of market niches
- Training for farmers and entrepreneurs on processing technologies
- Linking farmers and entrepreneurs to markets

Result 5 will be achieved through introduction of other better species and varieties for adaptation and growth in Rwanda.

Specific activities to achieve this result will include:

- Accessing improved germplasm, particularly from China and other countries
- Establishing field trials and demonstration plots on farmers' fields.

For Result 6 options for institutional and policy changes to promote and support sustainable bamboo production, processing and trade in bamboo products.

Specific activities to achieve this result will include:

- Review of existing policies and legislation
- Recommendations on the necessary changes in policy and legislation.

Study on Sectoral Development of Bamboo Culture in China

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ABSTRACT

The industrialization of Chinese bamboo culture in an organic combination of traditional bamboo culture with modern civilization, which is an important approach and carrier in developing culture productivity and efficient ways of securing the safety of local bamboo culture. But there are several problems such as inadequate attention by the government, lacks in cooperation inside the industrial organizations, imbalance in development between regions and the gradual disappearance of culture carrier. All of those problems had severely set back the industrialization development of bamboo culture and its internationalization. Based on the characteristics of Chinese bamboo culture and the situations in China, and on analysis of problems in the development of bamboo culture industry, this study explores seven industrialization development mode of combining bamboo culture with tourism, catering trade, entertainment industry, publishing industry, exhibition industry, processing industry in order to obtain the double win aim of culture and economy. The introduction of bamboo culture can enrich the connotations of bamboo culture products, while the booming of various bamboo culture industries can assure economic backup for the inheritance and development of bamboo culture.

Key words: Industrialization of Bamboo Culture, Development Mode, China

China is the most abundant nation in bamboo resources in the world. Bamboo is infiltrating into the every aspect of physical life and spiritual life gradually in the history long river of Mankind's civilization evolve evolvement and the unique Chinese bamboo culture became a excellent flower of traditional culture of Chinese nation. Just as the famed historian ChenYinke speak: The Chinese culture is bamboo culture. With the tenor of the new pattern of industrialization accelerating, the bamboo industrialization had already become four main rising sun industry of Chinese forestry. The ecological civilization is the aim and direction of Chinese ecological economy and society development as a higher layer civilization formation of human society after industry civilization. Today the develop quickly in the industrialization of culture how to seek the link point of Chinese bamboo culture and development of bamboo industry and construct the system of industrialization of bamboo culture in the stage of the ecological civilization is the need of protecting and inheriting the bamboo culture as well as the necessity to realize the sustainable of development of bamboo culture in China.

1 The development significance of industrialization of bamboo culture in China

The concept of industrialization of bamboo culture is based on Chinese bamboo culture to translate the potential value into cultural productivity and its direction is to product the production modern bamboo cultural and cultural service finally to become a circulating mode of marketable consumptive commercial industry of bamboo culture.

The relationship is a benign interaction of dependence and stimulating between bamboo culture and bamboo industry in China. The great and deep bamboo culture provide abundant cultural material for bamboo industry, the modern system of bamboo industry also provide a wide flat roof for the expanding of bamboo culture in the realm such as cultivation of bamboo resources, product processing of shoot and bamboo, exploitation of ecotourism and marketing.

1.1 Being advantageous to realize the request of knowledge-based economy

The era of knowledge-based economy bring great change for industry structure, namely, the industry of knowledge high tech and information service had occupied the main position. The development of industrialization of bamboo culture consider the advanced technology as measure, profound bamboo culture detail as spirit and vigorous developing bamboo industry as support which is agree with the request of knowledge-based economy development.

1.2Being advantageous to enrich cultural connotation of culture products

In the condition of steady upsurge for contemporary culture wave, intangibility acting as main characteristic of culture and abstractive can not satisfy people's demands. Materialization for traditional culture will become a trend of the development for culture industrialization. Industrialization of bamboo culture also adapts to the trend of times, the combination between bamboo culture and actual products will not only satisfy sprit demand for people, but also material demands.

1.3 Being advantageous to heritage and development of bamboo culture

According to unearthed potteries from Yangshao cultural relic before 6000, from recognizing symbol"Bamboo" to present , bamboo culture ubiquitously and everywhere plays an important roles in traditional culture of Chinese nationality centuries-old. Along with the social advancement and development of economy, science and technology, bamboo culture can omnibearingly inherit and develop in newer and higher platform of culture industrialization.

1.4 Being advantageous to protect safety of bamboo culture

In the present condition of cultural diversity, bamboo culture is faced with different culture shock from foreign , such as cultural products , culture capital and culture and education value; with the development of society, traditional bamboo products and facilities in daily life are gradually

replaced by portable and durable facilities . Whether bamboo culture has a stable position confronted with numerous and complicated culture is a problem paid close attention by many experts. But the protection for culture is not to keep firmly, stuffy not to simply and passively prevent , by contrary ,"walk out" is the most effective guide [2] . Bamboo culture chooses Industrialization of culture, take a path of attack in order to defend and show distinctive style and sustainable development.

2 The existing problems of the industrialization development of bamboo culture in China

The industrialization of Chinese bamboo culture produced at arisen background of knowledge-based economy in the global, because of short development course, it still at the primary stage of industrialization development as yet, concerning the study of the industrialization development of bamboo culture have no theory use for reference yet. The industrialization of bamboo culture in China is progressing in darkness as a result there are several problems in it.

2.1 Erring from right cognition and lacking powerful leading

For a long time, the profound of Chinese bamboo culture was confirmed by peoples, but they lack complete and general cognition for double attribute of bamboo culture carrier and only emphasize ideology attribute and ignore economy attribute. If things go on like this, it could err from the request of market economy can't get favor of market and impact the Comprehensive development of industrialization of bamboo culture seriously. Meanwhile, the departments of industrialization of culture pay less attention concretely to the development of bamboo culture, lack powerful encouragement for association and enterprise of bamboo culture and propaganda and leading for public.

2.2 The difference is obvious between southern and northern, regional culture is distinct

The familiarity degrees are different for the situation of bamboo growth and utilize between people in southern and northern and also their comprehension to bamboo culture exist great distinction. The main problem of the industrialization development of bamboo culture is to develop southern market and exploit northern market. Due of the restriction of economy level and traffic conditions the development speed and level of industrialization of bamboo in China is also imbalance between east and west. The eastern province such as Zhejiang, Fujian, Hunan province lead the development direction, but such as Sichuan, Yunnan province and so on development rather slow. However, the bamboo culture is more profound and history id more long in western. The imbalance development is one of main conflict between the heritage of bamboo culture and the industrialization development of bamboo culture.

2.3 The carrier disappear increasing and keep up with the time is exigent

Culture need by dint of some carriers to inherit and develop but due to the industrial stage coming, many cultural carriers such as bamboo weapon bamboo product tackle and means of transportation had loosed intrinsic function becoming adornment and handicraft, its cultural meaning also desalting and disappearing with it. Therefore, in the today of industrialization of culture keeping the authenticity nationality and traditional and using existing carriers adequately to dig deeply, so as to traditional culture and advanced civilization to integrate renovate and transform into economy benefit to serve Socialist Construction constantly.

2.4 Lacking industry cooperation and the industrial chains is over short

The connotation of bamboo culture is abundant and the form is various but it didn't integrate with other cultural industry forms such as tourism perform industry and film and TV industry but existing only one form also didn't provide powerful cultural sustain for more industry. As valued industry resource, the exploit and utilize of bamboo culture bring huge promotion effect consequentially for the industrialization development of bamboo culture in China.

3 The development pattern and prospect of industrialization in Chinese bamboo culture

The culture industry was core industry of economy in twenty-first century, the development of bamboo culture ought to keep up with epoch and weak up to begin road ,which was culture industrialization. The future should become brighter and brighter. History endows with bamboo culture of profundity are combined with epoch endows with industrialization of opportunity consummate, such as bamboo culture is linking up tourism show business dietetic and publish organic, which is propitious to achieve development of span innovative in more scope and more ambit.

3.1Excavate bamboo culture of nation and expansion bamboo forestry eco-tourism

Bamboo culture is the bamboo forestry ecotourism of soul. Actually, the bamboo forestry ecotourism is carrier of bamboo culture. The minority's bamboo culture plays an important role in Chinese bamboo culture. we should tidy up minority's bamboo culture symbol and excavate bamboo culture view, strengthen bamboo forestry resource cultivate characteristic ,construct bamboo forestry ecotourism scenery and construct bamboo forestry ecotourism environment interpretation system, which are getting into shape dot line and surface bamboo forestry ecotourism scenery network system. According to statistic that Zejian Sichuan Guizhou Chongqing Hunan and other province was taking advantage in bamboo resource respectively to form all kinds of views, such as nation □A views: hunanzhuhai and anje zhu bo yuan, nation forestry garden: anjidazhuhai chishui Bamboo Sea, yongchuanchashan Bamboo Sea , province view: Taohuajiang Bamboo Sea huanbaili Bamboo Sea of chonqing yixin Bamboo Sea of jiangsu and etc. To achieve bamboo culture industrialization of path effective is tapping indigenous characteristic 、 provincial

characteristics obviously、bamboo culture profound、infrastructure completely、environment protection fulfill of bamboo forestry eco-tourism.

3.2Disinter bamboo human landscape and fracture superior singing and dancing, film and TV

In a long history, which is forming bamboo literary arts、bamboo painting arts、 bamboo flock way civilization .According to imperfect statistic, exceed four thousands poetry, ci songs and fu glorify bamboo, at the same time, the flockway civilization and allusion—legend describes bamboo numerous to enumerate. Taking advantage in modern science and technology to impress bamboo human landscape from history in order to come into being graphic, audible and the education involved in the entertainment of production. For instance, from minority dai nationality, jinpo nationality, hani nationality etc bamboo flockway civilization and bamboo adore to collect ,agreement and creation old—ecology bamboo sings and dance perform ,bamboo culture arts transfer to commonage by stage art. Making use of the nationality bamboo instruments to perform classic music pop music and origin music to satisfy the requirement of audience.

AnJi country of ZheJiang province of southeast of China and Southern Sichuan Bamboo Sea act for a movie of *CROUCHINNG TIGER, HIDDEN DRAGON* of outdoor scene photography and Yongchuan Bamboo Sea of Sichuan province of southwest of china act for *HOUSE OF FLYING DAGGERS* of outdoor scene photography with which a beautiful environment, pastures and the perfect story, and won the great majority of the audience at home and abroad the love is a high box office revenue, and has won many international awards. September 2006, the *Banquet* is onto the screen, which is the *CROUCHINNG TIGER, HIDDEN DRAGON* after another movie bamboo forestry as background ,while time, the dramatic team chosen Anji bamboo sea as shooting area what make use bamboo build "Wuyue Posthouse". Consequently, make the best of modern mass media （movie, TV, internet, broadcast, creating singing and dancing、 film and TV production show bamboo culture art of magic, traditional bamboo culture ought to transform to popularization culture art is important development of aspect of Chinese bamboo culture industrialization.

3.3Inherit nationality bamboo handicraft, cultivate rural culture industrialization

The bamboo handicraft of Chinese minority is of nation characteristic, which is the essence of Chinese bamboo culture .For example, the people of dai nationality is famed for knot bamboo implement. Beside produce various living products, when the people of dai nationality are going off, their waist hitches bamboo basket exquisite. The bamboo basket not only decorates with them, and also is of applied value. The shelter—hat is the best feature in buyi nationality multitudinous handicraft .It used thin bamboo strip knot, the knot work not only is of ingenuity, and also art style is of value higher. The tong nationality bamboo knot work is very refinement also. The people of tong nationality used bamboo knot dinner bucket are unique. The Chinese minority region should layout sciencetic composition rational and guide organized to build nation bamboo knot handicraft

base in village. Bases on inherit national special arts and crafts to utilize modern bamboo machining ,at the same time ,expanding production scale and improving productivity ameliorating production craft in order to yield bamboo knot tourism handicraft batch-wise for impel minority region lumpish economy grow.

3.4 Adopy Bamboo dietetic culture and boost mensal eco—civilization

The modern medicine research is testify that bamboo shoot is abundant in protein, multi- amino acid, fat, sugar, calcium, phosphorus, ferrum, carotene, vitamin B, C and so on. For instance, per 500g bamboo shoot contains 15g protein, which contains 18 species amino acid. Bamboo shoot had the higher crude fiber known as human seventh nutrition, it is absolutely necessary nutrients in cure illness and extend longevity. Nowadays, eating bamboo shoot is very popular all over the world. It is reports that edible shoot should increase gradually 15 percent and international market price average increase 4.1 percent per year. Bamboo shoot is famous of the best green-food and organic food. Bases on inherit and develop traditional bamboo shoot processing technology, cooking, generalize tableware the use of bamboo, combined an idea of healthy and nutrition, constructed nation eatable shoot customer, western eat habit and ecology civilization integer modern bamboo eatable culture industrialization system, planed production bamboo shoot and bamboo dishware accord with demand of eastern and western market to realize Chinese bamboo eatable culture of sustainable development.

3.5 Testify bamboo culture history, build new pattern bamboo museum

China have had the glorious 6000 years bamboo culture, which is revealing Chinese nation “sensible spirit “and civilization, the use of bamboo of production appliance, living implement, bamboo architecture, bamboo vehicle had been play an important role in old times, but in these latter years, traditional apparatus had instead of implement of advance convenient and shortcut, faced with evanescent risk, It witnessed the development of bamboo culture history, we ought to take active steps to protect it. Accordingly, we should build new pattern bamboo museum, which melts protect and collection cultural relic、exhibition 、research and education, it attracts a large people to visit. Museum Shunanzhuhai、Bamboo Museum in China、Hunan Taohuajiang Bamboo Museum、Sichuan, China bamboo crafts museum are developing into culture industrialization .

3.6 The bamboo spirit connotations transform into materialize outcome and come into existence enterprise of culture

The protection and development of bamboo culture should look for way to integer materialize and immaterialize .One hand, it may inherit bamboo culture of immater, on the other hand, it may cater to demand of people for bamboo culture products .Thereby, we comes into existence relate culture industry is to immaterialize the bamboo spirit connotations, at the same time, I t is effective

approach to develop bamboo culture industry. The enterprise ought to integrate bamboo culture, tourism, food and drink service, publishing service and exhibition industry organic involved in modern elements applied internet market to tip domestic and international markets. It not only protects and adopts bamboo culture but also it innovates and progresses bamboo culture, simultaneity, it may integrate social benefits and economic benefits perfectly to boost economic development of culture enterprise.

3.7 Refine bamboo resource essence and vigorously develop processing enterprise

With the development of economy and progress of science and technology, people is further improve utilize rate of bamboo scourge, sheath, root, culms, reed. Recently, the domestic bamboo shoot and handicraft have 10 kinds and over 3000 species such as bamboo shoot, bamboo daily implement, bamboo handicraft, bamboo floor, bamboo veneer, bamboo furniture, bamboo coal, bamboo fiber, bamboo paper, bamboo chemical Products, bamboo production is abundant in gradually, the market is to be widened. Based on existing scale and technology, refining bamboo resource essence and stepping up taste of bamboo handicraft and vigorously develop processing enterprise will bring along development of local economy and impel enterprise to expand strength, which is new rise rate in culture industrialization.

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Study on the Models of Community Development of Bamboo Forest Ecotourism

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ABSTRACT

Recently, with bamboo forest ecotourism developing rapidly and the community participation in the development of bamboo forest ecotourism had become a focus. There is a benign relationship between bamboo forest ecotourism and community participation, that is, bamboo forest ecotourism can strongly promote the community's flourishing development, meanwhile, the improvement of life quality of the local residents also push forward the protection of environment and the sustainable development of bamboo forest ecotourism. Based on the centuries-old of community culture, tender ecological environment of bamboo forests, unique characteristics of landscape, obvious advantaged of the industry, several principles such as human-orientation and coordinated growth promotion, long-term programming and sustainable development, coherence of culture and subculture keeping the feature of community and giving prominence to visualize interaction of community and cooperation and mutual aid. Aim at the development histories industry structures and regional advantages of different community of bamboo forest ecotourism to bring forward the mode of ecotype, modes of culture, mode of service and mode of experience.

Key words: Bamboo Forest Ecotourism, Community Development, Mode, Study

Recently, bamboo forest ecotourism is developing rapidly. At the same time the study of community development of ecotourism had become a focus, however, no one as yet studied the mode of community development of bamboo forest ecotourism. This paper introduced the idea of community development of ecotourism into the study of bamboo forest ecotourism, based on the direction of the theory of community development and ecotourism, got the breakthrough point of combination of bamboo forest ecotourism and the mode of community development, discussed and groped a mode of community development to fit the requirement of bamboo forest ecotourism in China, the purpose is to provide theory basis for the benign and normative development of bamboo forest ecotourism.

1 The relationship between bamboo forest ecotourism and community development

1.1 Bamboo forest ecotourism drive community development

The direct representation of bamboo forest ecotourism driving community development is economy. It is by way of a new tourism industry of infiltration and amalgamation of forestry and tourism, the first industry and the third industry. Adjusting and optimizing forestry structure, stimulating bamboo industry development, adding employment opportunity, increasing residents' earning thereby advancing community economy development[1].

Besides that, bamboo culture is a necessary and important content of bamboo forest ecotourism, the history of bamboo culture is centuries-old and long standing in China, but no people understand and know well in deed, therefore, tourists enter bamboo forest ecotourism community to enjoy, study, feel and experience the local bamboo culture, change the past superficial and behindhand cognition of bamboo culture, understand the historical aggradations as well as development keep pace with the times of bamboo culture. Tourists comprehend the bamboo cultural connotation of community profoundly, make for the community bamboo culture is propagandized, carried forward and advanced community repute.

The community environment is the warrant and basis as well as harvest of community constructing and management[2]. In order to give a good impression of community to tourists, stimulate and enhance their consumption, inspire tourism of bamboo forest development thriftily, the stakeholders of community such as the department of local government, proprietor, the community residents have responsibility and obligation to maintain, regulate, beautify community environment, increase the constructing strength of establishment of community environment protection, it make community heading towards the auspicious and harmonious direction to develop.

1.2 Community development accelerate bamboo forest ecotourism progress

Bamboo forest ecotourism community is human group and activity region, which have some interactive relationship and common bamboo culture holding force, in which tourists could hold tour activity. Holding the life of local residents that is one of connotations of ecotourism[3], community participation is one of three test standards of ecotourism, ecotourism emphasize using establishment and service of local residents and bring economy benefit to local residents. Therefore, flourishing local economy and accelerating community development is ecotourism connotation, test standard and is benign consummation of bamboo forest ecotourism.

Community development of bamboo forest ecotourism depends on the growth condition of bamboo resource. Environment protectionism consider that ecotourism is main approach of sustainable

utilize of tourist resources and is ideal bourn of tourist operation, it was explained detailedly that satisfying the aim of protection and development and community participation just accord with this aim[4]. A normative and mature community demand residents use bamboo resource reasonably, prevent hewing bamboo and picking shoot, deteriorating riverhead, destroying biology diversity of bamboo forest, meanwhile, build harmonious environment-friendly ecological beauty community environment, to realize sustainable development of bamboo forest ecotourism.

2 The development principle of bamboo ecotourism community

2.1 The principle of human-orientation and coordinated growth promotion

Community tourism is a embodiment about the ideas of humanism in tourism, the community development of bamboo forest ecotourism should according to the springboard of human's need and based on human's contentment, treat human's activity as a center, deal with the relationship between long-term benefit and short-term benefit, part benefit and whole benefit of residents reasonably, adjust the relationships among tourists, residents, proprietors and other stakeholders , to advance community harmonious development.

2.2 The principle of long-term programming and sustainable development

The sustainable development theory is one of ecotourism theory base, if community economy, environment and culture realize sustainable development bamboo forest ecotourism could realize sustainable development. Community hold activity in rang of bearing capacity of environment and resource, it not only satisfy present human's need but also satisfy our offspring's need.

2.3 The principle of coherence of culture and subculture

The subculture is different from social mainstream culture at some aspect which appear from the especial soil and humanistic environment of bamboo ecotourism community, however, it bring important effect for community residents[5]. For instance, the bamboo forest community was influenced by custom of Dai nationality in Xishuangbanna of Yunnan province for a long time and form strong Dai nationality conditions and customs community culture, however, the residents of Southern Sichuan Bamboo Sea represent obvious southern Sichuan culture feature about their apparel, foods, house and travel. It is obvious that, different community possess respective subculture, these residents who was influenced by subculture should bring into and adapt mainstream culture, subculture bring into play active effect for community as well as reduce and avoid negative effect, to make community subculture and mainstream culture became harmonious and consistent.

2.4 The principle of keeping the feature of community and giving prominence to visualize

Nowadays, the assimilation phenomenon of tourism become serious increasingly in the world and the individuality of different tourism become illegibility gradually. The community of bamboo forest ecotourism is a potential selling point for the development of bamboo forest ecotourism, the whole community image is more important, meanwhile, community image is the base of sense of identity of community population is the headspring of community cohesion[6] is concentrated representation of difference among communities and is material expression of tourism destination zone culture. Bamboo forest ecotourism need vindicating unique image and strengthening constantly.

2.5 The principle of interaction of community and cooperation and mutual aid

Among different tourist community exists competition, collision and cooperative mutual relationship, the development of tourist community need consider the difference and complementarities of surrounding tourist community, avoid collision, reduce competition, enhance cooperation, mutual benefit and mutual aid and develop together as soon as possible.

3 Discuss on the mode of community development of bamboo forest ecotourism

3.1 The mode of ecological community

3.1.1 The connotation of mode of ecological community

The mode of ecological community of bamboo forest ecotourism is a community development form of resource gift. This kind of community is an ideal community of human, bamboo resource and environment of harmony, it based on ecological environment of bamboo resource, the community constructing on the foreland of sustainable development, seek the high-level harmoniousness between community environment and bamboo environment, the purpose consist in providing a green health clean and benefit for body and mind community environment.

3.1.2 The characters of mode of ecological community

The mode of ecological community of bamboo forest ecotourism consider bamboo resource as community environment main body, posses good entironment and social environment and thus ecological community have the feature of harmonious and durative. Due to the frangibility of bamboo resource and thus ecological community also have feature of frangibility.

3.1.3 The constructing of mode of ecological community

Constructing ecological community of bamboo forest ecotourism change the following thousands years consuetude of hewing bamboo and using bamboo, advocate protecting and using bamboo reasonable. The community to reduce destruct of material and energy exchange between

production and life of resident and surrounding environment as well as material exchange of between production and life of resident and tourists, based on protection to bring into play ecological effects to most and to limit all kinds of castoff of tourist activity in bearing capacity of environment strictly, make tourists to feel overflowing green and Vitality when they enter the ecological community.

3.2 The mode of cultural community

3.2.1 The connotation of mode of cultural community

The cultural community of bamboo forest ecotourism considers historical current potential and can be integrated cultural resource as the development pole soul and main atmosphere of community, concentrate and integrate cultural resource moderately, form unique charm cultural characteristic and long vitality to drive and accelerate industry of surrounding region to develop.

3.2.2 The characters of mode of cultural community

The cultural community of bamboo forest ecotourism should be provided with four features, first, the strategic character, cultural community consider culture as strategic pivot of community development, regional industry of culture possess strong driving force for the development of surrounding region. Second, the basic character, recondite and agelong bamboo culture is the stability base of cultural community, Bamboo formed a deep sensation with the Chinese nation connect with centuries-old Chinese culture close and play a main role in people's daily life. Third, the resource character, this kind of resource includes actual, potential and can be integrated resource. Concentrating and integrating resource moderately could coagulate into brand form unique charm cultural characteristic and long vitality. Four, the development character, cultural community is incapable of consuming the capital of bamboo culture. It is getting rid of the stale and brings forth the fresh with times advancement, only developing can be attracted tourists' sight and satisfied tourists' taste.

3.2.3 The constructing of mode of cultural community

The final aim of constructing cultural community consist in tourists enter the cultural community realize original and indigenous bamboo culture, give the bamboo culture which was nearly sheltered and covered by modernization and high-tech a chance to show up thereby inherit and carry forward. Besides that, as times changed, community culture can appear varying degrees acculturation phenomenon, but acculturation of community of culture don't touch the groundwork of traditional bamboo culture it thanks to the inveteracy of it, tourists can feel study and appreciate the bamboo culture of essence same but individuality dissimilar in different community of bamboo forest ecotourism. For instance, to seek the mystery of minority bamboo culture in hundred

bamboo garden in Xishuangbanna and to appreciate the lasting appeal of southern Sichuan culture in Southern Sichuan Bamboo Sea.

3.3 The mode of experience community

3.3.1 The connotation of mode of experience community

The experience community of bamboo forest ecotourism provides a community space in which people through vision, hearing, smell, touching and participation experience to satisfy psychology need of realizing ego for tourists. The aim is to making tourists to get a material and deep cognition and understanding of bamboo forest life.

3.3.2 The characters of mode of experience community

There are three characters about experience community, the first is participation character, only do something by oneself the impress can be deep and understanding can be comprehensive. The second is authenticity character, the more true and extensive of participation activity the understanding more deep of resident life for tourists. The third is unique character, the tour product

3.4 The mode of service community

3.4.1 The connotation of the mode of service community

The base and tenet of service community of bamboo forest ecotourism is to service tourists. The tourists could feel comfortable and harmonious as well as enjoy the unique service of bamboo forest ecotourism to relax mood and take care of themselves when they enter the service community.

3.4.2 The characters of the mode of service community

The main character of the service community of bamboo forest ecotourism is service character and the service objects are tourists. The secondly is the integration character, the service community integrate the cultural atmosphere of cultural community the ecological environment of ecological community and the experience items of experience community to become comprehensive service item and foundation. The last character is human-orientation, the service objects are tourists whose in the tourist areas the community provide humanity comprehensive and comfortable service.

3.4.3 The construction of the mode of service community

The service community will implement the tourists forget the unhappiness when they there forget to return when they dwell there and forget the fatigue as best it can. The tourists can enjoy the comprehensive unique service and feel at home in the community such as to taste the bamboo feast

to appreciate the performance of bamboo material to listen the sound of bamboo musical instrument, to wash out the fatigue and un comfortable from tour to relax the over pressure and return a relaxing and delighted body and mind to tourists.

Above four modes of community development has respective character and the development directions are different. Based on the history evolution the development mode could be single mode or complex mode. From the long-term to see, with the bamboo forest ecotourism becoming more and more perfect, the mode of community development of bamboo forest ecotourism will transform from single mode to complex mode more and more.

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Recommendations to the Development of Bamboo Industry in You Xi County

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ABSTRACT

Point out in next years the bamboo industry work in You Xi: From the model of being control by government to the model of market-directed economy; Suggest at present the main work of developing bamboo industry in You Xi is protecting *Ph.var.pubescens (Mazel) Ohwi* resource, developing market of *Dendrocalamopsis oldhami* and local bamboo.

Key words: You Xi County, Bamboo Industry, Development

The bamboo business and poverty reduction:Initial insights into high impact industrial development strategies from the Mekong

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ABSTRACT

Thirty years ago, industrial processing of bamboo was limited to bulk processing for paper and some medium value processing, such as chopsticks and fans. Recent commercialisation of new processing techniques has created new markets and new opportunities for the development of the industry.

Using evidence from the emerging bamboo industry in Vietnam, Laos and Cambodia, and the mature industry in Anji, China, this paper considers the potential impact of various industrial development strategies, with an emphasis on their pro-poor impact.

The paper concludes that policy makers now have the opportunity to choose high impact industrial development strategies and dramatically increase the pro-poor impact of an emerging bamboo sector.

Key words: Bamboo, Bamboo Sector Development, Mekong Rural Strategy, Poverty

Introduction

Recent commercialisation of new processing techniques has created new markets and new opportunities for the development of the bamboo industry. These new market opportunities have created new policy options to harness the bamboo sector for accelerating rural development and reducing poverty.

This paper is based on the recent Oxfam Hong Kong – IFC MPDF Mekong Bamboo Sector Feasibility Study. The objective of the paper is to illustrate the potential impact of the sector and its different component industries and to highlight potential policy options and quantify their impact. More detailed discussion and data can be found in the main study report (available on request).

Assessing the impact

The potential socio-economic[13] impacts of the sector have been assessed using a combination of measures based on data collected from businesses, farmers and traders currently active in the sector:

[13] Environmental impacts were examined but discussion is beyond the scope of this brief paper.

Box 1: What is 'pro-poor financial impact'?

In assessing the potential of the sector we want to understand not only its total size in terms of output value and revenue but also how much of this is captured by poor communities compared to being taken as profits of larger businesses, interest payments or other expenditure that leaks value from the local rural economy.

We have used the term **'pro-poor financial impact'** to describe this local component of total revenue that is captured by poor communities. To examine this we asked enterprises to estimate the proportion of their total costs that were spent on the main 'local' costs such as labour and bamboo and provide estimates of their profit margins and other main costs.

Bamboo and labour together typically represented approx. 80% of total cost of production for most bamboo processing industries with profit margins of approx. 7% (but ranging typically from 0% to 12%). So at the processor level, approx. **75% of revenue is captured by local costs compared to approx. 7% taken as profits**. (The notable exception is paper where only approx. 33% of revenue is captured locally.)

These estimates reflect the 'factory gate' price paid for bamboo. As such they include the total local value-added and profit captured by farmers, traders and transporters along the local value chain. They include local costs such as raw material, labour, local fees and profits of farmers and local traders but also transport costs. When bamboo businesses are sourcing bamboo from poor rural communities, as is most often the case, this is a useful approximation of the value captured by poor communities. However, it is only a proxy measure. The main limitations are that it:

- underestimates the total pro-poor impact as it does not reflect the wider impact of reinvestment of profits and surplus capital by farmers and local traders back into the local economy.
- overestimates the direct 'pro-poor' impact as they also include transportation fuel costs and do not differentiate between the benefit captured by non-poor farmers and traders and the genuine poor. For example, the study found that when transported up to 20km fuel costs may represent around 10% of the factory gate price.

1. **Overall financial impact**: the total value of the output of the supply chain.

2. **Pro-poor financial impact**: the component of the overall financial impact captured by waged income and income to farmers and small businesses close to source (i.e. 'local costs' – see Box 1). The study suggests that this typically amounts to around 75% for the sector (except for bulk products like pulp/paper).
3. **Employment creation**: the total number of Full Time Equivalent (FTE) jobs created in farming, pre-processing, secondary processing and in associated activities such as transport and loading, trading and wholesale.
4. **Total direct beneficiaries**: the total number of workers and farmers directly benefiting from the sector. This will be higher than the FTE Employment creation as most farmers only spend part of their time growing bamboo.
5. **Distribution of benefits between men and women**: the percentage distribution of benefits between men and women for each supply chain, based on the share of employment creation captured.
6. **Geographical distribution of benefits**: the distribution of employment creation along each supply chain is used as a proxy measure for the potential geographical distribution of benefits. The proxy indicator used is the percentage of jobs with potential to go to rural communities. This is assumed to equal employment creation among farmers, traders and primary processing workers.

Each of these measures is expressed in two forms:

a. **Efficiency of impact**: measured as the rate of employment creation or financial impact (pro-poor and total) in the sector per hectare of land committed to bamboo production. This measure permits very clear policy and strategic decision making, and permits the comparison of benefits with competing options for land-use.
b. **Scale of impact**: measures the overall scale of benefit which may potentially accrue with given market opportunities and resource base.

Taken together, these measures indicate clear choices about strategic policy options at both national and provincial level.

Efficiency of impact

The efficiency of impact is assessed for the supply chains associated with each individual industry in terms of the five socio-economic measures outlined above. For each industry, the rates of impact per hectare of bamboo include the full impact along the domestic supply chain. The analysis, summarised in Table 1, is based on data obtained by the study from farmers, traders and businesses operating in each industry.

Arguably the most critical measures from a pro-poor perspective are the rates of 'pro-poor financial impact' and 'employment creation'. Against these two measures, the analysis in Table 1 confirms important differences between and within the different sub-sectors:

Handicrafts: Very high rates of pro-poor financial impact and employment creation per hectare of bamboo. This is due to the highly manual processing of relatively small volumes of bamboo, with most benefit gained by small scale processors and factory workers. This supports the argument that handicrafts are a distinct sub-sector, based mostly on the sale of artisan labour rather than of large volumes of bamboo material.

Table 1: Rate of impact of bamboo industry supply chains

Industry	Overall financial output (wholesale) ($/ha.)	Pro-poor financial impact ($/ha.)	Employ-ment creation (FTE/ha.)	Total benef-iciaries (farmers & workers/ha)	Local Costs (% of total costs)	% women in supply chain (% FTEs)	% jobs in rural comm-unities (% FTEs)
Handicrafts (VN)	14,3000	11,300	39	40	85%	60%	95%
Bamboo Shoots (CN)	3.800	3,100	0.4	1.1	90%	31%	100%
Flooring (VN)	3,100	2,400	1.2	1.9	85%	49%	35%
Chopsticks (VN)	1,600	1,300	1.1	1.8	85%	49%	46%
Woven mat (VN)	1,100	1,000	0.9	1.5	100%	42%	100%
Mat board (VN, panels)	1,300	810	0.8	1.5	70%	46%	98%
Charcoal (CN)	600	420	0.2	0.9	75%	37%	95%
Charcoal (Laos)	320	180	0.3	1.0	60%	38%	79%
Paper + pulp (VN)	1,500	490	0.3	1.0	35%	38%	66%
Raw culms ‘luong’ (VN)	360	360	0.1	0.8	100%	31%	100%

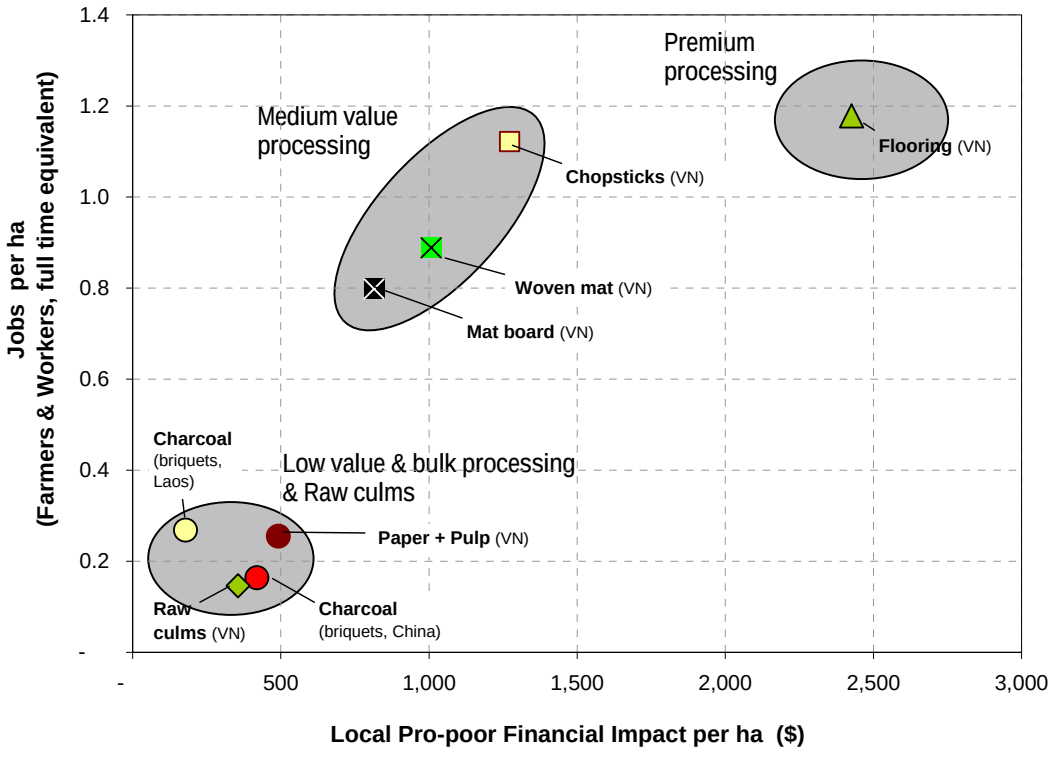
Data shown are for the whole supply chain for each industry, Source: Study analysis

Bamboo shoots: Deliver high levels of pro-poor financial impact per ha. due to the higher prices and yields of shoots compared to culms. In this sense, shoots are a high value agricultural crop. However, shoot farming creates relatively little employment. Most of the financial benefits are retained by farmers.

Industrial processing: From a pro-poor perspective, 3 distinct industry groups emerge within the industrial processing sub-sector. These are illustrated in Figure 1 below.

- **Premium processing industries**, such as flooring, have the highest rates of pro-poor financial impact and employment creation of the industrial processing industries, but require premium quality bamboo. Their rate of economic impact is twice the level of the Medium value processors and five times the level of the Low value and bulk processors. Similar results would also be expected for modern furniture industries.
- **Medium value processing industries,** such as chopsticks, woven mat and mat board (panels) create similar levels of employment to the Premium processing industries but only half the pro-poor financial impact per ha. of bamboo. However, they are able to use lower grades of bamboo.
- **Low value and bulk processing industries,** such as charcoal, paper & pulp, have low rates of both pro-poor financial impact and employment creation. They achieve only marginally higher levels than selling unprocessed bamboo to the construction industry. This lower impact is partially offset by the fact that the industry can utilise low quality bamboo, leftovers and processing waste from other industries and various species (e.g. "nua").

Figure 1: Employment creation and Pro-poor financial impact



Source: Study analysis & survey data

Scale of impact

The total scale of impact of the sector depends both on the efficiency of the impact of the component industries as well as the realistically achievable scale of each industry. The achievable scale of each industry was assessed according to both demand and supply driven scenarios. These were combined with the analysis above to assess the total potential impact of each.

At a sub-sector level the analysis leads to the following conclusions (see Table 2):

- **Handicrafts**: are the most important source of employment creation, accounting for more than 75% of all employment in the future sector. Their pro-poor financial impact is substantial but they deliver relatively little benefit to farmers.
- **Bamboo Shoots**: is the smallest of the three sub-sectors, but its high financial impact rate means that it provides 10%-20% of the pro-poor financial impact from just 1% - 2% of the employment.
- **Industrial Processing**: emerges to become the largest sub-sector for pro-poor financial impact, accounting for up to 60% of the total pro-poor financial impact of the sector. The sub-sector also consumes the largest share of bamboo (>85%) and so is the most important sector for delivering large scale benefits to farmers.

Table 2: Summary of Mekong Sector Potential

Sub-sector	Overall impact	Impact scale in Vietnam, Laos &			Impact efficiency			Gender bias of impact	Rural bias of impact
		Pro-poor financial	Financial output	Job creation	Pro-poor financial	Financial output	Job	% of	% of
		$m	$m	FTE	$/ha.	$/ha.	FTE/ha.	FTEs to	FTEs to
Handicrafts	*****	***	***	*****	*****	*****	*****	*****	*****
		266	336	920	11,300	14,300	39.2	60%	95%
Bamboo shoots	**	**	*	*	*****	*****	*	*	*****
		111	136	16	3,100	3,800	0.4	30%	100%
Industrial Processing	*****	*****	*****	****	**	**	***	***	***
		532	716	296	1,113	1,498	0.6	45%	62%
Premium Processing	****	***	***	***	****	****	****	****	**
		263	340	129	2,400	3,100	1.2	49%	35%
Medium Value	***	**	**	***	***	**	***	****	****
		163	190	123	1,037	1,333	0.9	46%	72%
Low value &	*	*	*	*	*	**	*	**	****

bulk processing		46	126	20	455	1,050	0.2	37%	81%
Raw bamboo	*	*	*	*	*	*	*	*	*****
		60	60	24	360	360	0.1	31%	100%
Total		**909**	**1,185**	**1,232**	**1,690**	**2,203**	**2.3**	**56%**	**87%**

Based on Mekong Sector Scenario 2 - "Greater share of growing world markets"
Data shown is for whole supply chain for each sub-sector.
Source: Study analysis

Policy options for Industrial Processing

The previous discussion has focussed on the differing scale and efficiency (rate) of impact from different component industries of the bamboo sector. We will now consider the practical policy implications of this for the Industrial Processing sub-sector.

As demontrated above, the greater range of bamboo processing industries now available creates opportunities for new industrial models for the Industrial Processing sub-sector that deliver high impact pro-poor rural industrialistion.

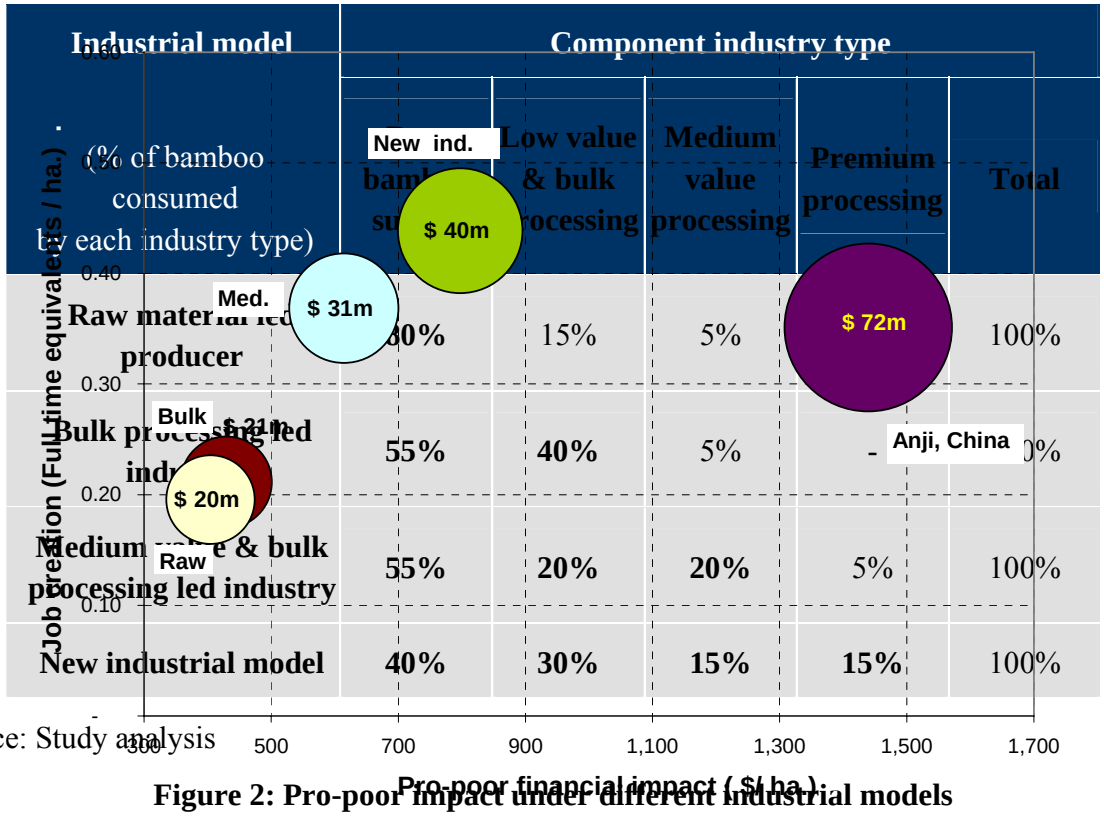
To illustrate the difference between the older and newer industrial models we can consider the impact that can be achieved by using a sample area of 50,000 ha. of bamboo. We shall consider four different industrial models:

1. Raw material led producer
2. Bulk processing led industry
3. Medium value and bulk processing led industry
4. New industrial model, balancing premium, medium, low value & bulk processing

In reality, in all bamboo sectors a large proportion of the bamboo harvested gets used in unprocessed form in construction and other houshold uses. Similarly, while one type of industry may dominate the sector in a particular location, there will always be other types of processors operating on a smaller scale. The differing scale of each component industry in the 4 broader industrial model examples is shown in Table 3.

These different component industry mixes can be combined with actual data from farmers and businesses in Vietnam, Laos and Cambodia to calculate the impact of each industrial models from a sample 50,000 h.a of bamboo. This is illustrated in Figure 2 below.

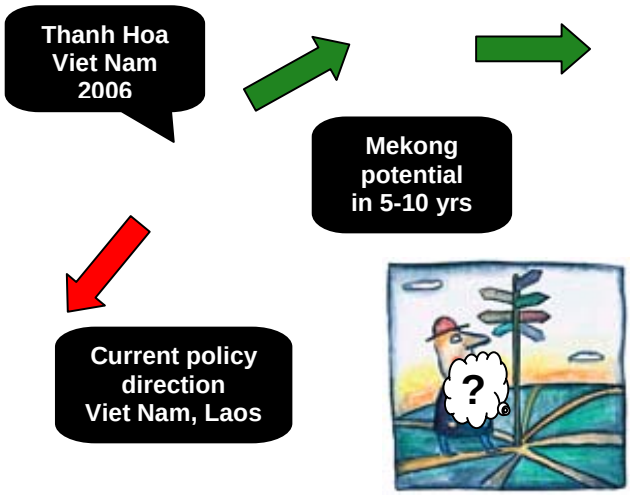
Table 3: Component industry mix in 4 different industrial models



Source: Study analysis

Figure 2: Pro-poor impact under different industrial models

Key: $40m = Total pro-poor financial impact from 50,000ha.



The four example industrial models outlined in Table 3 are illustrated by the four bubbles on the left of Figure 2. These are based on current material wastage rates in Vietnam, which are substantially higher than those in Anji, China.

Even at these higher waste rates, the better balance of component industries in the '*New industrial model*' creates twice the pro-poor impact of either the '*raw material led producer*' or '*bulk*

processing led' industrial models. This creates attractive options for policy makers in bamboo producing areas to promote improved industry mixes and achieve greater local impact.

It is notable that in Anji, the industry generates approximately 225% of the value from a give area of bamboo compared to the current Thanh Hoa industry in Vietnam, approximated by the "*Medium value processing led industrial model"* (Thanh Hoa is one of the leading bamboo provinces in Vietnam and the Mekong region). Of the additional 125% of value created, 80% is captured directly by farmers through higher prices while a further 20% is captured by workers through higher wages.

Anji's greater performance is possible due to greater added-value utilisation of the raw material. This in turn is based on structural efficiencies in the industry (centred around primary processing workshops) and diversified products. This means that despite prices of bamboo being more than twice those in Vietnam, actual costs of products sold on the market are typically 5-15% lower.

Policy makers wanting to develop local bamboo sectors can therefore act in two areas:

1. To promote a better mix of component industries, maximising the amount of premium and medium value processing but also balancing this with bulk and lower value processing to ensure good utilisation rates of the raw material.
2. To encourage the development of more efficient industry structures that allow waste rates to be reduced and different parts of the raw material to be easily used in the most productive way.

These issues are of particular relevance in the Mekong where current policy in some areas appears to be geared to the expansion of bulk and lower value industries, such as paper, without a corresponding growth in medium and premium processing.

Conclusions

Recent developments in the bamboo industry have created new opportunities for the development of high impact, pro-poor bamboo sectors to drive rural industrialisation.

These developments are already proven in practice. Furthermore, these high impact industrial development models for the bamboo sector are within the reach of policy makers in the more advanced bamboo producing regions in the Mekong countries and elsewhere.

The analysis summarised here provides an initial framework for re-examining the role of bamboo in rural economic development strategies as well as highlighting the potential for improving on existing bamboo sector development policies.

Action is recommended in two areas for the development of high impact industrial processing bamboo sub-sectors:

1. To promote a better mix of component industries, maximising the amount of premium and medium value processing but also balancing this with bulk and lower value processing to ensure good utilisation rates of the raw material.
2. To encourage the development of more efficient industry structures that allow waste rates to be reduced and different parts of the raw material to be easily used in the most productive way.

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Further details: Copies of the full report from the OHK- MPDF Mekong Bamboo Sector Feasibility Study are available on request from the authors and are also available on-line.

Comparative Analysis and Policy Recommendations on Developing Bamboo Resource Tenure Systems in Asia and Africa

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Summay of A full paper

Bamboo development in Africa and Asia varies extensively across countries, but many also share similar challenges and obstacles. This report has provided an overview of bamboo development in seven countries, highlighting current forest tenure systems, bamboo growing and manufacturing activities, the problems facing the bamboo community, and the role of the state in the bamboo sector. This concluding chapter will focus on the main thematic issues challenging these countries, as well as recommendations for what is needed to move bamboo development forward. The focus will be on general lessons, rather than country-specific lessons, since the latter is found at the end of each country chapter.

1. Political Willpower and Government Commitment to Reform

There are two important steps which governments must take to encourage the bamboo sector—yet many of the countries reviewed have yet to do so.

1) Recognize the potential of bamboo as a forest product that can help to alleviate rural poverty and that can provide important environmental, as well as economic benefits.

Many subsistence communities depend on bamboo, but as a forest product it has typically paled in comparison to timber, and has not received either the commercial interest or government funding that has benefited timber products. This recognition is essential before any progress can be made.

A few countries have started to realize the importance of bamboo and have designated new bamboo initiatives, such as creating agencies tasked with promoting bamboo development. For instance, a number of states such as Mizoram in India have established their own Bamboo Development Agencies to develop and promote activities that encourage bamboo development. These activities include mapping the bamboo resources, giving power to the village councils to manage bamboo resources, regulating bamboo harvest, developing bamboo plantations, organizing

bamboo trade organizations with linkages to bamboo growers and the bamboo processing industries, encouraging and promoting establishment of bamboo enterprises, and disseminating market information as well as transferring management technology. Yet most of the countries studies have yet to fully comprehend the importance of bamboo. Ethiopia, as African's bamboo kingdom with about 1 million ha of bamboo forest, has yet to make any real effort in bamboo development. Without acknowledging the potential of bamboo and designating it as a priority area, little else can be achieved.

2) Reform state-control over bamboo tenure rights

Once bamboo is recognized as important and warranting development, there is perhaps nothing more critical to bamboo development than reforms which grant improved access rights and tenure security on bamboo forests. Without tenure security, farmers are unlikely to be motivated to invest in or manage bamboo on their land.

Bamboo tenure is a complicated issue, in large part because in all the countries studied, bamboo ownership and user rights are lumped together with general forest user rights. That is, there are no specific rights attributed to bamboo use versus forest use. This is largely a reflection of the previously stated problem—that bamboo is not yet recognized as being important enough to warrant its own set of tenure rights.

Reform of forest tenure to encourage bamboo development is the foundation for any bamboo initiative. That is, without tenure reform, other initiatives are less likely to produce long-term success. Thus tenure reform comes a close second to the first step of prioritizing bamboo as an area worthy of further development.

Tenure reforms and new management initiatives have begun in some countries, such as India, the Philippines and Indonesia, but these reforms failed largely because the government's efforts fell short of giving real tenure security to forest dependent communities in these countries. China and Tanzania, which have achieved some significant improvements in tenure arrangement, still face many challenges as land allocation lacks transparency, and there is a lack of financial and technological investment in timber and bamboo management.

2. Reforms in forest tenure face a common set of problems across developing countries:

1) Lack of equitable tenure arrangements

Forests, as a renewable natural resource, have great economic value and are a source of income to many people. For those developing countries where much of the rural population is dependent on products gathered from the forest, forest rights allocation is central to the equitable distribution of wealth. To have property rights—either user or ownership—is to have secure control over a stream

of future benefits (Hazra 2002. Therefore, optimal forestland rights allocation is of great significance to the income generation of forest dependant people, and failure to do so leads to social conflict as well as poor management of the forest. Hazra (2002 concludes that deforestation often results from social injustice and political inequalities. An inequitable tenure system denies customary access to, and use of, forest resources, thereby generating resentment against the government. “The history of the struggle of forest dwellers for their rights is as old as the legislation governing them” (Singh 1986). Conflicts will always remain as long as the tenure system is unfair and achieving sustainable forest management will remain an elusive goal. The countries examined in this report illustrate clearly that where forest dependent communities are denied access to the forests, or have only limited rights, forests tend to become degraded as communities rush to use what they can before the state takes away their rights. Meaningful conservation can be expected only when a community is given property rights to the forests and thus rights to extraction from the ecosystem they conserve (Hazra 2002).

The state’s general reluctance to part with its sole authority over forest resources is a major obstacle to tenure reform. Forest resources are viewed as a revenue source, and thus governments are reluctant to give up state control over forest management even as many administrations publicly swear by land reform. All the selected countries in this study have undergone hundreds of years of colonial rule by foreign invaders. After gaining their independence in the 1950s and 1960s, their economies were nearly bankrupt. Forests presented an easy source to generate export income to restore economic capacity, and thus states were adamant about retaining sole control over forest resources. Unfortunately, the evidence suggests that absolute state control over forest resources usually results in inefficient and inequitable use of resources. The forest concession systems adopted by countries like India, Indonesia and the Philippines have led to rapid degradation of forest resources through over harvesting and unchecked exports of timber (Kant 2001, Talwar and Ghate 2003, Saigal et al. 2002, Hermosilla and Fay 2005, Gould 2002).

With the global shift in national forest policies towards a goal of sustainable forest management, there has been a dramatic shift emphasizing conservation, restoration, and meeting local subsistence needs, instead of extraction of timber resources. Correspondingly, initiatives were taken in some countries to reallocate forest resource control between the state and local forest dependent communities. While China and Tanzania have made some progress in this regard, others like Indonesia are still debating what user rights local communities should have, and reforms have been few. Although India, the Philippines, Ethiopia and Kenya undertook joint forest management (or participatory forest management) initiatives, progress in terms of improved forest management and conservation has been spotty. Furthermore, much of the financial support for initiatives on joint forest management is from foreign donors, and the results have fallen short of donor expectations (Hazra 2002 De La Paz 2000, Hermosilla and Fay 2005).

The reluctance of these governments to enact true forest tenure reforms can be seen from these facts: no land tenure was granted to the local communities, forest land under the JFM are mostly

degraded land, and management rights to forestland can be withdrawn at any time if the government changes its policy or local communities break the agreement. Obviously, the government is neither ready to give up control of forest resources nor to prioritize the people's needs. Programs like JFM in India are still viewed by forestry officials as a strategy to regenerate degraded forestland but not as a strategy for poverty alleviation and income generation for poor forest dependent people.

2) Denial of customary community rights to the forests

Prior to colonial rule, forest dependent communities had unrestricted user rights to the forests. The existence of the forest communities depends on a close and ecologically sustainable relationship with the forest they inhabit (Hazra 2002). Following the establishment of the state's property rights over forests with the intention of extracting the economic value of forests, customary rights to the forest were rescinded, depriving forest dwellers from accessing their primary subsistence resource. People who lost their traditional rights to the forest are the poorest in the country—forests are their lifeline. Losing access to the forests is a loss of basic living conditions.

Once local people realized that they might be prohibited from collecting the everyday products they needed from the forest, their reaction was to capture as much as they could as long as they could. People no longer cared about the traditional way of rational use and sustainable management of forests because their user rights to the land would now be curtailed and they had no long-term investment in the health of the forest. With no concern about the people's need for subsistence and local communities' customary rights to the forest, deforestation and indiscriminate felling became rampant in these countries. Indonesia is well know for its high rate of deforestation and illegal logging, while the Philippines went from being the world's biggest exporter of tropic hardwood in the 1970s to being a net importer of forest products by the 1990s.

3) Lack of legal clarity

As governments moved towards sustainable forest management strategies, new forestry policies were enacted, and existing laws amended to improve management. However, contradictions and inconsistencies in the laws or regulations can be found in each country. Many of these countries emerged from years of dictatorship and thus lacked the experience to develop laws on decentralization or denationalization. For example, India has had a forestry policy emphasizing local people's subsistence needs since 1988, but there is still no amendment of the forest act to give this policy legal backing. In Indonesia, too many government departments and local authorities have a role in allocating rights to forestland and resources, creating overlapping mandates and great contradictions and inconsistencies among administrative laws and regulations. In the Philippines and China, changes in rules or in land reforms themselves, have created uncertainty and confusion to forest users who crave consistency. In China, Ethiopia and Tanzania, while laws were enacted,

corresponding regulations were not. This lack of stability and clarity can itself contribute to continuing forest degradation, even though they were attempts to increase community involvement.

4) Weak law enforcement

Enacting laws and regulatory policies are important, and they are only as successful as legal enforcement is effective. To a great extent, weak law enforcement in developing countries contributes to ineffective forest reforms. In developing countries, while forest protection may be stated as a government priority, the requisite funding is rarely provided by the state. Given the open boundary of government controlled forests and conflicts over the land rights between local communities and government, as well as lack of manpower to exert inspections, there is weak enforcement of laws and regulations relating to forest management. In Indonesia, there are laws and regulations that do not include penalties in case of non-compliance. In those countries where forest concessions are granted, given the close relationship between big industrial corporations and politicians, the corporations have no fear of violating the rules regulating harvest practices and rarely are punished even if they are guilty of illegal activities. In China and Tanzania, tenure reforms were at least partly successful, but continued lack of transparency and corruption influence the complete implementation of tenure reform policies. Lack of supervision over law enforcement, and the power to allocate user rights to the land in rural China is largely concentrated in the hands of village leaders, which creates opportunities for corruption and inequality. Many village leaders use their political advantages to allocate larger and higher quality plots of forestland to their families or friends, or transfer forestland to the outside at a lower price to get the commission for themselves. Transparency of land allocation requires strict enforcement of law and increased oversight of the tenure agreement process.

3. Necessary Factors to Implement Forest Tenure Reforms

The issue of forest tenure is at its essence a question of balancing equality and efficiency. Lack of equality in the tenure arrangement evokes severe social conflict and large-scale deforestation. Does an optimal tenure regime necessarily lead to efficient forest management? No, but it is probably fair to conclude that efficient forest management is unlikely without an optimal forest regime. Tenure security raises the incentives of stakeholders to invest long-term in forest management; people living in poverty will find it very difficult to improve the quality of the forest resources allocated to them due to the lack of financial and technology capacity. An optimal tenure arrangement still cannot achieve the goal of efficiency in forest management without efficient market mechanisms. If farmers cannot sell their produce in free markets at prices that reflect the demand for those products, then their incentive to be productive and to care for the land will be diminished. That is why state control over forests, forest products and their sale is usually a formula for failure. Therefore, optimal forestland tenure arrangement, market mechanisms, and the requisite funding and technology assistance are key factors which must be considered to achieve effective and efficient forest management. Additionally, optimal tenure regimes must be backed by

legislation. As legislation is the embodiment of the ruling class, the first and most important issue required to establish a reasonable forestland tenure regime is to develop the appropriate political will to recognize the importance of granting the forest user rights to all stakeholders, not least of them local communities.

1) Political willpower and government commitment to reform

Although it is well acknowledged that community rights over forest resources should be recognized and backed by policies and laws, some governments in developing countries are not ready to return user rights to local communities. Fortunately, the global political environment with respect to forest conservation has improved in recent years (Hermosilla and Fay 2005) and is having a positive effect on raising public involvement in forest policy in many countries. Decentralization is occurring in many countries. In Indonesia and the Philippines, local communities are acquiring a greater say in the shaping of government policies over forest management. In India, the needs of local people have become a priority in the management of forests, although much remains to be done. With increasing democratization, people around the world are demanding a greater voice in decision-making and are holding their leaders more accountable. In China, farmers commonly voice their dissatisfaction with government policies, and local and state governments are increasingly responding to calls for reforms. The success of Anji's bamboo forests tenure reforms illustrate how political will brought a positive impact to bamboo management and the development of the rural economy. By transferring the user rights to bamboo forests to farmers through the government's adoption of the household responsibility system, farmers gained great incentive for bamboo management.

2) Developing a tenure arrangement model based on key characteristics

There is no single best model of tenure regime since political, economic, and social differences mean that each country must find their own solutions. Thus, the tenure arrangement suitable for China might not be transplanted to Indonesia directly. But it is clear that raising the incentive of the local communities and rural households to manage forests productively, helping them to be involved in decision-making, and lifting market restrictions on their forest produce are all characteristics of developing a sound forest tenure system. Other important characteristics include:

a) Recognizing the customary rights of communities to the forests and bamboo resources

Community rights in many countries have been traditionally ignored, which led to tense relationships between the government and rural communities, as well as continual depletion of forest resources.

The global community has attached great importance to the protection of community property rights. As stated by Hermosilla and Fay (2005):

> The Universal Declaration of Human Rights (United Nations General Assembly 1948) establishes that nobody shall be deprived of his property even if this property is not documented in official papers. The International Labor Organization Convention 169 contains provisions on indigenous and tribal land rights which require respect for customary occupations and provides measures to recognize and protect those rights. It states that indigenous customary ownership over lands should be recognized (ILO 1989). The UN Committee on the Elimination of Racial Discrimination also recommends the recognition and protection of the rights of indigenous peoples to own, develop, control and use their communal lands, territories and resources.

The verdict on whether community management of forests actually results in better management and conservation of forests is mixed, depending on the case study. In some cases communities have simply sold their land interests to industrial developers, while in others it has resulted in more conservation. But it is clear that depriving communities of legal rights to the land does not offer any positive incentives to manage the land more efficiently, and community participation is an important democratic trend which is increasingly sought after. Obviously, after giving communities their user rights to the forest, the government must retain regulatory oversight to ensure that communities manage their forest user rights soundly.

b) Granting secure forest user rights to farmers

Beyond customary user rights, granting farmers secure, long-term rights to forestland is essential to foster improved management of the forest and forest productivity. The decollectivization of forestlands in China was a big success in what had been a long checkered history of failed land reforms. Farmers now have unprecedented autonomy in managing bamboo forestland leased from collectives, with a reasonable operating term. Under the household responsibility system, farmers can make their own decisions about when and how to plant, manage and harvest their timber and bamboo, and where and at what prices to sell their products. Also, within the contract period, the farmers can transfer the leased land to others and leave it to their successors. The success of decollectivization is evident from the increase in China's forest coverage, which rose from 12.98% in 1980 to 18.21% in 2005 (SFA 2005). In 2002, China passed a new law on leasing rural land, which laid out several provisions on granting user rights on forestlands to farmer households for up to 70 years, protecting the legal rights to forestland held by farmers from being violated by any individuals and organizations. It is very difficult for those without tenure security to take good care of the land as they have less incentive to manage for the long-term.

Clearly, granting long term user rights to forestland and control over the use and sale of the products harvested can significantly encourage farmers to carefully manage their lands, even though the *de jure* land ownership of the forestland remains under the collective. Countries like Ethiopia and India with rich bamboo resources but without any management of them should take active bamboo tenure reforms to give rights to bamboo forests to the farmers or groups who are

committed to manage them properly. People take better care of property under their direct control because they can see the benefit and feel secure if they have the rights to the resources.

c) Development of due process for land allocation

The misuse of power in allocating common property by village heads is a common trait of many of the countries examined, including China, India, Indonesia, the Philippines, and Tanzania. A common concern shared by opponents to the decentralization of forestland tenure in Indonesia was that community elites would capture control of the common forest resources and use them to benefit their own friends and family. To address this issue, a well-understood and transparent due process must be introduced at the village level.

An important step in establishing due process in common property management at the village level is to ensure that villagers know what their property rights are, and have a voice in decision-making. In developing countries, where many farmers may be illiterate, farmers may not be aware of their forest use rights under the law, leaving them vulnerable to village heads who may choose not to inform them fully. Without transparency and information sharing, farmers are at a distinct disadvantage.

Farmers should be full participants in making decisions about management planning, management activities, produce use, and income-sharing generated from common properties such as collectively managed forest and bamboo lands. One way to protect their voice in decision-making is to ensure that the make-up of the decision-making body includes farmers, not just village heads. It is also advisable to include groups typically marginalized, especially women, who play a critical role in forest dependent communities but are often left out of decision-making.

India's Joint Forest Management only goes half-way in giving farmers the freedom to manage the forest but the JFM system has produced some important improvements in participatory management which are useful for other countries to take note. In a case study of community forests in three villages of India conducted by Talwar and Ghate (2003), a democratic decision-making institution was introduced into forest management by broadening participation to community stakeholders. The villages registered under JFM were required to form a general body and an executive committee. The general body of the committee is composed of one man and one woman from each household. All members are qualified to participate in the meetings that are held once a month. The decisions related to the forest are made only in the general body meetings. The executive committee is composed of eight men and three women who are elected by the general body, with a fixed term of around five years. The executive members can be removed by a majority vote by the general body. The members of the executive body work on a voluntary basis and do not receive any payment or material compensation (Talwar and Ghate 2003). This form and function of the community forest management committee prevents the possibility of power abuse by traditional community heads and gives the power of decision-making on forest management back to all

members in the community. This kind of decision-making process is viewed as an optimal institution that is extremely welcomed by the members of the community, and helps to enforce the rules on forest management and protection.

3) Introduction of market mechanisms

The government should give up some of its powers and functions to the open market, instead of trying to do everything itself. For marketing forest produce such as bamboo, the government should not have a monopoly, nor create such a monopoly for traders and enterprises. In the long run, development of market mechanisms will encourage healthy competition and bring more benefits to the rural communities and forests.

The failure of state controlled forest management in India and China has proved that forests can never be managed efficiently without the function of free market mechanisms. Facing the fixed and lower price of forest products as well as bamboo products under the rigid planned economy, even the state forestry company and the collectives had no incentive to practice good management. Tenure reforms in these countries show that the government is willing to bring benefits to forest dependent communities and people. In addition to tenure reforms, the realizations of the benefits that will accrue to the forest dependent communities depend upon the realization of just prices for the products (Hazra 2002).

In India, there are no free markets for bamboo products. The natural bamboo resources are under the control of the state. Even after the 1988 forest policy, there is no sharing of management rights on state owned land. Although households may hold rights over forest produce such as bamboo, the state allocates shares of the produce (including bamboo) to the households. This mechanism is inadequate and inefficient (Hazra 2002), and does not offer true freedom of user rights over the forest. The state monopoly of bamboo resources and bamboo produce price limits the establishment of bamboo-based local enterprises and the innovation of bamboo products. In contrast, in the Chinese province of Anji, the government abolished state monopolies over bamboo products and trade, and overnight hundreds of private bamboo enterprises and traders emerged. The free market was the determinant of bamboo prices, not state agencies. In effect, rapid development of bamboo processing enterprises and larger demand for bamboo raw material provided a necessary market to the farmers. Market competition became active and contributed greatly to the innovation of bamboo products and it development into value-added products, which in turn created more revenue. Obviously, land tenure reforms work best with the interaction of market mechanisms.

4) Structural changes in the role of forest departments

With the progressive shift of the forest to the local community and rural households, the function of the forest department must also change. Priorities should be on providing services to the

community or households in forest management, rather than directly managing the lands. The forest department's main task will be comprised of technical extension, training of the forest management stakeholders in forest management skills, assistance in preparation of forest management plans, forest research, regulatory duties, dissemination of market information and monitoring of contractual agreements if any between the government and the local people or between the local communities and outside individuals and corporations about forest management (Hermosilla and Fay 2005).

4. Increased Research to Fill Large Information Gaps in the Bamboo Sector

Across every country and at every level, it is clear that there remains large information gaps on the bamboo sector, including how much and where the bamboo is located, how to grow and manage bamboo, how to process bamboo into products, and what products are in demand and how best to market them. Some countries have a reasonable amount of data—such as China—whilst others, particularly in Africa—have yet to get even a good grasp of how much bamboo they have.

1) **Bamboo Inventory**

Any plan for bamboo development should be based on the bamboo inventory. It is essential to get a better sense of how much bamboo there currently is, where it is located, what species and quality the stock are, and which species and stands are good for commercial use. Many of the countries examined cite the lack of reliable data on their bamboo inventory as an impediment to further development. These information gaps need to be filled before the respective countries can develop a plan for bamboo development. Governments should allocate some funding to inventorying, and working with NGOs and local communities to map out their natural resources is valuable even beyond just bamboo data.

2) Bamboo growing and management

There is great need for an improved knowledge base and training in: bamboo growing, seedlings propagation, applying appropriate silvicultural treatments, and dissemination of these results to the field through training and technical extension services. INBAR has been very active and effective in this area.

a) Technical extension

Forests managed by rural communities using the traditional skills passed down over generations are unlikely to be able to compete with the higher productivity of industrial forests, which are more intensively managed. If forests and bamboo are to provide stable incomes for rural communities, they will need an infusion of technical assistance and modernization, as forests and bamboo under traditional management can only generate limited income at a slow pace, which weakens farmers'

enthusiasm to manage forests. Anji's experience in China shows how bamboo qualities were improved and higher returns were safeguarded due to the adoption of intensive management technologies. In Anji, the measures taken by the forestry department to encourage the application of scientific bamboo management included:

- Financial support for transforming the low-yield bamboo forests through a subsidy of 750 Yuan per ha,
- technical training and introduction of new technology, and
- establishment of demonstration households, which have had successful experiences (Zhong et al. 1998).

These measures were greatly welcomed by farmers, and result in considerable bamboo quality improvements and an income increase for farmers. Most notably, each year more than 1,400 ha of low-yield bamboo forests have become more productive, and the net income generated form the intensively managed bamboo is 8000 yuan higher than that from the traditionally managed bamboo (Zhong et al. 1998).

In the countries studied, the growers and producers often lack the technical skills needed, largely due to the lack of technicians, funding, transportation and equipment. Thus, enhancing the capacity of providing technical assistance should be put at the top of the task list for forestry departments.

b) Financial assistance

Apart from the lack of technology in forest management, lack of financial sources is another main difficulty confronted by farmers. Forest dependant people are usually the poorest, and even if land is allocated to them, the initial purchase cost of sampling, tools, and fertilizer are often unavailable, let alone long-term investment in silvicultural treatments. This is why forests and bamboo resources are still managed under traditional methods in many developing countries despite land reforms granting user rights to rural people. Forestland tenure reforms aim to raise income and productivity. However, if there is no financial assistance to help farmers with applying improved silvicultural practices, the targets of tenure reform can never be achieved. The rapid development of plantations in India is largely attributed to the bank loan scheme that allowed farmers to apply intensive forest management practices. In China, the new forest land reform in Fujian recently launched by the provincial government has realized the importance of financial assistance in improving the productivity of forest and bamboo land. Low and no interest loans have been arranged for farmers to apply for by using their forestland tenure certificates as collateral.

3) Bamboo manufacturing and processing needs more technology and capital investment

With the exception of China's relatively advanced bamboo processing industry, there are no modern bamboo industries characterized by high value added products existing in the other countries studied. The common funding is that the traditional handicraft sectors or cottage industries process bamboo products manually and there are no modern tools or equipment involved. In the African countries, most of the bamboo raw material is used without any processing. The bamboo manufacturing and processing sectors have a very low level of technological input during processing, and produce a very limited range of products, all of relatively low value. Most of these low-end products can only be sold locally with little income generated.

China's experience in technology improvement and industry development is useful for other developing countries. China has developed an advanced bamboo industry since the late 1970s and early 1980s when the policy barriers on bamboo forestland tenure, industry, and trade were lifted. At present, China has over 3000 bamboo processing companies engaged in the production of various bamboo based panels, bamboo flooring, bamboo pulping, bamboo charcoal, and edible bamboo shoots. The collaboration between companies, research institutes and universities contribute significantly to improvement of bamboo processing technology. The introduction of foreign investment also helped China to start its modern bamboo industry at an early stage. After nearly 20 years of capital accumulation, domestic investors have replaced foreign investors and now run most of the large-scale bamboo industries (J. Fu, personal communication, April 2006). Strong collaboration should be built among the bamboo industry, universities, and research institutes to create innovative products and develop improved processing techniques and equipment. Given the poor economic condition all of these developing countries face, favorable foreign investment policies should be created to attract foreign capital to invest in the bamboo industry.

4) Bamboo marketing

Lack of market information is a major obstacle that prevents farmers from gaining more benefits from forest management. Poor education and remote locations limit farmers' competitive capacity, especially compared to the forestry industries that have the advantage of technology, finances, and information. Dissemination of market information by the forestry department will help farmers to build their capacity in entering the market. If farmers gain the proper information about what the market needs and what buyers are willing to pay, they are more likely to make wise decisions in forest management and work in a more efficient way. In Anji, farmers can react quickly to market changes, and respond by changing bamboo species grown as well as the bamboo products demanded.

Setting up a local bamboo marketing center in or around the bamboo growing area or processing area would significantly help to build a strong connection between the bamboo growers, processing

industries and traders. Regular bamboo fairs at different levels should be held to enhance the dissemination of information on new bamboo product design and bamboo product exports.

5. Organization of Growers and Manufacturers

Given that many bamboo growers and manufacturers are small in output, individually they lack the negotiating power and resources to effectively voice their issues to the government, to bargain for better prices, and to market outside of their area. Collectively, they would be able to harness their group strength to be more effective in lobbying for their sector.

Forest groups promoted and directed by government officials have not proven to be effective because the members—such as farmers—often have little rights or are excluded from making decisions about management planning, management activities, product use, and income distribution. This may explain, at least in part, why the old-style collective management performed poorly in many cases in China in the past. Available empirical evidence shows that a self-initiating shareholder system created on a voluntary basis, with or without the involvement of government and forestry departments works better.

Grower associations (or grower cooperatives) are recommended. In this system, growers pool their resources to pay for more technical expertise, knowledge exchange, hiring loggers, forestry technicians and also marketing representatives to negotiate prices with buyers. This kind of cooperative has emerged in China since the 1980s, which allows farmers to continue to manage their own land, but to also receive support services from their joint cooperative through agreeing to pay a commission of 10% of their gross revenue to the cooperative. In countries like the Philippines where bamboo growers lack incentives in bamboo cultivation because of the lower prices paid for bamboo raw materials by middlemen or traders, associations can offer greater output volume to buyers, and this gives them more negotiation power by pooling bamboo resources.

The formation of regional and national associations will create organizations that can look after the interests of the bamboo industry. They can organize training and trade fairs, advance the diversity of bamboo products for export markets, establish bamboo product quality standards, test new products or conduct consumer surveys, implement quality control standards, unite small household producers into medium scale cooperatives, coordinate with government agencies in formulating favorable bamboo manufacturing policies with regard to export and import regulations, lobby for policy reforms, build a marketing network and provide marketing and production information.

6. Create Partnerships between the Public and Private Sectors

In transitioning from a system where the state has sole authority and control over bamboo tenure, production and marketing, it is advisable to seek new power-sharing arrangements in which

individuals and organizations representing the government, NGO, community, and private industry work together on common goals. For example, a new research institute on bamboo could be a jointly sponsored project to enhance technical know-how. In addition, since the African countries studied in this report cannot on their own provide sufficient capital for bamboo development, it is necessary to work with NGOs, donor agencies and technically advanced countries to transfer technology to local growers and producers.

7. Enhancement of Law Enforcement

Law enforcement is deeply influenced by the system of forestland tenure. In all the countries in this study, forestland tenure has been characterized by the strong concentration of power over forest resources in the central state apparatus, and the corresponding lack of local access to forests and participation in forest management. Centralized forestland tenure policy that is not backed with enough resources to enforce its rules has led to the condition where most forests are de facto open-access resources (Banana and Gombya-Ssembajjwe 1998). Available empirical evidence shows that individuals who lack secure rights to continued use of forest resources are strongly tempted to use up these resources before they are lost to the harvesting efforts of others. Thus, optimal forest tenure arrangement characterized by transferring the ownership or long-term user rights to the local people will reduce the pressure on law enforcement. Where a system of property rights is well-known and well accepted by the local population, the condition of forests is better than in those areas where locals play no part in forestry management (Banana and Gombya-Ssembajjwe 1998). However, a good tenure arrangement regime is not a panacea to address all the problems in forest management. If the policies are wrongfully implemented, further conflicts will be created. Thus, strong enforcement of law will guarantee the reform is moving forward in the designated direction. As mentioned above, introducing due process at the village level can prevent the misuse of powers by the village leader. The effective oversight of tenure arrangement process by the law enforcement agencies is as important as the internal supervision system conducted by the general body of the village. Furthermore, with the authority of law enforcement, the actions taken or the penalties made by the agencies are more likely to influence the behavior of individuals. Therefore, the government should input more funding and carry out more training to improving the capacity of law enforcement.

8. Summary

Bamboo has become a potential substitute resource to produce non-timber forest products that can help sustain forest dependent communities as well as provide environmental benefits to the forest. Policies to improve bamboo development, management, and marketing should be a priority for developing governments. Yet most countries lack specific guidelines on bamboo, including tenure policies. The problems facing bamboo tenure in developing countries are the same as those facing forestland tenure, and these are closely bound with the problems inherent in countries with limited financial resources, huge numbers of marginalized rural poor and an inconsistent history of

participatory management. This report cannot address all of these complex issues, but it attempts to provide an overview of tenure reforms and bamboo development in seven countries in Asia and Africa, and suggestions for further progress. For example, the success of bamboo tenure reform initiatives such as in China's Anji County, offers some useful lessons for other Asian and African countries that have abundant bamboo resources but manage them inefficiently.

For political and social stability, it is imperative that the wealth of rural people must also advance. Yet even in wealthy countries such as the US (see appendix), small family forest owners still face a lot of problems such as access to markets, technical expertise and financial hardships. Clearly, the problems facing tenure reform are significant and on-going, but reform is necessary in many countries, and it should begin with recognition of the need for reform and the political will to really do something about it. If policy makers clearly realize the problems facing bamboo tenure and are willing to take actions to address them, the improvement of bamboo management and poverty alleviation are attainable.

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China's Overseas Bamboo Market

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ABSTACT

In China there are many bamboo manufacturers who wish to exposes their products to the larger western markets. This is an idea that is over due if China is to have a world market for its bamboo products. The timing is ripe since the world face global deforestation and the current trend toward food independence. It would be an opportunity to exploit Chinese branding instead of OEM manufacturing. Ideally, a Chinese bamboo manufacturer should locate in America or their chosen target market. This would allow the manufacturer to use locally produced raw material. In this way the host country gain from the imported expertise in bamboo utilization and we eliminate the embodied energy of moving a product from Asia to our shore. The manufacturer would gain in being closer to their target market which will provide the necessary feedback toward better customer satisfaction. This shortens response time helps toward product improvement and customer acceptance. Both are strong factors in gaining market share. Also a very important consideration is the backlash against China from the unfavorable publicity generated by the charges of currency manipulation, the balance of payment imbalance, the huge amount of imports to this country versus our exports, and etc. These same politicians threatened to impose an import tax on all China goods in the American market. With production done in the target market, the imposition of taxes, negative publicity or other restrictive measures will enhance the position of the local bamboo manufacturer as compared to a foreign manufacturer.

The consumers are interested only in the cheapest products manufactured off shore. It is these habits that feed our over consumptive habits in America and give rise to the poor working conditions, but also the product quality. Poor quality is too often associated with the country or company that made the product. Seldom does the consumer place the blame \with the importer responsible for imposing the specifications.

Key words: Import, Export, Consumer, Bamboo Manufacturer

Conservation versus Sustainable Utilization of Bamboo resource in Kenya: A critical look into the utilization in light of the recently gazzetted Forest Act No: 7.

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ABSTRACT

In Kenya, the native bamboo species is *Yushania alpina*, a species restricted to the highland areas between 2300 and 3000 m.a.s.l mainly within the Aberdares range, Mt. Kenya, the Mau ecosystem and Mt. Elgon. In total is estimated that bamboo cover about 145,000 – 150,000 ha, an acreage estimated at about 11% of total natural forest cover within the highlands. The density in natural forest is 10,000 – 17,000 culms per hectare and can produce up to 100 tons of air dry weight. In addition, the species can produce 1200 – 1500 stems per ha annually. Another common species is the lowland's *Bambusa vulgaris* which was introduced some 70 years ago and has become naturalized.

Generally planting of bamboo in Kenya is negligible and is only now that some interest is being shown. In addition to *B. vulgaris*, some 22 species were introduced from Asia and 11 of these indicate potential for planting under several agro-ecological conditions.

Production and consumption of bamboo products in Kenya is very limited, and the value addition imparted during processing is minimal. The current uses include: construction, toothpicks, fencing etc. Small scale production of high-value and decorative items also occur. The major problem for the development of bamboo industries in Kenya is a ban on bamboo cutting from 1982 following indiscriminate harvesting in the years before. Nevertheless, some bamboo harvesting is continuing under controlled licensing. It is estimated that up to 88 % of bamboo is illegally harvested. In total 99.4 % of harvested bamboo comes from Government forests. Bamboo is considered a minor forest product and as such does not receive proper attention; therefore a right to exploit but many people has been denied this, effectively because of the ban. This decree exposes conservation-utilization conflict; yet the potential contribution of forestry to the socio- economic advancement has become a high priority issue in the development planning in Kenya with a move from heavy state regulation to a model of market driven, private sector-led economic growth.

This paper reports on the challenges facing utilization of bamboo resource despite the recently passed pro-development policies.

1.Kenya Forestry Research Institute/United Nations Industrial Development Organisation

1.0 INTRODUCTION

1.1 Bamboo Resource and Management in Kenya

Kenya has about 1.24 million ha. of closed canopy indigenous forests left (2.1% of the total land area), out of a possible 6.8 million ha. (Wass, 1995). Most of these are distributed in the moist central highlands where human population and agricultural settlement are also concentrated. In the extensive arid and semi-arid areas, forests are mainly found on isolated hilltops as island forests and in discontinuous narrow bands along some permanent and seasonal rivers. The country's forests consist of a variety of vegetation communities determined principally by rainfall, altitude and soil type. These forests are mixtures of many tree species interspersed in places with glades. Large areas of bamboo are common in some highland forests (Ongugo et al., 2000).

With increasing demands from ever growing population in addition to unsustainable management and utilisation managements, Kenyan forests are greatly threatened. The need to conserve forests is met by consistent need for agricultural and settlement land. The demand for wood is also growing while the capacity to produce it is impaired. To meet the increasing demand for forest products and services, the government is encouraging the development of farm forestry and improved management of other forest resources.

Bamboo is one of the important components of natural forest ecosystems in the tropics and in Kenya it covers 150,000 ha, which occur on the mountainous areas (Kigomo and Sigu, 1996). The only indigenous bamboo species is *Yushania alpina* (formerly *Arundinaria alpina K.Schum).* The species occurs between 2300 and 3000 m above sea level (a.s.l.) either as pure or mixed stands. Estimated coverage in Timboroa plateau is about 31 000 ha., Aberdares ranges (65 000 ha) and Mount Kenya, Mt. Elgon and Mau ranges (51 000 ha). The species is found mainly in high potential areas where competition for land is intense The density of *Y. alpina* in natural forest is 10,000 – 17,000 culms per hectare and can produce up to 100 tons of air dry weight. In addition, the species can produce 1200 – 1500 stems per ha annually. Another species that is relatively common, especially in the lowlands is *Bambusa vulgaris* which was introduced some 70 years or so ago and has become naturalized

Bamboo proved to be versatile in utility resulting in indiscriminate harvesting in the government and other protected lands, which were mainly water catchment highland areas. This resulted in the ban on cutting that was proclaimed in 1982 to control further cutting and to allow the over cut areas to regenerate to full potential (MENR 1994).

However, Kenya Forestry Research Institute (KEFRI) in collaboration with Asian Research and Development Institutions has since 1986 carried out research on bamboo species selection and growth. Through this research initiative, over twenty Asian bamboo species have been introduced into the country and 11 of these indicate potential for planting under several agro-ecological

conditions. Some of these are successfully growing in the field and on-farm in western, central and coastal Kenya. These are Kakamega, Vihiga, Yala (Siaya District), Kaptagat (Eldoret), Muguga (Kiambu District), Gede and Jilore (Malindi District. Some of the species tried in Kenya include: *Bambusa brandisii, B. vulgaris var. striata, B. arundinaceae, B. tulda, Dendrocalamus membranacea, D. strictus, D. brandisii, Gigantochloa aspera, Oxytenanthera abyssinica, Phyllostachys pubescens* and *Thysostachys siamensis.* In general, planting of bamboo in Kenya is negligible and is only now that some interest is being shown.

1.2 Bamboo as a Commodity

Production and consumption of bamboo products in Kenya is very limited, and the value addition imparted during processing is minimal.

Bamboo provides raw materials for many activities such as production of incense sticks, toothpicks, food and forage, water harvesting, medicine, supports for commercial flower growing, tea picking baskets and making handicrafts. These activities provide job opportunities and entrepreneurship to the poor rural population. Furthermore, bamboo is used for fencing and construction and constitutes a potentially vital source of raw material for the pulp and paper industry.

However, local farmers, small enterprises and horticultural industry use bamboo under controlled licensing. Two areas where the resource is plentiful and exploitation is going on to some extent are the Aberdare ranges and Mt. Kenya. These areas are close to the city of Nairobi and Naivasha which are major bamboo processing and consumption centres.

There are some constraints to the development of the bamboo sector in Kenya. According to the Forestry Department, bamboo is classified as a minor forest product. This has slowed the recognition and development of this resource. Other factors affecting the development of the bamboo resource include; the ban on harvesting, lack of awareness on its potential, production of unprocessed or semi-processed products, poorly developed marketing structures, lack of information on availability of planting materials, lack of information on the methods of propagation, establishment, crop management and harvesting (Kigomo, 1995; Kigomo, 1988).

Although some farmers have adopted cultivation of bamboo species, and controlled cutting is still allowed in natural forests under special license, detailed information on quality, quantity, and types of uses and characteristics of the users is unavailable to enable development of a vibrant and sustained bamboo enterprise sector in the country. The importance of the bamboo sector in Kenya needs to be more clearly understood from the above perspectives.

2.0 CONSTRAINTS AND OPPORTUNITIES

There are several obstacles restricting the harvesting of bamboo from reaching their fullest potential. The first and foremost problem is the lack of clear laws regarding user rights and access to forest lands. Another problem is how to manage bamboo harvesting in a sustainable way without over-harvesting. Where harvesting is occurring, it is done without regard to their sustainability. A third challenge facing this system is the lack of adequate distribution systems for bringing goods to market and a general lack of consumer awareness for potential and actual bamboo products.

2.1 constraints

There are several constraints to the development of bamboo based economic activities in Kenya. The key constraints can be classified in three categories, namely Policy, management and technical:

I.1.1 Policy and user rights

- Bamboo is classified as a minor forest product, thus suppressing its recognition and development.
- The continuing ban on harvesting bamboo is a disincentive to local innovative use and processing
- Being classified as Non timber forest product, the past forest policy did not place it among the forest development priorities
- Protectionist policy that excluded other stakeholders in the management of forest resources in Kenya

I.1.2 Poor Management

- Extension efforts are constrained by lack of resources and poor infrastructure.
- Inadequate information on *in situ* management which would allow sustainable harvesting
- General lack of knowledge on its potential as a key forest product, including its processing
- Poorly developed market structures

I.1.3 Technical Constraints

- The predominant species has a highly restricted natural range thus limiting its introduction beyond those ranges.
- Propagation by seed is difficult since bamboo flowers after many years, yet propagation by vegetative means is cumbersome. Consequently there are inadequate planting materials making planting outside of the indigenous bamboo sources difficult to achieve.

- Lack of appropriate technology and accompanying technical competence in bamboo processing for value addition. This has led in part to the restricted range of bamboo products currently available.
- Lack of knowledge on management and potential uses hamper growing of the species on-farm
- Low value addition and occurrence of other alternatives

2.2 Opportunities

Since the turn of the century, the Government has realized the need to reverse the increasing poverty, especially among the rural population. To this end, the Government has formulated policies that seek to enhance sustainable use of natural resources as a key pillar to fighting poverty. In summary, the following key Government papers contain provisions relevant to the bamboo sub-sector:

I.1.4 2.2.1 Policy

New opportunities have been presented by new Government policies as contained in the following government papers and policies:

The new forest act and policy

Enactment of the new forest act in 2005 and the accompanying policy, spells out opportunities to involve forest-adjacent communities in the management of forests. The following aspects that are relevant for the proposed project are highlighted in the new forest policy:

- Poverty reduction, employment creation and improvement of livelihood through sustainable use, and prudent conservational management of forest and trees.
- Promote the participation of the private sector, communities and other stakeholders in forest management.
- Promote forest extension
- Promote forest research training and education to ensure a vibrant forestry sector.

Kenya National Biodiversity Strategy and action plan 2000

The national objectives of the Strategy are to conserve Kenya's biodiversity, to sustainably use its components, to fairly and equitably share the benefits arising from utilization of biodiversity resources among all stakeholders, to enhance technical and scientific cooperation nationally and internationally, including the exchange of information, in support of biodiversity conservation.

The Poverty Reduction Strategy 2002-2003

Specific action proposed for rural areas will involve building an effective and efficient participatory extension and technology delivery service, facilitating participation of women, improving rural finance and credit system, implementing sound land use, water and environmental policies, protecting catchment areas by developing forest plantations, strengthening stakeholder contribution in local forest management through collaborative agreements with communities, societies and advocacy groups, encourage agroforestry on private farms, improve natural forest for water and biodiversity values

The Kenya National Environment Action Plan 1994.

Among the goals of the plan, one of them is to manage the bamboo and mangrove ecosystems for conservation and sustainable use, strengthen forestry planning to include ecological protection, biodiversity conservation, subsistence collection of forest produce, high impact commercial use, watershed protection, ecotourism, and community participation, support projects, which provide immediate and sustainable economic returns to the communities living adjacent to major biodiversity areas, encourage local communities to develop a larger market share for wild products harvested sustainably and ensure their appropriate and sustainable use.

The National Development Plan 2002 – 2008

The plan proposes a transition to sustainable development based principles for satisfaction of human needs and aspirations, recognition of natural resources to meet present and future needs, recognition that environment and development are interrelated, and emphasis on the ecological responsibilities of the present generation towards future generations. The Plan recognizes that poverty leads to over-use and destruction of the natural resources where short-term development goals and practices are pursued at the expense of long-term environmental sustainability

I.1.5 2.2.2 Management and Technical

- Occurrence of high value addition in some areas shows the enormous potential of the species.
- Product diversification locally and also learnt from outside the country, together with introduction of appropriate tools.
- To a great extent, propagation techniques are available in Kenya could be useful in the long-term in terms of expansion of the resource area.
- Other species have also been tried in Kenya for different agro-ecological zones. These form a basis for future growth of bamboo in lower zones than currently.
- Management techniques including harvesting techniques can be disseminated in bamboo utilization areas to enhance better use of the resource.

2.2.3 Eastern Africa Bamboo Project

The regional project is implemented in Kenya by Kenya Forestry Research Institute (KEFRI) and Ministry of Agriculture and Rural Development (MoARD) in Ethiopia. The project's long term objective is to promote the development of the sustainable production and use of bamboo products in East African Countries, with a focus on markets as the driving force behind such sectoral development.

The specific objectives of the project are targeting employment and income generation for poverty alleviation and sustainable development:

- Improving the technological and skills inputs in bamboo processing.
- Developing capacity for the sustainable supply of raw bamboo materials.
- Improving technical, functional and aesthetic aspects of bamboo products and diversifying into new markets.

3.0 RECOMMENDATION

It is recognized that the Government has formulated very sound policies aimed at improving incomes and livelihoods especially for the rural population. In general, actualization of these policies and strategies can tremendously support the growth of bamboo industry in Kenya. The most critical is the need to expedite the lifting of the existing ban on bamboo harvesting in public forests and replace with a well thought out, sensible and technically informed harvesting approaches.

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Market Development of Bamboo and Rattan Products and Trade in Bangladesh

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Introduction:

Bamboo and Rattan are the two important natural resources of Bangladesh forests and homestead and considered as important non-wood forest products in the country. So far 9 genera and 33 species of bamboo have been recorded in Bangladesh (Banik 2000). The genera are: *Bambusa, Melocanna, Dendrocalamus, Oxytenanthera, Schizostachyim (Neohouzeaua), Dinochloa, Gigantochloa, Melocalamus* and *Thyrsostachys*. Most of the species in the country belongs to the genera *Bambusa* and *Dendrocalamus*. On the other hand, only two rattan genera are found namely, *Daemonorops* and *Calamus.* The former is represented by a single species only, *Daemonorops jenkinsiana.* The later, on the other hand, has 10 species (Alam 1990).

Bamboo and rattan, although considered as minor forest product in Bangladesh, they play a significant role in the rural economy of the country. The rural people of Bangladesh have been traditionally using this raw material to meet up their daily needs. Major needs of household articles and construction of the rural populace are being met by Bamboo and rattan. Bamboo and rattan are also the important materials of cottage industries and adds considerable amount of revenue to the economy of the country.

In the cottage industries level, bamboo and rattan products are mainly limited to various crafts and basketry items. Significant numbers of manpower are employed in this trade. A report of Bangladesh Small and Cottage Industries Corporation (Anon 1994) showed that 1,79,293 numbers of persons were engaged in the various bamboo and rattan products making units in the country. The same report showed that 9,464 numbers of persons were engaged in the various rattan and bamboo furniture units in the country. Therefore, considering the socio-economic situation this renewable and environmental enhancing resource has the great potential in poverty alleviation and economic development of the country.

Status of bamboo and rattan products

Although the history of bamboo and rattan craft in the country is more than 100 years, no significant improvement has been achieved in these sectors. With few exceptions, many of craft units still using traditional design and technology and equipped with traditional hand tools. Traditional skill and craftsmanship of this trade inherited from their forefathers by the artisans.

There is no recent data on the total number of bamboo-based industries in the country. Bangladesh Small and Cottage Industries Corporation (BSCIC) in 1994 recorded 53,143

numbers of bamboo and rattan products units and 1,646 numbers of bamboo and rattan furniture units (Anon 1994). The former type produced products of Tk. 1,32,824 thousand whose sales value was Tk. 1,39,987 thousand; the later type produced products of Tk. 1,13,216 thousand whose sales value was Tk. 1,28,283 thousand (Anon 1994)(at present 1USD=Tk.69.00). Most of the products were consumed in the local markets.

Recent trend shows that in addition to the traditional crafts, few of the craftsmen have started producing exportable products made of rattan and bamboo. To meet the demand from sophisticated buyers both in the city and outside Bangladesh, the craft has undergone a metamorphosis. Artistically fashioned baskets have found their way from a village home to the homes of craft connoisseurs. Consequently, there is a brisk trade in basket ware and other products made from rattan and bamboo. There is huge demand of Bangladeshi bamboo and rattan handicrafts and basketry items to the European markets. But only few of the cottage industries are able to produce such exportable products due to the lack of appropriate technology. Therefore the demand of the western markets is not fulfilled. But it is encouraging to note that in order to increase livelihoods, recently many organizations come forward to support the craftsperson's to produce such products for both local and international markets. Due to the initiative of these organizations and the artisan's ingenuity, these products have entered the international markets. In addition to create new designs, some artisans have adopted new tools to increase their productivity. They are also learning the use of chemicals to protect their products from fungus. Lots of young people and entrepreneurs are coming forward to contribute in this sector. Positive tendency has been created among the investors that these two cheap products can lead to great profit if they are highlighted properly.

Bamboo and rattan trade

Export promotion Bureau (EPB) has recorded 17 exportable bamboo products viz. Basket (small), Basket (large), Flat basket, Flower vase, Bowl, Hair clip, Flute, Storage container, Table Mat, Luggage, Flower Carrier, Cylinder, Tray, Ashtray, Pen stand, Pencil stand and Bengals (Anon 2004a). On the other hand 23 exportable products of rattan has been recorded by EPB. The products are: Bowl, Bucket, Boxes, Bar Chair, Book rack, Cylinder, Cradle, Corner tables, Rattan basket, Decorative partition, Grain basket, Hand bags, Letter case, Lamp shade, Mirror frame, Rice pot, Sofa set, Tray, Tourist hat, Umbrella stand, Walking sticks, Wine cradle, Wicker stool (Anon 2004a). The products are exported as handicraft items. Other exportable products from bamboo are the bamboo flutes and hukka (smoking device). In 1991-92, bamboo hukka of 1.41 million taka (1 taka=69.00 USD) has been exported (Anon 2002). There is also a good demand of bamboo pole in the international market. During July 2002-June 2003, Bangladesh earned TK. 3,84,44,621 by exporting bamboo (Anon 2005a). However, in the present export policy Bangladesh bans exporting of bamboo and rattan in whole or in the log form.

Unfortunately there is no individual export code for either bamboo or rattan commodities and these products are exported under handicraft items like jute, leather, silk, handloom, garment, pottery etc. Therefore the exact foreign currency earned from these two individual commodities

is not recorded. However, it is to be noted that in 2003-2004, Bangladesh earned 4.20 million dollar by exporting handicraft items (Anon 2005b). In the recently held Frankfurt International Trade Fair (February 19-14, 2006) the Bangladesh pavilion displayed handicraft and other gift items in association of EPB. Participating companies in the Bangladesh pavilion received more than 300 business queries and were able to establish 75 new business contracts. More than 31 business meeting were held in the fair with the representatives of participating companies of Bangladesh. They received spot and prospective orders of Tk. 8.00 crore approximately (Anon 2006). Therefore, participation of such trade fair has tremendous impact on the economy of the country. In a report it showed that Bangladesh is failed to fetch at least Tk 500 crore in foreign exchange due to lack of proper initiative to export attractive handicraft item made of bamboo which are in high demand in abroad (Anon 2004b).

Markets and marketing of bamboo products:

Marketing of bamboo and rattan products to the international market is comparatively new concept in Bangladesh and only recently has attracted attention by the concerned group. Therefore, the proper supply chain system has yet not developed.

It has found that bamboo made agricultural implements, kitchen stuffs, storage and carryings baskets hold a high demand in the local, specially in the rural markets.

1. Local Markets

    - Rural market:

In the rural markets main bamboo products sold are agricultural implement like different types of baskets, bamboo lids of different sizes, mathal or farmers hat, mat, fishing traps, stool, etc. Basketry is most widely produced all over Bangladesh and almost every village market has a section earmarked for sale and purchase of baskets. Usually these markets sit twice a week. The producers bring their product from far away by van or truck depends on the amount of products. The products are sold both to the individuals and to the wholesaler.

Due to scarcity of rattan, ordinary rattan baskets hardly seen in these rural markets.

- Urban market:

In the urban area bamboo handicrafts products mainly sold in big show rooms. Most bamboo handicrafts producing industries have their own show rooms. They have their own artisan groups and designers. These sale canters of bamboo handicrafts are very attractive places to the urban people and to the tourists. Sometimes the handicrafts association arranges some trade fairs to promote the products. BSCIC also arranges handicrafts fair which are also a good place to get in touch between the traders, designers and the buyers.

- Bamboo and rattan furniture market:

As there is limited number of bamboo furniture industries in the country, there is no separate special market for this. Most of the bamboo furniture sold in the rattan furniture shop. Only few have their own sale center.

There is a high demand of rattan furniture in the domestic market. Owing to the natural beauty and its uniqueness, rattan furniture creates an artistic environment in its surroundings. The use of rattan furniture has expanded from household to the hotels and restaurants.

- International market:

As stated earlier that bamboo and rattan handicrafts items hold good international market. The exporters attend the various international fairs and display their products and establish a close contact with the buyers. Business enquires are exchange and contract is made between the parties. In this way the exporters maintain their international market channels. Sometime EPB also arrange some international trade fair to promote the Bangladeshi products in abroad.

Prospects of making bamboo laminated products in the country:

In Dhaka and Chittagong districts several industries are making various wood laminated products from indigenous and imported wood. They are making laminated boards, doors, plywood etc. for both local and international markets. In these factories, there is a good scope to make bamboo laminated products. As imported wood costs lots of foreign exchange and due to the scarcity of wood raw materials, the potentiality of making bamboo-laminated products was discussed with the owners of these factories. They informed that scarcity of bamboo would be the main problem to run such big scale industries. The production capacity may hamper without sustainable supply of raw materials. If the sustainable supply of raw material is ensured, they will prefer bamboo as alternative raw materials. In addition, production technologies and good marketing facilities have to be developed.

Suggestion for future development:

Bamboo artisans of the country are facing the acute shortage of raw materials. Due to the immense economic potentiality of this incredible material, artificial planting of the raw materials should be taken as priority basis. Interviewing of the people of this trade revealed that they are very much concerned about the present unimpressive situation of this trade. They also feel that to compete the international market they should go for alternative products such as bamboo fabricated or laminated products. To promote the bamboo and rattan products in the country a project “Market development of Bamboo and Rattan Products with Potential” has been implementing in BFRI. It is expected that the after successful implementation of the project, Bangladesh would be able to develop improved technology for making the traditional and as well as other alternative bamboo product such as bamboo laminated and fabricated products.

For the future development of bamboo and rattan products, the following steps should be taken as priority basis:

- For the sustainable supply of the raw materials massive plantation programme of bamboo and rattan should be taken immediately. Government should come forward to allocate land

and financial and institutional support for the purpose.Creation of awareness through seminars, exhibition

- Development of proper and appropriate technology backed by scientific knowledge
- Training of artisans, producers at the level of the entrepreneurs as well as the buyers.
- Arrangement trade fairs at national and international level.
- Introducing individual export code for bamboo and rattan products.Considering the great potentiality of bamboo commodities in the national and international markets, the traders, exporters, researchers and policy makers should come forward for proper utilization and sustainable management of this important resource.

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World bamboo markets: Preliminary analysis of selected bamboo product markets

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ABSTRACT

While there is much talk of the growth in the bamboo industry, there is little firm data on current and future market demand for different bamboo products. Policy makers and businesses can only guess what markets to invest in.

This paper presents a first attempt to address this gap and draws on work from the recent Oxfam Hong Kong – IFC MPDF Mekong Bamboo Sector Feasibility Study. From analysis of numerous secondary data sources and industry interviews, estimates are presented for current and potential future demand in a range of bamboo product markets.

Key words: Bamboo, Bamboo Market, Bamboo Products, World Market Size

Introduction

This review provides an overview of international markets of greatest potential interest to the current Mekong Bamboo Sector Feasibility study[14]. The objective is to inform the strategic decision making process on the market potential for the selected markets.

Consistent with this objective, all data presented are estimates based on secondary information sources. These have been checked for consistency between different sources wherever possible. The information has been supplemented with industry interviews.

Ten product markets are covered.

1. Handicrafts
2. Blinds[15]
3. Bamboo Shoots
4. Chopsticks
5. Furniture
6. Panels/Boards
7. Flooring
8. Builders' Joinery and Carpentry (BJC)
9. Charcoal

[14] For details of the sources, calculations and assumptions behind the data presented in this paper please refer to the "Mekong Bamboo Sector Feasibility Study Report" and supporting "Bamboo International Market Research" available on request.

[15] 'Blinds' market is only covered in term of market size estimates. Deeper research on this market has not yet been completed.

10. Activated Carbon

This review does not cover the markets for bamboo in paper/pulp production nor for unprocessed bamboo supplied to domestic construction industries and other users. While these are known to be large consumers of bamboo in many countries, consideration of these markets was beyond the scope of this study.

Overview

It is estimated that the bamboo markets analysed in this study have a combined value of approximately USD 7bn p.a.. Traditional products account for almost 95% of this by value. Newer industries offer interesting growth potential and may begin to rival traditional bamboo-related markets over the medium term. Global market demand may reach USD 17 bn p.a. in the next decade under favourable market conditions.

Markets for bamboo can be grouped into traditional or emerging markets. Demand remains strong in traditional markets such as handicrafts, blinds and bamboo shoots with profitable opportunities despite moderate growth. Other traditional markets, such as chopsticks, are highly commoditised with low growth and low margins.

Emerging bamboo markets, particularly wood substitutes, have been pioneered by Asian producers and include flooring, panels and furniture (non-traditional). These represent the largest growth opportunities for bamboo. Strong world (& Chinese) demand and China's productive capacity and exports have produced a structural change in the wood industries. Increased restrictions of certified timber supply create a positive market outlook for bamboo.

Additional niche market opportunities exist for example with processed bamboo charcoal (driven by growing demand for bio-fuels) and bamboo activated carbon which has the potential to develop strongly in the growing activated carbon market.

Overall prospects for a diversified bamboo sector look strong.

Market Recommendations

From a demand perspective, the following markets offer potential for emerging producers of bamboo: Furniture, Handicrafts, Blinds, Bamboo shoots, Wood Flooring, Charcoal and Activated Carbon. Markets for wood panels and chopsticks have some attractive characteristics but need further investigation. Wood panels in particular should be oriented initially towards furniture and then Asian construction markets. There is a risk in the lack of diversification prevalent in wood industries. Most industries are heavily correlated towards the residential property sector. In formulating a strategy, it would be advisable to seek non-correlated or sufficiently diversified industries to minimise the concentration of risk.

A key risk to the developing bamboo industries is poor quality product entering the new, higher value product markets (as seen in the US flooring markets). This could restrict growth and the ability to command higher margins.

Current size of selected markets

No authoritative estimates have yet been published as to the size of the various markets for bamboo products. This study attempts to address some of these gaps in a manner consistent with the study's primary purpose: evaluating the potential of the sector for the Mekong countries.

In developing market size estimates, a key consideration has been that a large proportion of potential growth for the bamboo industry relies on increasing substitution of bamboo-based products into more general markets. To reflect this the study has examined markets for bamboo at two levels:

- Firstly, estimates have been made of the 'Global markets' in which bamboo competes against other products and has the potential to be a substitute for alternative products in these markets, for example 'wood and laminate flooring'.
- Secondly, estimates have then been developed for the size of the current bamboo markets in particular. This second stage is based on either direct estimates of market size, e.g. bamboo shoots, or on estimates of the share of bamboo products in the 'global market', e.g. 'bamboo flooring'.

The conclusions from the market sizing analysis are illustrated below. Figure 1 shows the estimated current size of the 10 selected 'Global Markets'. Figure 2 shows the estimated current size of the corresponding 'Bamboo Markets'. From Figure 1, the largest 'Global Markets' are wooden furniture, wooden panels and wood and laminate flooring. In contrast, Figure 2 shows that the main current markets for bamboo are dominated by the traditional bamboo products of handicrafts, shoots, bamboo & rattan furniture, bamboo blinds and chopsticks. These traditional products represent almost 95% of the current world bamboo market (excluding paper and construction). The basis for the estimates of the current bamboo market is summarized in Table 1 below.

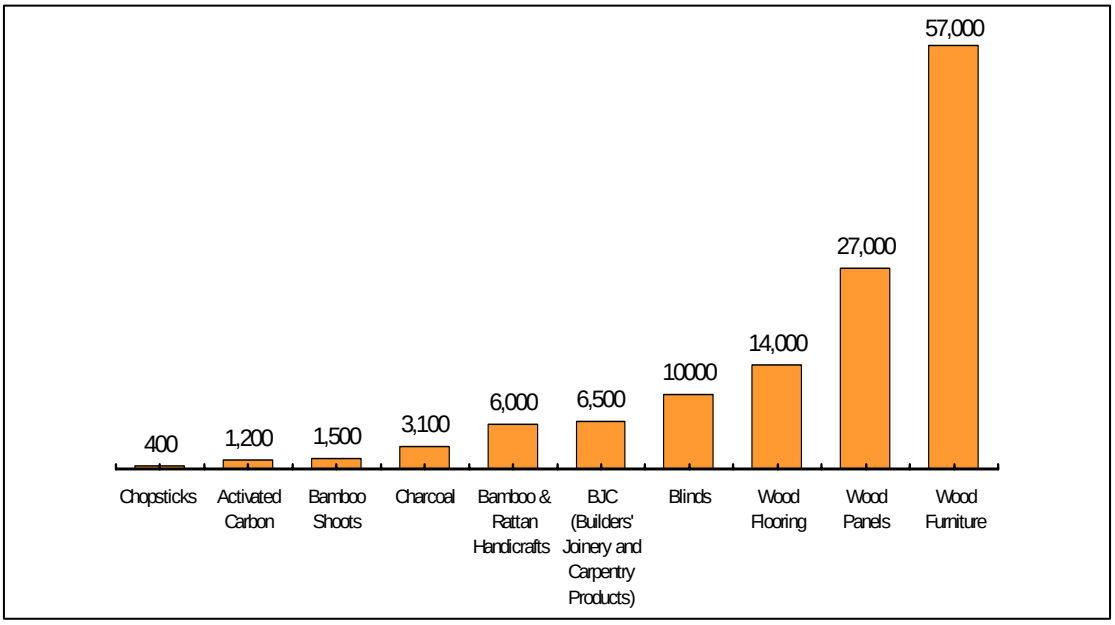

Figure 1: Size of selected 'Global Markets' (USD m)

Source: Enterprise Opportunities research

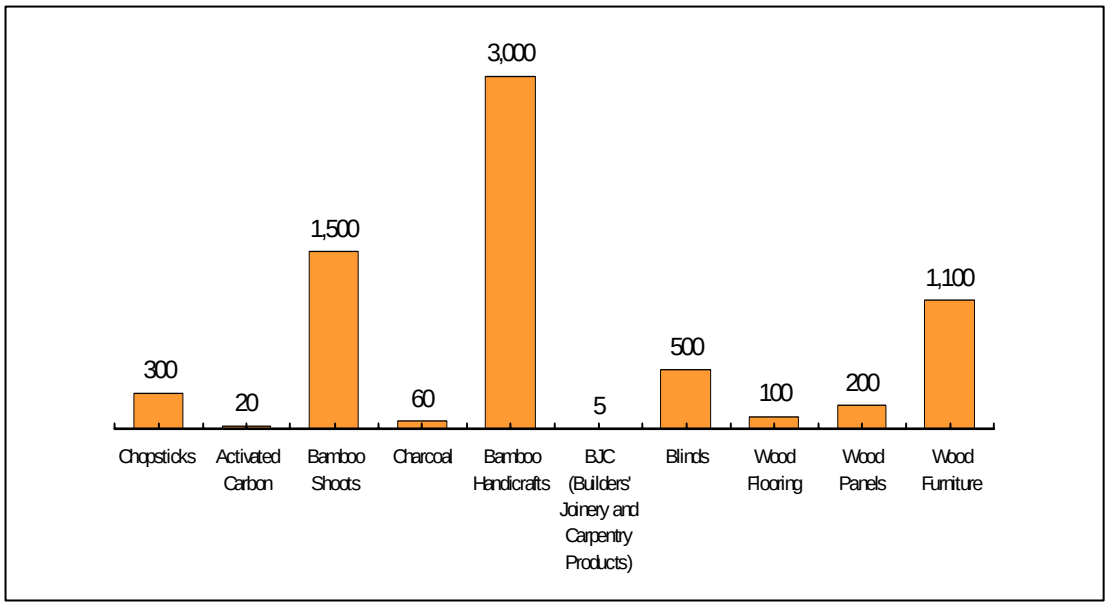

Figure 2: Size of selected 'Bamboo Markets' (USD m)

Source: Enterprise Opportunities research

Future market sizes

Whilst current demand is heavily concentrated in the traditional markets for bamboo, growth rates for bamboo products are highest in the emerging wood-substitute based markets (e.g. flooring, panels, furniture). How these factors will combine to determine the shape of the future market is an important question.

The scale of future demand for bamboo products will be driven by:

a) ***'Global market' growth rate***: Growth in global markets in which bamboo products compete, linked to global GDP growth etc.

b) ***Penetration rates of bamboo into these 'global markets'***: Driven by the attitudes of buyers and the price/performance competitiveness of bamboo products compared to existing and new alternatives.

There is significant uncertainty about both of these factors. To better judge the potential importance of different bamboo markets in the future, a number of bamboo market scenarios have been analysed that show the combined impact of these two key market drivers.

The research into each individual 'global market' has generated information on prevailing forecasts for industry growth for the relevant industries (see Table 2). These forecast growth rates have then been extrapolated out to estimate the size of the future 'global market'.

Against these future 'global market' estimates, we have developed 3 different scenarios for the penetration of bamboo into the 'global markets'[16] (see Table 2). These are based on estimates of current bamboo penetration and informed by the review of international markets and bamboo product price/performance competitiveness.

Table 1: Rationale for Current Bamboo Market Estimates

Market	'Global' Market		Bamboo Market		Rationale
	$m	Definition	%	$m	
Handicrafts	6,000	Bamboo & Rattan	50%	3,000	US is largest market for handicrafts, data shows 5% of imports are bamboo & rattan. Given domestic role of bamboo and rattan in developing countries (e.g. baskets), share is likely to be higher than 5% as in US market. So, share for bamboo and rattan is at least 6% of $100bn = $6bn. Bamboo may be 50% of this.

[16] It is also possible to generate scenarios for the 'global market' growth rates. However, the range of market sizes from the market penetration scenarios is large and means that applying different 'global market' growth scenarios would not yield any further insights.

Bamboo shoots	1,500	Bamboo shoots	100%	1,500	100% (unless the counterfeiters have a new target)
Blinds	10,000	Handicrafts and decoratives	5%	500	Blinds represent 10% of US imports in decoratives and handicrafts, so for world 10% x $100bn =$10bn. 'Blinds' also includes metal, plastic, fabric and other blinds. Given prominence of bamboo blinds in developing countries a conservative estimate of market share is 5%. Speculative as not studied in detail.
Chopsticks (disposable)	400	Chopsticks (disposable)	80%	300	Bamboo is the dominant source for disposable chopsticks, but no firm data is available on relative share, hence assume estimate of 80%
Furniture	57,000	Wood furniture	2%	1,100	ITTO data indicates cane and bamboo furniture was 4.3% of world wood furniture export market in 2002. Cane/rattan is arguably likely to be a larger part of this than bamboo => bamboo = c.2%, rattan =2.3%.
Flooring	14,000	Wood flooring	0.75%	100	Even in China, bamboo flooring was only 5 M m^2 from a total 290 M m^2 wood flooring (1.85%) but up to 3% in value. Value of China bamboo flooring estimated as $60m, assume China is c.60% of world output gives estimated world bamboo flooring market size of $100m = c. 0.75% of wood flooring
Panel	27,000	Wood panels	0.75%	200	Bamboo panel production in China is >1.4M m^3 (Inbar) from 45M m^3 total panel production. China has c.20% of world panel production of 225M m^3, but arguably will dominate bamboo panels. Assuming China is 80% of world bamboo panel production, gives bamboo world panel mkt share of 0.75%
BJC (Builders' Joinery and Carpentry Products)	6,500	BJC	0.1%	<5	The technology exists but has only really been applied in China and on a small scale. Given estimated market share in flooring, bamboo BJC is not comparable in scale or market penetration. Hence, maximum estimate of 0.1% but may in fact be almost zero.
Charcoal (fuel)	3,100	Charcoal	2%	60	Bamboo fuel charcoal is not a preferred charcoal in unprocessed form if alternatives are available

					due to low density and burning temperature. Overall use is likely to be very small, but there is a growing export trade in processed bamboo charcoal (e.g. briquettes), so estimated market share may be, say, 2%.
Activated Carbon	1,200	Activated carbon	2%	20	Recent CCM survey of AC market in China noted that bamboo AC was available but actual production volumes 'ignorable'. Hence assume upper estimate of market share = 2%

Source: Enterprise Opportunities research

Scenario Analysis

Given the high degree of uncertainty over future bamboo market growth, especially in new markets, two market scenarios have been used for further analysis to illustrate the range of potential market sizes:

World Bamboo Market Scenario 1: Existing market – zero growth scenario (Worst case), based on current market size only assuming zero growth in global markets or bamboo penetration (highlighted on the left below).

World Bamboo Market Scenario 2: Mid-level future scenario, based on the prevailing forecasts for 'global market' growth and the mid–level scenario for bamboo penetration growth (highlighted on the right below).

While it is useful to consider a worst case scenario, the current dynamic expansion of the sector and global economic outlook means that a 'zero growth' scenario is unlikely to occur.

Table 2: World bamboo market scenarios

Industry[17]	**Current Bamboo Market**	**Global Market Growth**	**Bamboo Product Penetration %**				**Future Bamboo Market ($m)**		
	US$m	% p.a. (x 7yrs)	Current	Future lower	Future mid level	Future upper	Lower	Mid	Upper
Handicrafts (Bamboo/rattan)	**3000**	5%	50%	40%	50%	80%	**3,400**	**4,200**	**5,100**
Bamboo Shoots	**1500**	1.5%	100%	100%	100%	100%	**1,700**	**1,700**	**1,700**

[17] The list of industries is not intended to be exhaustive and hence the 'Total' is only for the markets covered and not the entire 'bamboo' sector. Notable exceptions include paper/pulp, domestic construction and others

Blinds	**500**	8%	5%	5%	7%	10%	**900**	**1,200**	**1,700**
Chopsticks (Disposable)	**300**	3.5%	80%	80%	90%	95%	**400**	**400**	**500**
Wood Furniture	**1100**	10%	2%	2%	5%	10%	**2,200**	**5,600**	**11,100**
Wood Flooring	**100**	8%	0.75%	2%	5%	10%	**500**	**1,200**	**2,400**
Wood Panels	**200**	7%	0.75%	2%	5%	10%	**900**	**2,200**	**4,300**
BJC	**5**	7.5%	0.1%	0.0%	0.3%	0.5%	**-**	**30**	**50**
Charcoal	**100**	5%	2%	2%	3%	4%	**90**	**130**	**170**
Activated Carbon	**20**	5.5%	2%	5%	10%	20%	**90**	**170**	**350**
Total[17]	**6,800**						**10,200**	**16,800**	**27,400**

World bamboo market scenario 1

World bamboo market scenario 2

Source: Study analysis

Under these two scenarios, there is a significant change in the relative importance of different industries, as illustrated in Figure 3 below:

- Under zero world market growth (Scenario 1), traditional markets such as handicrafts, blinds, shoots, chopsticks and traditional bamboo furniture account for 95% of the market as they do today.
- Under mid-level world market growth (Scenario 2), new markets for bamboo including modern/laminated furniture, flooring and panels, emerge to account for approx. 45% of the world market from only approx. 5% today.

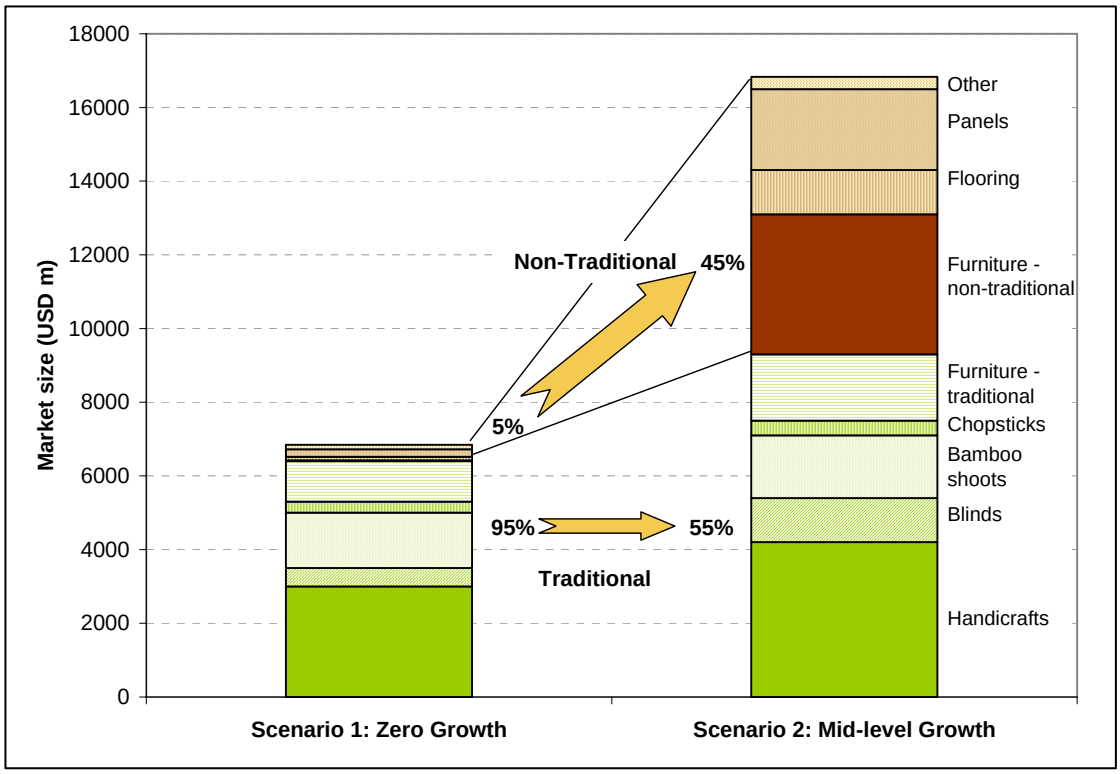

Figure 3: The growing importance of the new bamboo markets[18]

Source: Study analysis

Industry outlook

There are significant macro-economic changes driving the wood-based markets at present:

- Strong worldwide demand for materials alongside an established and growing environmental awareness are forcing changes in the way wood-based products are produced and marketed.
- Production and exports in China are changing the business context for US and European suppliers who are forced to either build their own factories in lower-cost countries or go out of business.
- A global shortage of certified renewable wood and shortage of all wood kinds in Asia is opening up opportunities for substitute products i.e. bamboo.
- Growth in interest in sources of environmentally friendly energy such as biomass will have an effect on wood-based industries and potentially bamboo.

Key issues expressed in interviews with industry participants from a range of bamboo and wood related industries included:

[18] Furniture is split between 'traditional' bamboo furniture that accounts for almost all of the current bamboo furniture market and 'non-traditional' bamboo furniture such as laminated bamboo furniture where there is likely to be the majority of growth for bamboo within the 'global' wooden furniture market.

- Rise in demand for certified timber products and chain of custody documentation
- Shortage of certified timber products and chain of custody documentation
- Biggest issue apart from sourcing wood remains quality assurance
- General positive disposition towards bamboo as a material, if some reservations about "the hype"
- Perception of bamboo as a suitable product for use in furniture and flooring but not construction based products in Western export markets
- Perception of bamboo as uncompetitive for use in wood panels, especially in high income economies

Conclusions

At present traditional bamboo products (e.g. handicrafts, shoots, chopsticks) dominate world demand. However, over the next decade newer products (e.g. flooring, laminated furniture, panels) can be expected to begin to rival demand for traditional products.

From a demand side perspective, there are three industry groupings that should be considered in any sector development strategy:

1. Handicrafts – household and enterprise level production and marketing of very wide variety of different products.
2. Shoots – high value, agricultural, standalone market
3. Industrial Processing (furniture, flooring, panels, chopsticks, blindmaking) – both lower tech and new higher tech application creating new market opportunities.

Strategies for market intervention and sector development are likely to benefit from progressing a combination of these three sub-sectors as this provides size and growth as well as important diversification (i.e. no over-reliance on one market for example the Western housing markets). Other markets are likely to warrant further investigation in the future, particularly those that would allow the development of more high-tech applications of bamboo such as activated carbon or textiles.

Macro-economic developments suggest that products that can replace wood-based products will be in demand due to shortages of certified (and non-certified) timber. Overall prospects for the world bamboo industry look strong.

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International Workshop on Bamboo

Bamboo for the Environment, Development and Trade

Wuyishan City, Fujian Province, China

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