



Forestry Department

Food and Agriculture Organization of the United Nations

And



International Network for Bamboo and Rattan

**GLOBAL BAMBOO
RESOURCES ASSESSMENT
(2005)**

CHINA

COUNTRY REPORT

STATE FORESTRY ADMINISTRATION, CHINA

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PREFACE

There are about 1 200 species and 70 genera of bamboo in the world, widely distributed in the tropical and subtropical areas of Asia, Africa, America and Oceania, and Pacific islands, and the distribution center of global bamboo resources is situated at the monsoon areas in Southeast Asia. Bamboo, one of the most important non-timber forest products in terms of their ecological conservation, feasible economic profit and social benefit, are increasingly playing an important role in increasing farmer income and promoting local economic development.

Fast growing, high productivity, strongly regeneration capability and various benefits of bamboo help draw focused attention in countries, where the plant growing, to result in the building up of an industry based on bamboo. Through the many years of its development, bamboo areas has progressively increased, bamboo business has speedy developed, many breakthroughs have been achieved in bamboo cultivation, processing and utilization, a lot of products have entered the market. However, how to develop bamboo forest, improve bamboo forest quality, and spread their environmental impact have become the dominant issues in the world.

In order to grasp global bamboo resources status, the developing level of bamboo industry, and international trade about bamboo products, INBAR has paid special attention in global bamboo resources assessment. As a result, global bamboo resources assessment workshop (GBRA2005) will be hold by FAO/INBAR and State Forestry Administration P.R.C in May 2005 in Beijing, China.

According to specification of GBRA2005, the project team, involving relevant departments and experts, compile country report about bamboo resources in China, following FRA2005 methodology. The Country Report includes:

- introduction of bamboo resources cultivation, processing and utilization in China, includes status of bamboo resources, bamboo resources investigation system, bamboo research and bamboo industry.
- preparation of country reporting tables, scheduled by INBAR, e.g. area, ownership, origin, growing stock, biomass and carbon stock, diversity of bamboo resources and bamboo products.

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Bamboo in China

Benefiting from its geographic position at the northern of bamboo distribution center of the world, China, a nation noted for the management and exploitation of bamboo resources, owns rich bamboo forest area and high bamboo yield. Bamboo is the integration of ecological value, feasible economic profit and social benefit. With regulation of local economic structure and implementation of six key forestry programs in China, bamboo has been attracting more and more sights. As one of the four “sunrise industries” in China, bamboo industry is increasingly playing an important role in sustainable development of economy. Especially due to positive affection in increasing local living, promoting provincial economic development where bamboo growing, and improving ecological conditions, bamboo industry has become one of dominant industries. Furthermore, the long history of bamboo utilization, more 6000 years, has led to especial bamboo culture in China.

1. Status of Bamboo Resources in China

China is one of the richest countries in the world in terms of number of bamboo species, area and reserve of bamboo, which do great contribution to regional water and soil conservation, water sources protection, wind-sand prevention and climatic improvement, et al.

1.1 Biodiversity of the Species

Bamboo germplasm enjoys a wide diversity in China, which ranks first among the bamboo growing countries. The diversity of bamboo germplasm is rooted in geographically and climatically complex features. The vast territory with its various geographical environment that differ greatly in terms of elevation and topography, and climatic zones that range from frigid to temperate, subtropical and tropical-acts as a haven for a larger number of bamboo species. According to *FLORA REIPUBLICAE POPULARIS SINICAE Tomus 9(1)*, China has over 500 species of bamboo plant within 37 genera, account for 36% and 39% of the total in the world, respectively, as showed in Appendix I. Of those species, more than 50 is listed as the commercial species.

1.2 Distribution of Bamboo Resources

According to the zonal distribution, bamboo areas in China are grouped into 5 geographic distribution areas, as shown in Appendix II:

- **Monopodial bamboo area in North China**, where the dominant bamboo is monopodial bamboo, about 29 species within 10 genera.
- **Mixed bamboo area in the south of Yangtse river**, where mixedly growing sympodial and monopodial species, and is the primary area for *P. heterocycla* cv. *Pubescens*.
- **Mountainous bamboo area in Southeast China**, where the dominant bamboo are monopodially mountainous bamboo.
- **Sympodial bamboo area in South China**, where sympodial bamboo (*Cephalostachyum Munro*, *Thyrsostachys Gamble*, *Dendrocalamus Nees*, and *Gigantochloa Nees*) are the

familiar to us.

- **Climbing bamboo area in Hainan and Yunnan province**, growing several climbing sympodial bamboo species.

1.3 Dynamics of Bamboo Resources

Since 90s in the 20th century, the area of bamboo forests has been steadily increasing at the rate of 50000 hm² per year. According to the 6th NFI, bamboo forests have extended to 4.99 million hm², a 1.5-fold increase over the figure for the 1950s and 1.60 million hm² more than that in the 1970s, 2.5% of the country's total forest land, and 39% of global bamboo area. Bamboo growing stock is 6.83×10^{10} culms, and that of moso forest is 7.46×10^{10} culms.

The quality of bamboo forests has been enhanced. With optimized structuring and upgraded management levels, the quantity and quality of bamboo stocks is evidently increasing. The average stock of moso forests has increased from less than 1 350 culms/hm² in the 1970s to 2 000 culms/ hm² at present.

2. Bamboo Resources Investigation

Bamboo resources information is gathered through national forest inventory (NFI), inventories for forest planning and design, operational design and specific investigation related to bamboo resources.p

2.1 National Forest Inventories

National forest inventory (NFI), carried out by the provinces (autonomous region or municipalities) throughout the country, are to assess and monitor the status and trend of macro forest resources regularly at a five years period, and give strong support for the formulation of national policies for forestry and related sectors. NFI are characterized as regular measurements based on ground sample plots (including fixed plots and temporary plots). The network of fixed sample plots is located on topographic map by system sampling. Plot shape can be set as square, rectangular, round plots or angle count method.

Forest resources of one fifth of provinces are surveyed every year, and NFI should be finished at a five years interval. Up to 2003, 6 NFIs have been conducted, including the 1st NFI (1973-1976), the 2nd NFI (1977-1981), the 3rd NFI (1984-1988), the 4th NFI (1989-1993), the 5th NFI (1994-1998) and the 6th NFI (1999-2003). During the 6th NFI, covering area is 9.567 million km², and 415 thousands fixed ground sample plots and 2.8444 million remote sensing plots had been arrayed all over the country.

Two species (groups) (*P. heterocycla* cv. *Pubescens* and others), with the diameter at breast height (DBH) over 2cm and canopy cover more than 0.2, can be derived from NFI. The indicators include bamboo type, area, culms, ownership, origin, closure and so on.

2.2 Inventories for Forest Planning and Design

Different from NFI, inventories for forest planning and design, whose survey range is forest

management unit such as forest farm owned by state, nature reserve and forest park or county, is generally conducted at the local levels for making forest management program and forestry plan. Its main tasks are to collect data on the change of forest resources in quantity, quality and distribution at the local levels, to image impersonally natural and economic conditions in survey range, to assess forest resources management, and to table a proposal about forest resources cultivation, protection and utilization.

The indicators related to bamboo resources include bamboo forest area, culms, ownership, origin, diameter, management, naturally geographical conditions and ecological factors, et al.

2.3 Other Related Investigation

Besides NFI and forest management inventory, operational design and a number of specific investigation, especially about bamboo timber removal, bamboo germplasm, biomass, disease and insect pests, and biodiversity, have been carried out by relevant research organism and local forest management department, and have provided strong scientific and technological support for bamboo industry.

3. Bamboo Research

Bamboo researchers in China have already made considerable achievements in bamboo resources cultivation, bamboo processing and utilization, which promote the effective utilization of the useful qualities of bamboo.

3.1 Bamboo germplasm resources. Investigation of bamboo species at national scale has brought to success. *FLORA REIPUBLICAE POPULARIS SINICAE Tomus 9 (1)* (BAMBUSOIDEAE Nees) was published in 1996, and several bamboo arboreta are founded.

3.2 Bamboo forest Cultivation. High-yielding approaches and tissue culturing techniques for important economic species are explored, and studies about life history and happening pattern of bamboo insect pests, and the prevention and cure on them are fulfilled.

3.3 Bamboo products utilization, including bamboo plywood, bamboo floor, bamboo shaving board, shoot preservatives and bamboo handcrafts and so on.

3.4 Theory study, for example, selection of the primary economic species, their growing and propagation, colony structure of bamboo forest, physical characters of bamboo timber, and specie-based biomass models and so on.

4. Bamboo Utilization

China has centuries-old history for application of bamboo in daily social lives. Along with the increasing requirements of people for forest resources, Bamboo is becoming more and more closely related with people, economy and ecology, owing to its strong adaptive capacity, short growing cycle and easy regeneration. In the 50 years since the founding of the People's Republic, particularly in the last 20 years since China's economic reforms, the bamboo industry has

witnessed rapid development, and is booming in harmony with economic prosperity of the nation. Currently, it is a major newly emerging sector that incorporates resource cultivation, processing, utilization and export. Bamboo, floriculture, eco-tourism and forest-based food industries jointly form the four “sunrise industries” in the development of the Chinese forestry sector.

4.1 Achievements

(1) Bamboo utilization has spread to more areas. In the old days, the use of bamboo was traditionally confined to construction. Today, it is widely used in the fields of construction, papermaking, food, furniture, packaging, transportation, medicine, health food and tourism. The bamboo industry is now a newly emerging sector that incorporates resources cultivation, processing, utilization, and foreign exchange earning through export.

(2) Scientific and technological support for the industry has been further strengthened. Up to 2000, bamboo-based scientific research in China has won 21 awards, 6 of which were at the national level and 15 at the provincial or ministerial level. All those research projects were production-oriented, and had given active guidance to enterprises at the grassroots level. The research results have been used in forest renovation, the second-season shooting, processing of bamboo ply boards and the development of bamboo leaf flavone, which drive bamboo industry rapid advancement.

(3) The market for bamboo products has expanded. After years of development, the bamboo shoot products have gained a considerable market share in south China, and are gaining popularity in other parts of China as well as in other countries. Today, market for bamboo products, liking bamboo culms, shoot products, bamboo coal, paper pulp and ply board has expanded to over 50 countries in Southeast Asia, Europe and North America.

(4) Substantial economic benefits have been realized. Statistics show that the annual GDP of China’s bamboo industry has been increased from 2.4 billion USD (1USD=8.277RMB) in 2000 to over 4.4 billion USD in 2002, and the foreign exchange earning through export is over 600 million USD. The number of bamboo enterprises whose sale income exceeds more than 120 thousand USD comes to 2300 until 2002. These figures are three times as those of the early 1990s. The bamboo industry has shown rapid development. At the same time, significant social benefits have accrued. As the bamboo industry is resource-dependent and labor-intensive, the bamboo culms and shoot processing yields significant social benefits. Bamboo cultivation and processing work has provided more and more job opportunities.

(5) The ecological environment has been remarkable improved. Green bamboo covering the mountain helps to protect the water resources, and bamboo forests help to conserve water and soil. Bamboo forests also help to regulate the climate and improve the ecological environment.

4.2 Prospect for Bamboo Industry Development in China

Entering the 21st century, the guidelines for developing China’s bamboo industry can be summarized as following:

“Exercising overall planning and striving for rational distribution; operating based on

different categories and trying to enhance efficiency; promoting development with certain dimensions and strengthening the management; developing the resources and upgrading utilization; gaining greater market shares and enhancing the efficiency; and relying on science and technology and invigorating the bamboo industry”.

Based on the principle of economic benefits incorporating the other two benefits, new achievements will have been made in the next 10a:

- In order to strengthen protection of existing bamboo forest resources, efforts will be made to renovate or newly plant 4 million hm² of bamboo forests by 2015.

- To boost the international trade of the bamboo products. The future export is estimated to reach 1 billion USD by 2010. Steps will be adopted, including developing new products with highly additional value and potential market, accelerating transformation of the existing research achievements.

Country Reporting Tables

1 Table T1 – Extent of Bamboo Forest

1.1 GBRA 2005 Categories and Definitions

Category	Definition
Bamboo forest	Bamboo on lands defined as "Forest" in FRA 2005.

1.2 National Data on Bamboo Resources

1.2.1 Data sources

References	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
National forest resources statistics (1984-1988)	H	Extent	1986	The 3 rd NFI
National forest resources statistics (1989-1993)	H	Extent	1991	The 4 th NFI
National forest resources statistics (1994-1998)	H	Extent	1996	The 5 th NFI
National forest resources statistics (1999-2003)	H	Extent	2001	The 6 th NFI
National forestry statistical yearbook	H	Plantation		

1.2.2 Classification and definitions

Category	Definition
Bamboo forest	Forest land spanning more than 0.0667 hm ² ; growing bamboo species with the diameter at breast height over 2 cm; Canopy cover of which is more than 20%.
Thereinto: <i>P. heterocykla</i> cv. Pubescens forest	Bamboo forest growing <i>P. heterocykla</i> cv. Pubescens.
Other bamboo forest	Bamboo forest growing other species except <i>P. heterocykla</i> cv. Pubescens.

1.2.3 Original data

National Class	Area (1000 hm ²)			
	1986	1991	1996	2001
<i>P. heterocykla</i> cv. Pubescens forest	2605.7	2681.6	3027.8	3478.1
Other bamboo forest	1054.5	1223.1	1335.3	1516.8
Total	3660.2	3904.7	4363.1	4994.9

1.3 Analysis and Processing of National Data

1.3.1 Calibration

Not necessary.

1.3.2 Estimation and forecasting

Estimation:

$$Area_{1990} = Area_{1991} - (Area_{1991} - Area_{1986})/5 \quad (1-1)$$

$$Area_{2000} = Area_{2001} - (Area_{2001} - Area_{1996})/5 \quad (1-2)$$

Forecasting:

In recent years, plantation of bamboo is increasing at higher rate than before. As a result, bamboo area in 2005 is forecasted by bamboo area in 2001 from the 6th NFI plus annual increasing amount in recent 4 years, presented as Eq. (1-3):

$$Area_{2005} = Area_{2001} + 4 * P - 4 * S, \quad (1-3)$$

where, P denotes annual forested area of bamboo since 2001, expressed by multiplying annual plantation (153 711hm², from *National Forestry Statistical Yearbook*) by forested rate (0.75, from *China Forestry Development Report*); S is annual bamboo area converting to other land use types; $S = 11\,920\text{hm}^2$, coming from the 6th NFI.

1.4 Data for National Reporting Table T1

GBRA 2005 Categories	Area (1000 hm ²)		
	1990	2000	2005
P. heterocykla cv. Pubescens forest	2666.4	3388	3790.9
Other bamboo forest ¹	1189.4	1480.5	1653.2
Total	3855.8	4868.5	5444.1

Note: 1. Other bamboo forest is composed of other species excluding P. heterocykla cv. Pubescens forest, liking *Fargesia spathacea*, *Neosinocalamus affinis*, *Chimonocalamus delicatus*, *Dendrocalamus giganteus* et al.

1.5 Comments to National Reporting Table T1

Among existing species of bamboo in China, P. heterocykla cv. Pubescens (moso) is the most common bamboo specie, and plays an important role in bamboo cultivation and utilization. So, P. heterocykla cv. Pubescens forest is separately defined as a category in this table, and the others, such as *Fargesia spathacea*, *Neosinocalamus affinis*, *Chimonocalamus delicatus*, *Dendrocalamus giganteus* et al., is calculated as other bamboo forest.

2 Table T2 – Ownership of Bamboo Forest

2.1 GBRA 2005 Categories and definitions

Category	Definition
Private ownership	Same as FRA: Land owned by individuals, families, private co-operatives, corporations, industries, religious and educational institutions, pension or investment funds, and other private institutions.
Public ownership	Same as FRA: Land owned by the State (national, state and regional governments) or government-owned institutions or corporations or other public bodies including cities, municipalities, villages and communes.
Other ownership	Same as FRA: Land that is not classified either as “Public ownership” or as “Private ownership”.

2.2 National Data on Bamboo Resources

2.2.1 Data sources

References	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
National forest resources statistics (1984-1988)	H	Ownership	1986	The 3 rd NFI
National forest resources statistics (1989-1993)	H	Ownership	1991	The 4 th NFI
National forest resources statistics (1994-1998)	H	Ownership	1996	The 5 th NFI
National forest resources statistics (1999-2003)	H	Ownership	2001	The 6 th NFI

2.2.2 Classification and definitions

National class (Bamboo)	Definition	
	Land ownership	Tree ownership
State ownership	Land owned by the State and state-owned institutions and enterprises.	Tree owned by the State and state-owned institutions and enterprises.
Collective ownership	Land owned by villages and communes.	Tree owned by villages and communes.
Private ownership		Tree owned by individuals, families, private co-operatives, corporations, and other private institutions.

2.2.3 Original data

National Class (Ownership of tree)	Area (1000 hm ²)			
	1986	1991	1996	2001
State ownership	385.8	376.5	437.9	471.9
Collective ownership	3274.4	3528.2	3925.2	2488.5
Private ownership				2034.5

2.3 Analysis and Processing of National Data

2.3.1 Calibration

Not necessary

2.3.2 Estimation

For the reference year 1990, estimating equation for ownership of bamboo forest is same as Eq. (1-1). For the reference year 2000, estimation process of bamboo forest area by land ownership is also same as Eq. (1-2).

But, for ownership of trees in 2000, two steps in the estimation process are included:

First, private ownership and collective ownership are incorporated into a group, and annual average change of p of the group is calculated:

$$P = (Area_{1991} - Area_{1986}) / 5 \quad (2-1)$$

And then, the ratio R of private bamboo forest or collective bamboo forest to non-state ownership bamboo area is computed. With p and R, bamboo forest area by collective ownership and private ownership are estimated, respectively, as Eq. (2-2) showing.

$$Area_{2000} = Area_{2001} - R * P \quad (2-2)$$

2.3.3 Reclassification

National class	GBRA 2005		
	Public ownership	Private ownership	Other ownership
State ownership	100%		
Collective ownership	100%		
Private ownership		100%	

2.4 Data for National Reporting Table T2

Ownership (Land)	Ownership of trees (1000 hm ²)		
	Bamboo on Forest Land		
	1990	2000	
	Public	Public	Private
Public	3855.8	2993.5	1875
Total	3855.8	2993.5	1875

2.5 Comments to National Reporting Table T2

(1) In China, ownerships of bamboo forest are surveyed by land and trees during 6th NFI, respectively. Thereinto, land ownerships include state ownership and collective ownership, tree ownership include state ownership, collective ownership and private ownership.

(2) For the reference year 1990, estimating equation for ownership of bamboo forest is same as Eq. (1-1). For the reference year 2000, estimation process of bamboo forest area by land ownership is also same as Eq. (1-2).

But, for ownership of trees in 2000, two steps in the estimation process are included:

First, private ownership and collective ownership are incorporated into a group, and annual average change (p) of the group is calculated;

Then, the ratio (R) of private bamboo forest or collective bamboo forest to non-state ownership bamboo area is computed. With p and R , bamboo forest area by collective ownership and private ownership are estimated, respectively.

3 Table T3 – Characteristics of Bamboo Forest

3.1 GBRA 2005 Categories and definitions

Category	Definition
Natural forest	Bamboo forest naturally formed by native species.
Plantation	Bamboo forest formed by native or introduced species, established through planting and seeding.

3.2 National data on Bamboo in Forests and Other Wooded lands

3.2.1 Data sources

References	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
National forest resources statistics (1984-1988)	H	Characteristics	1986	The 3 rd NFI
National forest resources statistics (1989-1993)	H	Characteristics	1991	The 4 th NFI
National forest resources statistics (1994-1998)	H	Characteristics	1996	The 5 th NFI
National forest resources statistics (1999-2003)	H	Characteristics	2001	The 6 th NFI
National forestry statistical yearbook	H	Plantation		

3.2.2 Classification and definitions

National class	Definition
Natural forest	Bamboo forest naturally formed by native species.
Plantation	Bamboo forest established through planting and seeding, the bamboo species of which may be native or introduced species.

3.2.3 Original data

National Class	Area (1000 hm ²)			
	1986	1991	1996	2001
Natural forest	2646.4	2824.1	3008	3291.7
Plantation	1013.7	1080.6	1355.1	1703.2

3.3 Analysis and Processing of National Data

3.3.1 Calibration

Not necessary

3.3.2 Estimation and forecasting

Estimation:

The estimated equations for the reference year 1990 and 2000 are same as that of Table T1.

Forecasting:

Plantation

$$Area_{2005} = Area_{2001} + 4 * R_p - 4 * R_n \quad (3-1)$$

where, R_p denotes annual forested area of bamboo since 2001, expressed by multiplying annual plantation (153 711hm², from *National Forestry Statistical Yearbook*) by forested rate (0.75, from *China Forestry Development Report*, $R_p=115\ 283$ hm², and R_n the dynamics of bamboo forest from plantation to natural forest, $R_n=18\ 543$ hm², coming from the 6th NFI.

Natural forest

$$Area_{2005} = Area_{2001} + 4 * R_N \quad (3-2)$$

Where, R_N is the net increasing amount of bamboo natural forest after 2001, equal to new natural forest area per year (18 543 hm²) subtract converting area from natural forest to other land per year (2 384 hm²), both of them coming from 6th NFI.

3.3.3 Reclassification

Not necessary

3.4 Data for National Reporting Table T3

GBRA 2005 Categories	Area (1000 hm ²)					
	Bamboo on forest land			Total		
	1990	2000	2005	1990	2000	2005
Natural bamboo forest	2788.6	3234.9	3353.9	2788.6	3234.9	3353.9
Plantation	1067.2	1633.6	2090.2	1067.2	1633.6	2090.2
Total	3855.8	4868.5	5444.1	3855.8	4868.5	5444.1

3.5 Comments to National Reporting Table T3

4 Table T4 – Bamboo Growing Stock

4.1 GBRA2005 Categories and definitions

Category	Definition
Bamboo Growing stock	Number of bamboo forest more than X cm in diameter at breast height. It includes the stem from ground level to a top diameter of Y cm.

4.2 National data on Bamboo Resources

4.2.1 Data sources

References	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
National forest resources statistics (1984-1988)	H	Culms	1986	The 3 rd NFI
National forest resources statistics (1989-1993)	H	Culms	1991	The 4 th NFI
National forest resources statistics (1994-1998)	H	Culms	1996	The 5 th NFI
National forest resources statistics (1999-2003)	H	Culms	2001	The 6 th NFI

4.2.2 Classification and definitions

Same as table T1, bamboo growing stock is calculated by *P. heterocykla* cv. *Pubescens* forest and other bamboo stands. Other bamboo forest is composed of the other species except *P. heterocykla* cv. *Pubescens*, such as *Fargesia spathacea*, *Neosinocalamus affinis*, *Chimonocalamus delicatus*, *Dendrocalamus giganteus*, et al.

Category	Definition
Growing stock of <i>P. heterocykla</i> cv. <i>Pubescens</i>	The number of <i>P. heterocykla</i> cv. <i>Pubescens</i> with over 2 cm diameter at breast height in bamboo forest.
Growing stock of other bamboo forest	The number of other bamboo with over 2 cm diameter at breast height in bamboo forest.

4.2.3 Original data

National Class	Growing stock (10000 culms)			
	1986 ¹	1991 ¹	1996 ¹	2001 ²
<i>P. heterocykla</i> cv. <i>Pubescens</i>	795733	499537	584420	745777
Other bamboo forest	3068133	3797769	5170753	6084335

4.3 Analysis and Processing of National Data

4.3.1 Calibration

4.3.2 Estimation and forecasting

Estimation:

The same methods as Eq. (1-1) and Eq. (1-2).

Forecasting (Extrapolation):

$$Culms_{2005} = Culms_{2001} + (Culms_{2001} - Culms_{1996}) / 5 * 4 \quad (4-1)$$

4.3.3 Reclassification

Not necessary

4.4 Data for National Reporting Table T4

GBRA 2005 Categories	Growing stock (1000 culms)		
	1990	2000	2005
Bamboo growing stock	42106180	66151242	76900632
Thereinto :			
P. heterocykla cv. Pubescens	5587762	7135056	8748626
Other bamboo forest ¹	36518418	59016186	68152006

Note: 1. Other bamboo forest is composed of other species excluding *P. heterocykla cv. Pubescens* forest, liking *Fargesia spathacea*, *Neosinocalamus affinis*, *Chimonocalamus delicatus*, *Dendrocalamus giganteus*, et al.

4.5 Comments to National Reporting Table T4

5 Table T5 – Bamboo Biomass and Carbon Stock

5.1 GBRA2005 Categories and definitions

Category	Definition
Above-ground biomass of bamboo	All living biomass above the soil including stem, shoot, branches and foliage.
Below-ground biomass of bamboo	All living biomass of live roots.
Carbon in above-ground biomass	Carbon in all living biomass above the soil, including stem, stump, branches, bark, seeds, and foliage.
Carbon in below-ground biomass	Carbon in all living biomass of live roots.

5.2 National Data on Bamboo Resources

5.2.1 Data sources

References	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Table T1	H	Area	1990 2000 2005	
Land use and lists of greenhouse atmosphere letting in forestry land in 1994	M	Biomass density	2004	Chinese Academy of forestry

5.2.2 Classification and definitions

Category	Definition
Above-ground biomass of bamboo	All living biomass above the soil including stem, shoot, branches and foliage.
Below-ground biomass of bamboo	All living biomass of live roots.
Carbon in above-ground biomass	Carbon in all living biomass above the soil, including stem, stump, branches, bark, seeds, and foliage.
Carbon in below-ground biomass	Carbon in all living biomass of live roots.

5.2.3 Original data

Table T1

5.3 Analysis and Processing of National Data

5.3.1 Calibration

Not necessary

5.3.2 Methods on biomass

At present, three approaches for bamboo biomass estimate are available, including regression model based on plot measurement, biomass density method and LAI-based model. According to spatial scale and existing available data, bamboo forest biomass is estimated by multiplying bamboo area by biomass per hectare, as described by Eq. (5-1). Here, for no available biomass per hectare for above ground biomass and under ground

biomass, respectively, the total biomass of bamboo forest is calculated.

$$biomass = area \times BH, \quad (5-1)$$

where, area is bamboo forest area, *BH* denotes the biomass stock per hectare for the reference year 1990, 2000 and 2005, 166.67±137.39 ton/ hm² for *P. heterocyclus* cv., and 119.35±91.69 ton/ hm² for other species.

5.3.3 Carbon deposit

Carbon conversion coefficients are different, considering species, age, formation and community structure of vegetation types, from 0.45 to 0.55. For carbon stock in bamboo forest, we use a carbon conversion coefficient of bamboo forest biomass of 50%.

5.3.4 Reclassification

Not necessary

5.4 Data for National Reporting Table T5

GBRA 2005 Categories	Biomass (million ton)			Carbon (million ton C)		
	1990	2000	2005	1990	2000	2005
Above ground	ID	ID	ID	ID	ID	ID
Below ground	ID	ID	ID	ID	ID	ID
Total	642.65	811.44	907.37	321.32	405.72	453.68

Note: 1. T5 only records total amount of biomass and carbon stock.

2. Conversion coefficient of carbon with bamboo forest biomass is 0.5.

5.5 Comments to National Reporting Table T5

(1) The figures in table 5 are the total amount of biomass and carbon stock in bamboo forest, including that in above ground and below ground, excluding that in litter layer under forest and soil layer.

(2) Studies on bamboo biomass are being performed in China. Biomass value per hectare in this table comes from existing research results. Because of regional difference of bamboo growing, it's not sure whether they are representative. So, the accuracy of estimated results in T5 can't be forecasted, and the figures in this table may be rectified in the future.

6 Table 6 – Diversity of Bamboo Resources

6.1 GBRA 2005 Categories and Definitions

Category	Definition
Number of native bamboo species	The total number of native tree species that have been identified within the country.
Number of introduced bamboo species	The total number of native tree species introduced from other countries.
Number of critically endangered bamboo species	The number of native tree species that are classified as “Critically endangered” in the IUCN red list.
Number of endangered bamboo species	The number of native tree species that are classified as “Endangered” in the IUCN red list.
Number of vulnerable bamboo species	The number of native tree species that are classified as “Vulnerable” in the IUCN red list.
Number of insect pests	The number of pests affecting bamboo health.

6.2 National Data on Bamboo Resources

6.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
FLORA REIPUBLICAE POPULARIS SINICAE Tomus 9 (1), Science Press, Beijing: 1996.	H	Species	1996	
List of Forest Diseases and Insect Pests in China	H	Pests	1983	

6.2.2 Classification and definitions

Category	Definition
Number of native bamboo species	The total number of native tree species that have been identified within the country.
Number of introduced bamboo species	The total number of native tree species introduced from other countries.
Number of critically endangered Bamboo species	The number of native tree species that are classified as “Critically endangered” in the IUCN red list.
Number of endangered bamboo species	The number of native tree species that are classified as “Endangered” in the IUCN red list.
Number of vulnerable bamboo species	The number of native tree species that are classified as “Vulnerable” in the IUCN red list.
Number of insect pests	The number of pests affecting bamboo health.

6.3 Analysis and Processing of National Data

Not necessary

6.4 Data for National Reporting Table T6

GBRA 2005 Categories	Number of species
Native bamboo species ¹	Over 500
Introduced bamboo species ¹	About 10
Critically endangered bamboo species ²	ID
Endangered bamboo species ²	ID
Vulnerable bamboo species ²	ID
Bamboo insect pests ³	About 400

Note: 1.Number of native bamboo species and introduced bamboo species come from *FLORA REIPUBLICAE POPULARIS SINICAE Tomus 9 (1)*.

2.No available information about bamboo species under critical endangered, endangered and vulnerable conditions.

3.Number of bamboo insect pests comes from *List of Forest Diseases and Insect Pests in China*

6.5 Comments to National Reporting Table T6

Up to now, Chinese scientist are investigating diversity of bamboo species, and some achievements have been made, such as *Exploring the Criteria for Endangered Categories of bamboo species from China* (Ma Naixun, 2004), however, the recognized criteria for endangered categories of bamboo species in China has not been established. Furthermore, there are not available information about critically endangered bamboo species, endangered bamboo species and vulnerable bamboo species from IUCN.

7 Table T7 – Removal and Value of Bamboo Products

7.1 GBRA 2005 Categories and Definitions

Category (GBRA2005)	Reporting unit	
	Removal	Value
1. Shoot	10000 ton	Million USD
2. Building timber	10000 m ³	Million USD
3. Craft	10000 units	Million USD
4. Bamboo pulp	10000 ton	Million USD

7.2 National Data

7.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
National forestry statistical yearbook	H	Removal of shoot and bamboo timber removal	1988-2003	
Research results	M	Removal and value of bamboo products		(Chinese Academy of Forestry)

7.2.2 Classification and definitions

National class	Reporting unit	
	Removal	Value
1. Bamboo timber	10000 culms	Million RMB
2. Shoot	10000 ton	Million RMB
3. Building timber	10000 m ³	Million RMB
4. Bamboo pulp	10000 units	Million RMB
5. Craft	10000 ton	Million RMB

7.2.3 Original data

Year	Removal					Value (10 ⁶ RMB) ³				
	BT ¹ (1000culms)	SH ¹ (10000t)	BTI ² (10000m ³)	BP ² (10000t)	CR ² (10000p)	SH	BTI	BP	CR	BT
1988	262110	6.6	15	15.3	9170	1000	221		82.19	
1989	152390	7.5	15.3	13.2	9088	1000	278		85.95	
1990	187140	8.6	16	20		1000	263			1428
1991	291730	9.0	18	20		1000	303			1815
1992	404300	10.7	18	20		4000	512			2488
1998	692530	25.3	30	30		3000				6786
1999	539210	32.0	30			4000				6057
2000	561830	35.0	40							
2001	581460	36.5								
2002	668110	49.7								

2003	968670	42.6		50						
2004	1098460	44.4								

Note: 1.BT and SH are the abbreviation of bamboo timber and shoot, removal statistics of them come from *National Forestry Statistical Yearbook*.

2.BTI, BP and CR are the abbreviation of building timber, bamboo pulp and crafts, respective, statistical information on the removal of them from related studies.

3. Value of BT, SH, CON, BP and AP come from related studies.

7.3 Analysis and Processing of National Data

7.3.1 Calibration

Not necessary

7.3.2 Estimation and forecasting

$$Output_{1990} = \sum_{i=1988}^{1992} Output_i / 5 \quad (7-1)$$

$$Output_{2000} = \sum_{i=1998}^{2002} Output_i / 5 \quad (7-2)$$

(1) Bamboo timber

- The reported figures on removal for 1990 and 2000 are based on an average of a five years period, as Eq. (7-1) and Eq.(7-2). The figure for reference year 1990 is the average of 1988 to 1992, and that for 2000 is that of 1988 to 2002. Removal in 2005 is estimated by removal in 2004 plus the average change amount per year since 2001.
- The value for 1990 is expressed with bamboo timber value in 1990, and that for 2000 is based on average price of bamboo timber in 1999. Due to insufficient data for bamboo timber price since 2000, the value for 2005 is filled with “ID”.

(2) Bamboo shoot

- The reported figures on shoot for 1990 and 2000 are based on an average of a five years period, as Eq. (7-1) and Eq. (7-2). The figure for reference year 1990 is the average of 1988 to 1992, and that for 2000 is that of 1988 to 2002. Bamboo shoot removal in 2005 is estimated by removal in 2004 plus the average change amount per year since 2001.
- The value for 1990 is expressed with an average of a five years period from 1988 to 1992, and that for 2000 is based on average price of bamboo shoot in 1999. Due to insufficient data for bamboo shoot price since 2000, we write “ID” for the value in 2005.

(3) Building timber

- The reported figure on building timber for 1990 is based on an average of a five years period from 1988 to 1992, namely Eq. (7-1), and that for 2000 is replaced with removal in 2000. Due to insufficient data for building timber removal since 2000, the value for 2005 isn't forecasted.
- The value for 1990 is expressed with an average of a five years period from 1988 to 1992. Due to insufficient data for building timber price since 1998, the value for 2000 and 2005 are documented with

“ID”.

(4) Bamboo pulp

- The reported figure on bamboo pulp removal for 1990 is based on an average of 1988 to 1992, Eq. (7-1). And that for 2000 is expressed with removal in 1998. Due to insufficient data for bamboo pulp removal since 2000, the value for 2005 isn't forecasted.
- Due to insufficient data for bamboo pulp price, the value for 1990, 2000 and 2005 are documented with “ID”.

(5) Crafts

- Bamboo crafts removal for 1990 is that of 1989, and there is insufficient information since 1990.
- Due to insufficient data for crafts price, the value for 1990, 2000 and 2005 are documented with “ID”.

7.4 Data for National Reporting Table T7

Years	Removal					Value (million USD)				
	BT (10000 Culms)	SH (10000t)	BTI (10000m ³)	BP (10000t)	CR (10000p)	BT	SH	BTI	BP	CR
1990	26000	8.2	16.5	17.7	9088	172.53	193.31	38.66	ID	10.39
2000	61000	34.6	40	30	ID	762.47	538.84	ID	ID	ID
2005	123000	46.7	ID	50	ID	ID	ID	ID	ID	ID

- Note: 1. BT, SH, BTI, BP and CR are the abbreviation of bamboo timber, shoot, building timber, bamboo pulp and crafts, respectively.
2. Removal statistics of bamboo timber and shoot come from *National Forestry Statistical Yearbook*, and the others from related studies results.
3. 1USD = 8.277RMB

7.5 Comments to National Reporting Table T7

(1) In order to more perfectly reflect the status of bamboo industry in China, we also add bamboo timber item in T7.

(2) Bamboo timber excludes small bamboo timber. Small bamboo timber is widely applied in bamboo pulp, craft and so on, and the removal in 2003 reaches 135.09 million ton.

(3) Some information about bamboo products removal and value is cited from relevant research results, the criteria and extent are different among them, and may not accurately reflect the status of bamboo industry in China.

Appendix I

Table 8 List of Bamboo Species in China

Bambuseae	Genera	Number of species ¹	Important economic species
MELOCANNEAE Benth.	Melocanna Trin.	1	M. baccifera (Roxb.) Kurz
	Schizostachyum Nees	9	S. hainanense Merr. Ex McClure S. brachycladum (Kurz) Kurz
	Pseudostachyum Munro	1	P. polymorphum Munro
	Cephalostachyum Munro	4	C. pergracile Munro C. pallidum Munro
	Thyrsostachys Gamble	2	T. oliveri Gamble T. siamensis (Kurz ex Munro) Gamble
	Melocalamus Benth.	2	M. elevatissimus Hsueh et Yi M. arrectus Yi
	Monocladus Chia et al.	4	M. saxatilis Chia et al. M. amplexicaulis Chia et al.
BAMBUSEAE Trin.	Neomicrocalamus Keng f.	2	N. prainii (Gamble) Keng f.
	Bambusa Retz. Corr. Schreber	60	B. arundinacea (Retz.) Willd. B. ventricosa McClure
DENDROCALAMEAE Benth.	Dendrocalamopsis Keng f.	8	D. vario-striata (W.T.Lin)Keng f. D. oldhami (Munro) Keng f.
	Neosinocalamus Keng f.	2	N. affinis (Rendle) Keng f. N. recto-cuneatus W. T. Lin
	Dendrocalamus Nees	29	D. giganteus Munro D. latiflorus Munro
	Gigantochloa Kurz ex Munro	5	G. nigrociliata (Buse) Kurz G. verticillata (Willd.) Munro
SHIBATAEEAE Nakai emend. Keng f.	Shibataea Makino ex Nakai	7(2)	S. kumasasa (Zoll. Ex Steud.) Makino S. nanpingensis Q. F. Zheng et K. F. Huang
	Semiarundinaria Makino	1	S. fastuosa (Mitford) Makino
	Qiongzhusa Hsueh et Yi	8(1)	Q. rigidula Hsueh et Yi Q. communis Hsueh et Yi
	Indosasa McClure	13	I. angustata McClure I. sinica C. D. Chu et C. S. Chao
	Sinobambusa Makino ex Nakai	13	S. seminuda Wen S. dushanensis (C. D. Chu et J. Q. Zhang) Wen
	Brachystachyum Keng	1(1)	B. densiflorum (Rendle) Keng
	Chimonobambusa Makino	20	C. marmorea (Mitford) Makino C. hirtinoda C. S. Chao et K. M. Lan

	<i>Phyllostachys</i> Sieb. Et Zucc.	50	<i>P. makinoi</i> Hayata <i>P. heterocyclus</i> cv. <i>Pubescens</i>
CHUSQUEEAE (Munro) E. G. Gamus	<i>Chimonocalamus</i> Hsueh et Yi	8(1)	<i>C. delicatus</i> Hsueh et Yi <i>C. dumosus</i> Hsueh et Yi
	<i>Drepanostachyum</i> Keng f.	10	<i>D. microphyllum</i> (Hsueh et Yi) Keng f. ex Yi <i>D. melicoides</i> Keng f.
ARUNDINARIEAE Nees	<i>Fargesia</i> Franch. Emend. Yi	79	<i>F. spathacea</i> Franch. <i>F. altior</i> Yi
	<i>Yushania</i> Keng f.	58(1)	<i>Y. brevipaniculata</i> (Hand.-Mazz) Yi <i>Y. oblonga</i> Yi
	<i>Thamnocalamus</i> Munro	2	ID
	<i>Ampelocalamus</i> S. L. Chen et al.	2	ID
	<i>Acidosasa</i> C. D. Chu et C. S. Chao	5	<i>A. chinensis</i> C. D. Chu et C. S. Chao <i>A. longiligula</i> (Wen) C. Z. Chao et C. D. Chu
	<i>Oligostachyum</i> . P. Wang et G. H. Ye	15	<i>O. glabrescens</i> (Wen) Keng f. et Z. P. Wang
	<i>Pleioblastus</i> Nakai	20	<i>P. gramineus</i> (Bean) Nakai <i>P. simonii</i> (Carr.) Nakai
	<i>Bashania</i> Keng f. et Yi	4	<i>B. fargesii</i> (E. G. Camus) Keng f. et Yi <i>B. fangiana</i> (A. Camus) Keng f. et Wen
	<i>Gelidocalamus</i> Wen	9	<i>G. stellatus</i> Wen <i>G. tessellatus</i> Wen et C. C. Chang
	<i>Pseudosasa</i> Makino ex Nakai	23(5)	<i>P. japonica</i> (Sieb. Et Zucc.) Makino <i>P. amabilis</i> (McClure) Keng f.
	<i>Sasa</i> Makino et Shibata	10	<i>S. longiligulata</i> McClure <i>S. fortunei</i> (Van Houtte) Foiri
	<i>Metasasa</i> W. T. Lin	2	<i>M. carinata</i> W. T. Lin
	<i>Indocalamus</i> Nakai	22(6)	<i>I. latifolius</i> (Keng) McClure <i>I. hispidus</i> H. R. Zhao et Y. L. Yang
	<i>Ferocalamus</i> Hsueh et Keng f.	1	<i>F. strictus</i> Hsueh et Keng f.

Appendix II

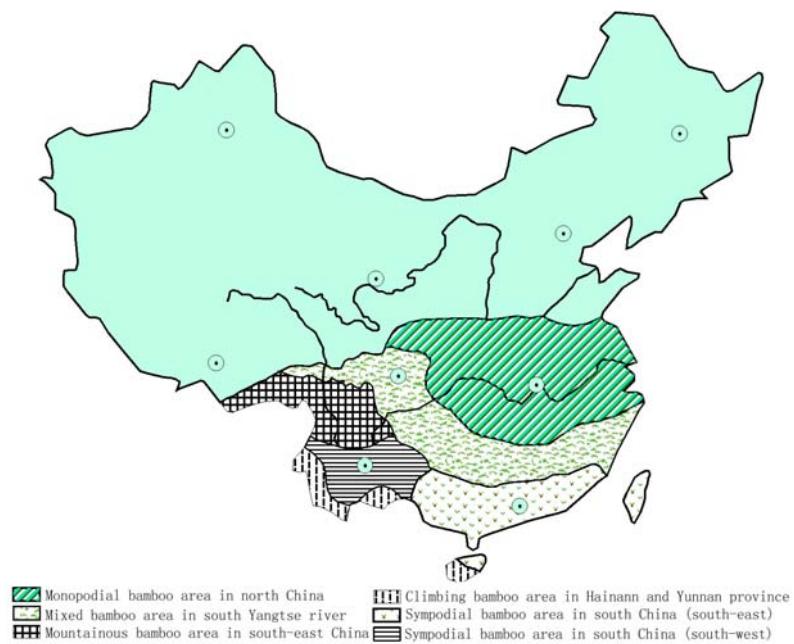


Figure 1 Geographic distribution of bamboo resources in China