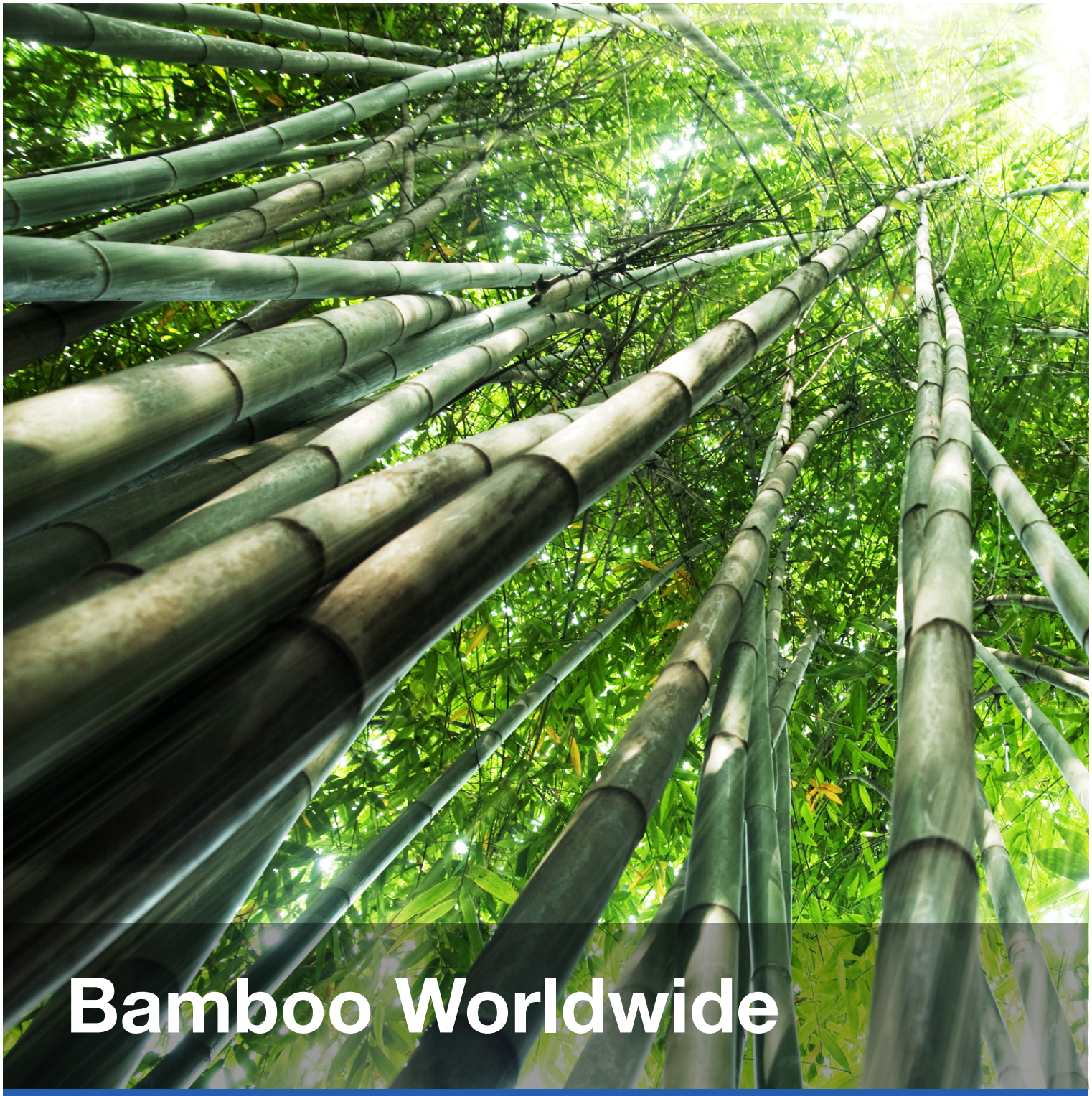


Bamboo Worldwide

The Current Market & Future Potential

ecoplanet™ bamboo

About the Authors

Inga Muller

After her undergraduate studies Inga spent four years working for a major European investment bank in one of the most successful energy project finance teams in Europe. In this role she was responsible for credit analysis, financial modelling and due diligence for energy infrastructure projects in Europe, Middle East and Africa, including pipelines, power plants and gas terminals. Wishing to combine her long-time passion for the environment and her financial knowledge, she subsequently left the bank to pursue a postgraduate degree specialising in environmental economics. Her dissertation was entitled “Sustainable Tropical Forestry Projects as an Investment Opportunity”. During her studies Inga started working as a freelance consultant providing market research and financial analysis services for forestry project developers. Inga holds a BSc in International Business & Modern Languages from Aston University and an MSc in Environmental Technology from Imperial College London.

Camille Rebelo

Camille Rebelo has built her career around the development of innovative financing mechanisms for the commercialization of sustainable forestry initiatives. She has worked in both public and private sector and has experience in the origination, implementation and management of forestry and land use programs. Starting through her work with the Permanent Mission of Papua New Guinea to the United Nations, and subsequent extensive consulting experience, Camille has been involved in the global markets for forest based carbon credits since 2005. In addition to being involved in international policy work, she has extensive experience in the creation and development of both community based initiatives and large scale commercial forestry plantations across Latin America, Africa and Southeast Asia. She holds a BSc in Ecology from Imperial College, London, and a Master’s from Yale University’s School of Forestry and Environmental Studies.

About This Report

This report is designed to provide an introduction to bamboo as a plant as well as its current and future potential as a commercial commodity. Elements of the report refer to technical and biological factors and to assist in this a glossary has been provided.

The report has been written using rigorous academic standards and utilises a number of research sources which are all quoted and detailed in the References section.

“Due to new developments in the industrial bamboo sector, virtually any wood product can be produced from bamboo. Therefore the market for wood products can be considered as an analogous substitute market”

Executive Summary

With increasing global attention towards the potentially devastating effects of climate change has come an increasing focus on the role of deforestation and land use change. Fuelled by an ever growing demand for wood products, tropical deforestation continues to increase at an alarming rate.

To successfully reverse the current trends of deforestation and forest degradation, it is imperative that market demands for wood and timber products that cause such land use change, are addressed. The development of a sustainable supply of timber bamboo such as G. angustifolia, provides one such solution. Mature in a fraction of the time of tropical hard woods (4yrs compared to 20+ for species such as teak, mahogany, ironwood, rosewood etc) and with new technology that enables the processing of bamboo for high end products such as flooring, decking, construction and furniture, bamboo represents a sustainable alternative.

If grown under the correct conditions, with a particular focus on the utilization of degraded land for reforestation initiatives, bamboo's green credentials are impressive. It not only prevents further soil degradation and erosion, but it utilizes very low levels of water from the soil, and its extensive root system acts as a watershed protector. Furthermore bamboo sequesters significant volumes of carbon dioxide from the atmosphere within a relatively short time period. If used for high end wood products, such carbon remains stored for long time periods, contributing to the fight against climate change.

Sustainable bamboo plantations provide direct employment for many rural, unskilled people in areas where opportunities for economic development are low, both within the plantations themselves, and within processing facilities. Outgrower schemes and revenue from the sale of carbon credits provides additional potential for poverty alleviation and economic diversification.

Yet for a multitude of reasons the market for bamboo outside of China is in its infancy. A disconnect between agronomists, financiers and potential end users has resulted in the slow commercialization of this valuable species. Furthermore the unusual flowering pattern of bamboo requires careful consideration for commercial reforestation entities. Through the vertical integration of reforestation with adequate business and marketing expertise, such barriers can be overcome, and the market grown exponentially.

This report provides an overview of the newly emerging market for bamboo as an alternative to traditional timber products. Although it considers all species, the focus is on the market for G. angustifolia, with a focus on Latin America. It concludes that there are few commercial G. angustifolia ventures, with the majority of current supply originating from natural stands. The prices achieved for G. angustifolia by the small number of commercial bamboo plantations that do exist is found to be an average of US$4.15 per linear metre. The review concludes that there is potential for the market to double by 2015 and grow substantially more beyond that. Bamboo represents an economic and sustainable alternative to traditional timber species and thereby represents a valuable opportunity for investors looking for a triple bottom line investment.

What is Bamboo?

1.1 Introduction

Bamboo is an ancient woody grass widely distributed in tropical, subtropical and mild temperate zones. Traditionally seen as the “poor man’s tree”, in recent years bamboo has risen to a high-tech, industrial raw material and substitute for wood. Although the commercialization of planted bamboo has been slow, bamboo is becoming an increasingly important economic asset in poverty eradication, economic and environmental development (FAO, 2005).

The purpose of this report is to give an overview of bamboo and its uses as well as the current supply and demand for bamboo products worldwide. The information presented has been taken from publicly available resources and is referenced accordingly. A lot of the information available has been provided directly or indirectly by the International Network for Bamboo and Rattan (INBAR), an organisation dedicated to the promotion of bamboo and rattan.

Given the immature nature of world bamboo markets, verifiable data is limited or incomplete in some areas. Despite these restrictions the report attempts to provide a useful summary of the current market for bamboo and its future potential.

1.2 Bamboo as a plant

Bamboo is a group of perennial evergreens in the true grass family Poaceae and includes the largest members of the grass family. There are more than 70 genera of bamboo divided into about 1,450 species, of which only around 50 species are routinely cultivated (Hunter, 2003). Native bamboo grows in many parts of the world, including East Asia, Sub-Saharan Africa and the Americas. Bamboo is not limited to tropical climates, with some species able to withstand frost and survive in Northern Europe.

Bamboo is an extremely fast growing plant, with some species obtaining growth surges of 100cm per 24 hour period. Most bamboo species grow to their full height within a single growing season. Over the following seasons the walls of each culm (or stem) dry and harden, reaching maturity within 3 to 5 years. After a maximum life, which varies by species and climate, the individual bamboo culm will collapse and decay, although the plant itself may survive. Furthermore bamboo tolerates poor soils, which makes it useful for planting on degraded land. (Hunter, 2003).

Another peculiarity of bamboo is that most species flower very infrequently, with intervals as long as 60 to 120 years. These species exhibit what is called ‘mass flowering’ where all plants in the population flower at the same time (Wikipedia, 2010). This phenomenon has restricted the commercialization of many species, as flowering causes the bamboo plant to die. In vegetatively propagated plants, it is almost impossible to predict the flowering pattern. However, if a flowering event occurs and seedlings are utilized, flowering is not expected for another 60-120 years depending upon the species.

Bamboo shoots and culms grow from the dense root rhizome system. There are two main categories of rhizomes: monopodial and sympodial. Monopodial rhizomes grow horizontally, often at a surprising rate, thus their nickname of ‘runners’ or ‘running bamboo’. The rhizome buds develop either upward, generating a culm, or horizontally, with a new tract of the rhizomal net.

Monopodial bamboos generate an open clump with culms distant from each other and can be invasive. They are usually found in temperate regions and include the genera Phyllostachys and Pleioblastus. Sympodial rhizomes are short and thick, and the culms above ground are close together in a compact clump, which expands evenly around its circumference. These are known as ‘clumping’ bamboo and the development of clums around the core of the plant is predictable. Their natural habitat is tropical regions and they are not invasive. The clump size is self limiting and will not continue to increase past a certain size, dependnt on species and growing conditions. The plants can therefore be easily controlled. Sympodial bamboos include the genera Bambusa and G. angustifolia. (FAO, 2005)

1.3 Bamboo's Environment Credentials

Although technically a grass, bamboo exhibits a number of properties that make it a valuable species for reforestation initiatives, particularly in areas that have suffered high environmental and soil degradation. Unlike trees, individual bamboo culms are connected underneath the ground by a network of rhizomes, from which the culms grow. This intricate system of rhizomes means that bamboo forests are excellent at controlling soil erosion and have been shown to be particularly effective within water catchment areas. INBAR's work on bamboo and biodiversity has found that bamboo plantations have been used successfully to rehabilitate degraded land back in to productive, fully functioning ecological systems.

In their natural states, bamboo systems are intermixed with tree, shrub and herbaceous vegetation. This provides valuable habitat for numerous species at the soil and tree layer including spiders, butterflies, birds and other higher life forms. The mix of plant species is important for maintaining high levels of nutrients in the soil, and a high degree of resilience of the ecosystem to weather events and disease and insect infestation. Although in the early years of a planted bamboo ecosystem, it is necessary to keep the undergrowth clear for maximum growth, once the bamboo clumps are established it is possible to recreate a natural ecosystem, thereby increasing biodiversity within a previously degraded area.

The following table indicates that management practices can be maximized not only for productivity but also for the environmental and biodiversity characteristics of the reforested area. The work carried out by INBAR on the relationship between biodiversity and bamboo reforestation initiatives concludes that the retention of tree species, selective clearance of plants and conservative use of organic fertilizer provide positive effects on ecosystem health. These practices can be adopted without compromising bamboo productivity, and therefore serve as the basis for recommended practices for sustainable bamboo cultivation (Henley 2010).

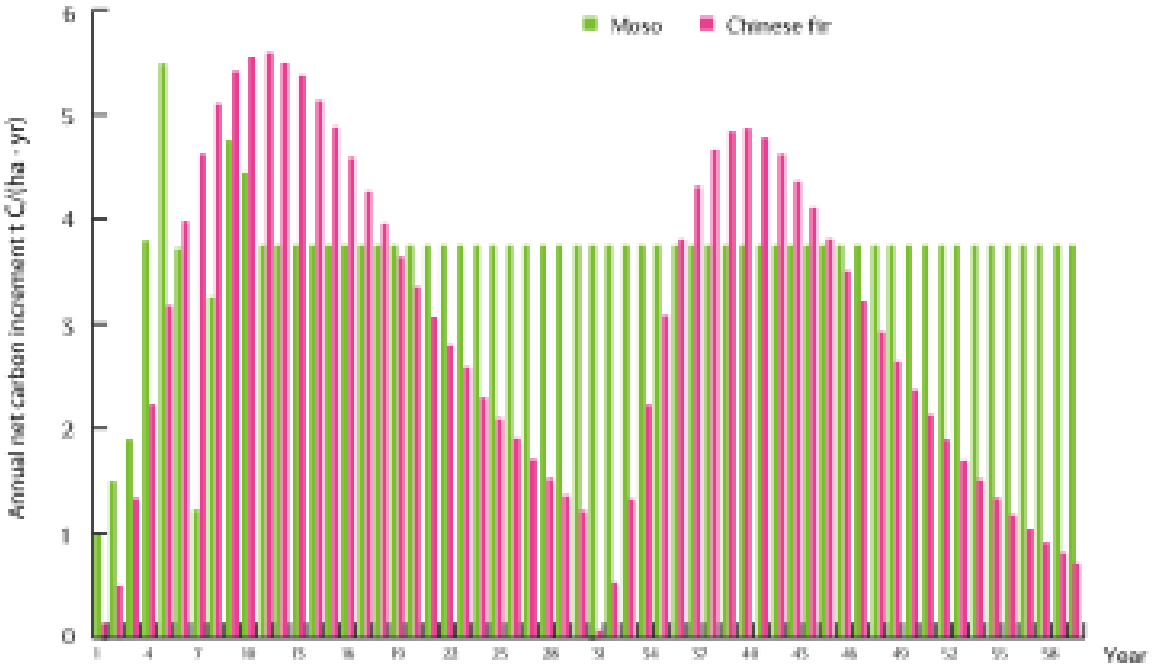
Effects on	Description	Reference
	Monoculture forest in Hunan and Sichuan showed lower bird diversity in comparison to nearby mixed forest in Hunan, 15 species of bird were observed compared to 25 species in nearby mixed forests. In Sichuan, 12 species were observed compared to 24 species in nearby mixed forests.	INBAR Project Bird Diversity Report, 2010
Biodiversity	Decline in the number of fungi and bacteria species in monoculture forests in Zhejiang and Fujian, by 45% and 90% respectively over an 11-year period.	Pan, 2000
	Decline in grass and shrub species diversity in monoculture forests from 58 to 31 species over an 11-year period.	He & Lou, 1999
	Monoculture forests displayed higher incidence of damage compared to mixed forests following winter snow storms. Monoculture forests experience 12-35% more damage due to lower weight tolerance and higher wind speeds.	Jiang, 2003
Stand quality and resilience	Monoculture forests showed increased susceptibility to mite infestation compared to mixed forests.	Zhang et al, 2000
	Mixed bamboo stands exhibited higher amounts of desirable soil nutrients and soil qualities compared to monoculture stands, including soil porosity, aeration and bulk density.	Zheng et al, 1998
Productivity	Monoculture forests in Zhejiang and Fujian Provinces showed a 25% decline in productivity over an 11-year period.	He & Lou, 1999
	Bamboo produced in mixed broad-leafed forests was higher in terms of quality (culm diameter and weight) and biomass than bamboo produced in monoculture.	Huang et al, 1993
Effects of management regimes on bamboo plantations (Yipping & Henley 2010)		

1.3.1 Carbon Sequestriation

Global attention to the potential role of afforestation and reforestation in the fight against climate change has been increasing. However, the majority of traditional reforestation schemes utilize slow growing species. With regards to the sequestration properties of trees, bamboo differs in two major ways: (1) it's fast growth enables it to sequester significant quantities of carbon dioxide (CO2) in a relatively short time period, and (2) the harvesting of selective culms does not kill the tree but rather stimulates further growth.

Over the past few years the focus on bamboo within global carbon markets has started to increase, along with studies in to the sequestration properties of various species.

In comparison to traditional fast growing timber species such as eucalyptus or Chinese Fir, it has been found that bamboo sequesters significantly more carbon within the first 5 yr period. Thereafter, if regular harvesting occurs, bamboo plantations continue to sequester carbon on 5 year intervals, resulting in the net sequestration (if accounting for carbon stored in harvested bamboo products) over a traditional 30yr rotation length of bamboo being considerably higher than that of tree species.



Annual net carbon sequestration with regular harvesting patterns (Yipping et al 2010)

1.4 Regional Species Introduction

1.4.1 Asia

In China the most widely spread types of bamboo are Phyllostachys heterocycla var. Pubescens, also called Moso bamboo, covering two thirds of the total bamboo forest area (Xuhe, 2003).

The market for bamboo is best developed in China, which has large scale plantations, and processing facilities, mostly for domestic use.

1.4.2 Africa

Africa has about 43 species of bamboo covering about 1.5 million hectares. Forty of these species are mainly distributed in Madagascar.

In Ethiopia and Kenya, which is where significant effort has been made to develop the bamboo industry, there are two main types of indigenous bamboo: highland and lowland bamboos (Eastern Africa Bamboo Project, n.d.).

1.4.3 Latin America

Almost 50% of world bamboo biodiversity is from South and Central America, with Brazil as the country with the largest national complement of species, with 134, followed by Venezuela with 68, Colombia 56 and Peru with 48 (Takahashi, 2006).

It is an estimate that around 11 million hectares of Latin America are covered with bamboo. 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”.

The most important native genus in Latin America are G. angustifolia sp. and Chusquea sp. Among the largest bamboos, G. angustifolia is the most studied and used native species, due to the impressive physical and mechanical characteristics of the 25-30m high culms, appropriate for constructions and several other high end uses as a substitute for traditional hardwoods.

G. angustifolia Bamboo

Guadua is a genus of bamboo with consists of 30 species, including G. angustifolia, and is native to Colombia, Ecuador and Venezuela. Although not originally native, Nicaragua has stands of G. angustifolia that were established as far back as the 1930s and have become fully integrated in to the tropical forests of the Atlantic Coast .

G. angustifolia is the most economically developed and commercialized of the Guadua species. Under optimal conditions it can reach a height of around 30m, with a diameter of 20cm and reaches maturity around 4 years.

In addition to the utilization of seeds from flowering events (with the most recent event occurring in Nicaragua in 2010) reproduction can be done through vegetative propagation of small plants. They can be multiplied rapidly and can be ready for transplanting within 3 months (Cleuren & Henkemans, 2003).

Uses of Bamboo

Bamboo can be used in a variety of ways ranging from little processed culm based products to newly developed industrial products as a substitute for traditional hardwoods. Another dimension to the rapidly growing bamboo market is the wide range of uses from low-cost products such as cheap housing (such as the growing use of bamboo based disaster relief housing) to high-end products such as parquet flooring and decking.

Bamboo has received increasing attention over the last two decades for its economic and environmental values. In Africa, Asia and Latin America it is closely associated with indigenous culture and knowledge and is widely used for housing, forestry, agroforestry, agricultural activities and utensils. In countries undergoing economic development, traditional bamboo culture gradually disappears. However, industrial development of bamboo is offering a new opportunity to younger generations to retain and continue developing cultural traditions related to the cultivation, harvesting and use of bamboo (FAO, 2005).

The physical and environmental properties of bamboo make it an exceptional economic resource for a wide range of uses. It grows quickly and can be harvested annually without depletion of the parent plant and without causing harvesting damage or deterioration of the soil. Bamboo can grow on marginal land, not suitable for traditional agriculture or forestry, or as an agroforestry crop. It is relatively light weight, because the culms are hollow, and unlike wood can be easily harvested and transported without specialized equipment or vehicles. Processing normally does not require highly skilled labour or special qualifications and can be started at a minimal cost (FAO, 2005).

Bamboo use and trade have been growing rapidly in recent years. Bamboo is becoming popular as an excellent substitute for wood in producing pulp, paper, board and charcoal. It is widely used in construction, either in its natural form or as a reconstituted material (laminated boards and panels) (FAO, 2005).

2.2 Culm based products

Bamboo culms are widely used as a construction material due to its low cost of production and its strength:

- Scaffolding (Cleuren & Henkemans, 2003)
- Bridges (Cleuren & Henkemans, 2003)
- Housing material (Hunter, 2003)
- Re-inforced concrete (Hunter, 2003)
- Pipes (Cleuren & Henkemans, 2003)

These uses of bamboo require very little processing of the culm other than preservation against insects and rotting.

2.2 Industrial based products

In recent years a number of new bamboo-based products have been developed using industrial methods. As such, bamboo can provide a sustainable and renewable resource as an alternative to traditional wood sources.

2.2.1 Pulp, Paper and Clothing

Several bamboo-producing countries, such as China and India use bamboo in pulp, paper and more recently cloth. Bamboo paper has practically the same quality as paper made from wood. Its brightness and optical properties remain stable, while those of paper made from wood may deteriorate over time. The morphological characteristics of bamboo fibres yield paper with a high tear index, similar to that of hardwood paper. The tensile stiffness is somewhat lower compared with softwood paper. The strain strength is between that of hardwood and softwood papers. The quality of bamboo paper may be improved by refining the pulp (FAO, 2005).

Bamboo clothing is a relatively new product, but is expected to grow rapidly due to the materials unique mechanical and environmental qualities. The natural fibres in bamboo clothing give it exceptionally high performance and a soft feel which is often compared to cashmere. Its non-iritant qualities means it is often used in baby clothes.

2.2.2 Furniture

Traditional bamboo furniture uses natural round or split bamboo. A new type of 'pack-flat,' 'knockdown' furniture uses glue-laminated bamboo panels. Unlike the traditional design, this furniture may be shipped in compact flat packs, to be assembled on the spot. The new design overcomes many of the problems of traditional bamboo furniture, such as high labour and transportation costs, low productivity, instability, varying quality and susceptibility to insects and fungi. At the same time, it retains the distinct physical, mechanical, chemical, environmental and aesthetic features of bamboo. Export of laminated bamboo furniture is growing rapidly. However, trade statistics currently do not capture the value, owing to the absence of a special code for bamboo furniture. It is usually classified as wooden furniture (FAO, 2005; Hunter, 2003).

2.2.3 Flooring

Bamboo flooring is a quality product that can be used widely and has a large and growing global consumer market. It has certain advantages over wooden floors due to its smoothness, brightness, stability, high resistance, insulation qualities and flexibility. Bamboo flooring has a soft natural luster and maintains the natural gloss and elegance of bamboo fibre. This flooring is attractive to the demanding hardwood flooring markets in Europe, Japan and North America. The estimated annual production of bamboo flooring in China was 17.5 million square metres in 2004. Exports account for some 65 percent of total production (FAO, 2005). Large retailers such as IKEA have also started selling bamboo flooring (van der Lugt & Otten, 2006).

2.3 Other Uses

2.3.1 Soil rehabilitation

Bamboo protects steep slopes, soils and water ways, prevents soil erosion, provides carbon sequestration and brings many other ecosystem benefits.

A second benefit of bamboo as a resource is that it can thrive on pieces of land where wood may not (e.g. degraded land on slopes), and due to its extensive root network may help to prevent erosion and facilitate the restoration of a healthy water table, potentially diminishing the environmental effects of erosion, landscape deterioration and desiccation relating tothe environmental problem of ecosystem deterioration (see table 1.1).

2.3.1 Soil Rehabilitation (Cont.)

The features mentioned above make some bamboo species very suitable for reforestation of deserted land which is no longer useful as agricultural land (e.g. over exploited land created by the clear cutting of tropical rain forests). Therefore, bamboo in the future may be able to increase the biocapacity by simultaneously increasing the area of fertile global hectares that is able to supply resources (van der Lugt, 2008).

2.3.1 Food

Bamboo shoots are increasingly popular, not only in Asia but other markets around the world (Hunter, 2003).

2.3.2 Charcoal

Bamboo charcoal is traditionally used as a substitute for wood charcoal or mineral coal. It can serve as a fuel, absorbent and conductor. The calorific value of bamboo charcoal is almost half that of oil of the same weight. Activated bamboo charcoal can be used for cleaning the environment, absorbing excess moisture and producing medicines. The absorption capacity of bamboo charcoal is six times that of wood charcoal of the same weight. Bamboo charcoal can be used as an air purifier and for other anti-pollution purposes (Hunter, 2003). China is a leader in its production. At present, Japan, the Republic of Korea and Taiwan are the main consumers, but its importation is rapidly expanding in Europe and North America (FAO, 2005).

2.3.4 Fuel

Through pyrolysis, bamboo can be converted into three valuable products: bamboo charcoal, oil and gas. Changing the pyrolysis parameters can change the product shares depending on the purpose and market conditions. Bamboo extracts contain valuable elements and can be used in pharmaceuticals, creams and beverages. Bamboo gas can be used as a substitute for petroleum. Bamboo charcoal is an excellent fuel for cooking and barbequing (FAO, 2005).

Bamboo Supply

3.1 Bamboo Resources Worldwide

Most bamboo harvested for commercial use is from naturally growing, wild stands, although more attention has been given in recent years to the establishment of planted bamboo (FAO, 2005). Bamboo occurs often as an understory component in many forest types in the tropics and warm temperate climates (Hunter, 2003).

Although bamboo species differ in wood characteristics, they do not differ as much as different species of trees in this regard (Hunter, 2003). As a result, in discussions of world markets and bamboo products little distinction is made in terms of bamboo species. Most bamboo producing countries tend to favour their own native species.

3.1.1 Asia

Country	Area of Bamboo (1,000ha)
India	11,361
China	5,444
Indonesia	2,081
Laos	1,612
Myanmar	859
Vietnam	813
Malaysia	677
Other	340
Thailand	261
Philippines	172
Total Asia	23,620

Source: FAO (2005)

India accounts for roughly half the total area of bamboo reported for Asia and, together with China, approximately 70 percent. Over the last 15 years, the bamboo area in Asia has increased by 10 percent, primarily due to large-scale planting of bamboo in China and, to a lesser extent, in India. Approximately 30% of the total area of bamboo in Asia is planted as opposed to wild (FAO, 2005).

3.1.1 Africa

Country	Area of Bamboo (1,000ha)
Nigeria	1,590
Ethiopia	849
Tanzania	128
Kenya	124
Uganda	67
Total Africa	2,758

Source: FAO (2005)

The total area of bamboo reported by the five African countries makes up over 2.7 million hectares. This equals 4.1 percent of their total forest area. Bamboo has not been commercialized in Africa, although INBAR and other organisations have done research on the bamboo production in East Africa and implemented community based initiatives to start building a market.

3.1.1 Latin America

Country	Area of Bamboo (1,000ha)
Brazil	9,300
Chile	900
Peru	190
Ecuador	9
Total Latin America	10,399

Source: FAO (2005). Note: Not all countries participated in the study

Latin America has no reliable data on the bamboo area at the regional level. Information exists in some countries, but it is insufficient, scattered and at times contradictory.

Lack of reliable data on bamboo resources in Latin America is partially explained by the current low economic value of bamboo on the continent. There, like in Africa, many people regard bamboo as a weed plant and do not yet appreciate its huge economic potential for development and poverty alleviation. Although the resources of native species are abundant, their exploitation is limited to mostly low-end, low-profit, traditional non-mechanized manufacturing.

In Brazil, Colombia and Ecuador, bamboo plays a more conspicuous economic role. In these countries, small-scale cultivation of commercial bamboo is limited to a few native (G. angustifolia, G. amplexifolia) and introduced species (Bambusa vulgaris, B. tuldoides, Phyllostachys aurea) (FAO, 2005).

Bamboo resources in Latin America mainly consist of native G. angustifolia species. One source identifies Mexico and Colombia as the main exporters of bamboo products in Latin America (Parker, 2005). Colombia certainly appears to be one of the most developed producers of bamboo, in particular G. angustifolia, in Latin America.

Brazil

The country report from Brazil notes that there is no reliable information on the total extent of bamboo forest, but that an estimated 9 million hectares of forest in the south-eastern Amazon region are dominated by bamboo. There is also a private area of planted bamboo with 30,000 ha of Bambusa vulgaris, which provides raw material for a paper mill in the north-eastern region. Interest in bamboo, particularly its industrial utilization, is growing rapidly (FAO, 2005).

3.2 Bamboo Trade

Bamboo culm products only serve small niche markets in the US and in Europe. Since the early 1990s new industrially manufactured bamboo products entered world markets, mainly supplied from India and China, and have seen moderated but steady growth. Given the attractive prices obtained, more countries are planning to develop bamboo industries to produce bamboo for panels, paper, fabrics, charcoal and shoots. Information on international bamboo trade is limited due to a lack of customs codes and information on national markets is often incomplete (van der Lugt & Lobovikov, 2008). The figures presented below have been collected from a number of different sources and need to be viewed critically.

About 2.5 billion people in the world depend economically on bamboo and the international trade in bamboo amounts to between $5 and $10 billion. National and local trade is likely to be a few times higher. There are other numerous examples of the importance of bamboo for national economies and international trade. However, reliable statistics are still lacking. Most of the economic activities related to bamboo are not recorded officially as it is often traded within a country and within the informal economy (FAO, 2005).

Most of the bamboo traded internationally is exported by China (Hunter, 2003; Parker, 2005; van der Lugt, 2005). Figures quoted range from 75% to 95% of total bamboo world trade.

The table opposite shows a breakdown of the top exporters in 2005:

Region of Origin	Value (USD '000)	% of World
Asia	53,707	95.27
China	42,477	83.16
Europe	2,485	4.41
Latin America	182	0.32

Source: Parker (2005)

It has to be noted however, that a large share of bamboo trade is informal and therefore not reported, so the actual figures may be slightly different. Latin America currently represents an insignificant part of world bamboo trade, although represents excellent opportunities for growth due to its proximity to the United States.

3.2.1. Asia

As previously mentioned Asia is the main exporter of bamboo products.

China

In 2002, China exported USD 314 million worth of bamboo and rattan products. The main importers of Chinese bamboo products are the USA (32%), Japan (22.5%), Hong Kong (15.1%) and European countries (Xuhe, 2003).

3.2.2. Africa

In Africa, the share of removals from forests used for fuel is substantially higher (FAO, 2006). Although little quantitative information was presented on bamboo removals and products, several countries indicated that bamboo energy use is substantial in rural areas. Lack of knowledge of bamboo management and utilization is indicated as the main obstacle to developing the bamboo sector on the continent (FAO, 2005).

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 USD 1,463, 000 for the period 1989 to 2000 inclusive, but that after a peak of over USD 3 million worth of exports in 1994 the figure has remained relatively steady at about USD 800,000 per annum.

Ethiopia did not export bamboo or rattan products between 1989 and 2000, except for a surprisingly large USD1.5 million dollars worth in 1998, all of which went to other East African nations. The export market in Ethiopia remains largely unexplored but has a lot of potential given the international demand for bamboo and rattan products (Tadesse, 2006).

3.2.3. Latin America

From this region, Chile and Ecuador provided information. Chile estimated that 4.5 million culms were traded in the country in 2000 and over 10 million culms in 2005 (corresponding to approximately 6 000 tonnes in 2000 and 13 000 in 2005). Most of the bamboo trade is not formally recorded. Ecuador harvested 36 000 tonnes in 2000 and 53 000 tonnes in 2005. These figures reflect the annual allowable cuts of bamboo issued by the Ministry of the Environment (FAO, 2005).

In both Ecuador and Colombia, there have been initiatives to develop the bamboo industry. Because of these efforts the first part of the production chain (plantation, harvesting, and initial processing) has improved. However, there is still very little high quality supply or valued added products manufacture for export markets. Moreover, commercialisation skills for market development are lacking in both countries. Although accurate trade date is not available for either country, it is estimated that exports from both countries are mainly to other countries in the region (van der Lugt, 2005).

Markets for Bamboo

4.1 The Current Market Situation

Global bamboo trade volumes are estimated to be between USD5.0 billion and USD10 billion (Van der Lugt & Lobovikov, 2008, Indian Ministry of Agriculture, 2010), although these figures are not very precise. This compares to global trade in timber of USD600 billion (van der Lugt & Lobovikov, 2008, UN FAO 2009). When considering the market for timber bamboos such as G. angustifolia, it is important to consider that much of the current market for timber can be replaced with G. angustifolia.

4.1.1. Main Markets by Region

USA & Europe

Most sources agree that the US and Europe are the main markets for bamboo products, taking around 80% of world trade (Hunter, 2003; van der Lugt & Lobovikov, 2008).

The US is the largest Western consumer of bamboo products with annual imports of USD 300 million, almost entirely from China. Between 2000 and 2003, imports to the US grew by 98% in volume and 127% in value (van der Lugt & Lobovikov, 2008). Most of the bamboo comes in the form of flooring (4.2 million sqm) and baskets. The market for bamboo poles in the US is estimated at USD 15 million (with 90% coming from China).

In the EU, consumption of bamboo flooring has increased from 0.67 million sqm in 2003 to 0.9 million sqm in 2005 and is expected to continue growing.

Category	Value (US$ 1 000)	Market share (%)
Handicrafts	2 415	0.9
Kitchen articles	23 796	9.1
Basketry	70 645	27.0
Decoration	31 221	11.9
Garden	27 000	10.3
Raw material	15 654	6.0
Furniture	20 081	7.7
Furniture with woven parts	6 452	2.5
Cane based furniture	4 778	1.8
With other materials	3 289	1.3
Tables	1 794	0.7
Chairs	1 613	0.6
Crates	1 352	0.5
Shelves	473	0.2
Bedroom articles	185	0.1
Flooring	70 453	27.0
Flooring as such	64 600	24.7
Accessories	2 952	1.1
Without finishing	1 563	0.6
Finished	544	0.2
Parquet	455	0.2
Panels	154	0.1
Veneer	104	0.0
Total	262 265	100.0

Source: adapted from CORPEI, 2005.

Market size in the USA of various bamboo product categories based on 2004 import figures (van der Lugt & Lobovikov, 2008)

Latin America

For a long time, bamboo was considered to be a low cost inferior material used mainly for rural construction. However, in recent years several countries have started initiatives to promote the production and use of bamboo products in Latin America for higher end construction.

In Latin America, most of the bamboo produced is either used within the producing countries or traded within the region. In Colombia 70% of the G. angustifolia produced is used by the Colombian construction industry for scaffolding or to support concrete (Cleuren & Henkemans, 2003).

G. angustifolia produced in Ecuador is mostly exported to Peru where it is used by the banana industry to prop up banana plants. If the banana industry in Peru was to replace all their props with bamboo - which is increasingly the case due to environmental concerns - they would need the equivalent of 70,000ha of bamboo. A large portion of Ecuadorian G. angustifolia is also used domestically for social housing projects.

Examples of domestic use of G. angustifolia are listed below (Takahashi, 2006):

- Ecuador: Christian NGO 'Viviendas del Hogar de Christo' has been using G. angustifolia bamboo for over 30 years to build housing for the poor; started industrialisation of G. angustifolia.
- Colombia: 'National Project of Bamboo' created in 1986 to promote earthquake resistant housing using bamboo; started industrialisation of G. angustifolia;.
- Colombia: Promotion of earthquake resistant housing built with G. angustifolia bamboo.
- Brazil: Building infrastructure with bamboo; bamboo paper production.
- Peru: Construction of high-end tourism infrastructure using bamboo; social housing; bamboo furniture using imported bamboo from Chile and Costa Rica; bamboo is national priority natural resource for rehabilitation and reforestation of degraded land.
- Chile: Government is strongly promoting the development of the sector.
- Central America & Carribean: Chinese government has launched initiatives in several countries (El Salvador, Dominican Republic, Cuba) to develop the production and use of bamboo.

4.1.2. Main Markets by Product

Bamboo flooring is considered to have the highest potential, with major retail chains like IKEA and Home Depot iincreasingly nterested in this product. The demand for bamboo veneer is also expected to grow (van der Lugt & Lobovikov, 2008).

Countries	Year	Bamboo	Wood
Netherlands	2005	150	n/a
Germany	2002	n/a	21 000
	2003	300-350	n/a
	2005	450-500	n/a
EU	2003	670	95 000
	2005	850-900	n/a
USA	2005	4 200	n/a

Sources: VON REITZENSTEIN, 2004; CORPEI, 2005; MALIN, BOEHLAND, 2006; ZAAL, 2006.

Consumption of Bamboo and Wooden Flooring in the EU and USA, 1,000 sqm (van der Lugt & Lobovikov, 2008)

The demand for bamboo poles and culm based products is expected to be higher in the US than in the EU, where this type of design is less popular (van der Lugt & Lobovikov, 2008).

The market for bamboo shoots as food has grown to over USD 150 million per year in China mainly exported to Japan (Hunter, 2003).

There is limited information available on market prices for bamboo culms. This is largely due to the infancy of the market outside of domestic uses. However, the following section reviews four sources of G. angustifolia prices in Latin America:

4.2 Market Value of Bamboo Culms

Current market prices for G. angustifolia have been obtained from the main suppliers currently found in Central America. All these prices are Farm Gate (excluding delivery charges) and with simple processing such as drying and treatment against rot and insect attack. These prices therefore reflect the current market price of raw G. angustofolia produced in Central America.

Ecobamboo Source: Ecobamboo email quote (February 2011)

Diameter (inches)	Length (metres)	Price USD	USD / linear metre
2	6	9.6	1.6
3	6	14.4	2.4
4	6	19.2	3.2
5	6	24	4
6	6	28.8	4.8
7	6	33.6	5.6

Bambuver Source: Bambuver email quote (March 2011)

Diameter	USD / metre
1.5-2 inches	1.28
2 - 2.5 inches	2.16
2.5 - 3 inches	2.72
3 - 3.5 inches	2.88

Koolbamboo Source: KoolbambooWebsite www.koolbamboo.com (Dec 2010)

Diameter	Length (metres)	Price (USD)	USD / linear metre
Small (2-3 inches)	19.7	75.00	3.81
Small (2-3 inches)	9.5	37.50	3.95
Medium (3-3.9 inches)	19.7	80.00	4.06
Medium (3-3.9 inches)	9.5	45.00	4.74
Boric Treated Poles (4-5 inches)	18	80.00	4.44
Boric Treated Poles (4-5 inches)	9.5	65.00	6.84

Bamboo Costa Rica Source: Email quote (www.bamboocostarica.com)

Diameter (inches)	Length (metres)	Price USD	USD / linear metre
2 - 2.5	6	11.02	1.84
3 - 3.5	6	15.56	2.59
4	6	19.52	3.25
4.5	6	23.20	3.87
5	6	27.02	4.50
5.5	6	34.50	5.75
6	6	37.98	6.33
6.5	6	48.86	8.14

4.3. Future Market Potential

With the growth of demand for environmentally friendly green products, the world bamboo market is expected to double by 2015 (from USD 10 billion to USD 20 billion) (Xuhe, 2003).

Bamboo is generally perceived as a green commodity, but the fact that China is the main producer is damaging its reputation from a sustainability perspective. The opportunity for forest managers and producers growing certified bamboo (eg under the Forest Stewardship Council, (FSC) for sustainable forest management) is significant. An advantage for Latin American producers is that G. angustifolia is well known as one of the strongest bamboos in the world and that they may be able to use their role as an alternative supplier to China as a point of differentiation (van der Lugt, 2006).

4.3.1 Competition with Timber

In some countries, like Ecuador, competition from cheap natural forest timber is seen as a threat for the nascent Bamboo industry (Cleuren & Henkemans, 2003). However, on a global scale, taking into account increasing concerns about natural forest resources and growing demand for sustainable timber resources, bamboo can be seen as a viable substitute for many timber products. Bamboo products are particularly hard and durable, which is why bamboo represents a good substitute for hardwood products (Hunter, 2003). Furthermore, whilst traditional sources of timber are a significant contributor to global greenhouse gas emissions, sustainable plantations of bamboo can be managed to sequester significant quantities of carbon dioxide from the atmosphere, and therefore contribute to the fight against global climate change.

At the moment the market share of bamboo products is marginal compared to wood products, but it is growing. Due to new developments in the industrial bamboo sector, virtually any wood product can be produced from bamboo. Therefore the market for wood products can be considered as an analogous substitute market. Given the stable global demand for wood combined with increasing interest in sustainably produced timber, the market for industrial bamboo products is expected to grow. The table below shows consumption of bamboo and timber in the West, highlighting the significant growth potential for bamboo. Growing demand for certified wood (e.g. FSC or PEFC) provides further opportunity for bamboo products. Industrial bamboo can target high-volume markets, such as the construction industry, where bamboo might be able to substitute hardwoods. Smaller high-end niche markets with higher margins, such as yacht coverings, also still hold potential. It has to be kept in mind however, that industrial bamboo is still a new commodity with a need to further develop the market (van der Lugt & Lobovikov, 2008). Global carbon markets can be utilized to help the paradigm shift from traditional sources of natural wood, to fast growing and renewable plantations of sustainably managed bamboo.

Bamboo is recognized as a wood substitute for its potential to reduce pressure on naturally regenerated forests. According to the UN Food and Agriculture Organisation, around 30% of world timber demand is currently met by illegal logging and it is widely recognised that another 40% is currently met from unsustainable sources. Bamboo has the opportunity to sustainably replace this supply.

Countries/products	Year	Bamboo (m^2)	Bamboo (m^3)	Wood (m^3)
Netherlands				
Veneer	2003	n/a		30 000
	2005	25 000	150	
High quality boards for top layers of flooring	2005	50 000		
High quality boards for furniture and special interior projects	2005	25 000		
Germany				
Veneer	2003	n/a		436 000
	2005	300 000	1 800	
High quality boards for top layers of flooring	2005	200 000		
High quality boards for furniture and special interior projects	2005	75 000		
European Union				
Veneer	2003	n/a		1 753 000
	2005	575 000	3450	
High quality boards for top layers of flooring	2003	2 400 000		
High quality boards for furniture and special interior projects	2003	2 400 000		
USA				
Veneer	2003	US$ 140 000		662 000

Sources: ITTO, 2004; CORPEI, 2005; ZAAL, 2006.
Note: consumption data for bamboo veneer is available only in m^2. For a better comparison with wood veneer consumption, cubic meter figures were calculated and added to the table based on a standard veneer thickness of 6 millimetres (ZAAL, 2006).

Consumption of various industrial bamboo products in the West compared to wood consumption in the EU and the US (van der Lugt & Lobovikov, 2008)

Studies have shown that giant or timber bamboo species, such as G. angustifolia, are able to produce more cubic metres of semi-finished material per hectare than any plantation grown hardwoods and most softwoods. Only the fastest growing softwood species such as Eucalyptus and Pine achieve similar productivity, but these species have less aesthetic qualities (van der Lugt, 2008).

Summary & Conclusions

Bamboo is an abundant natural resource that grows in many parts of the world. Traditionally used as low-cost construction material in developing countries, bamboo is being processed into increasingly sophisticated products that serve consumers in developed countries and high end markets. Nowadays, with new technologies for processing, most products made from wood can be made with bamboo, resulting in the potential for a multi billion dollar market.

There is a large variety of bamboo species. Nevertheless final product qualities do not differ greatly between different timber bamboo varieties. Given that most bamboo that is currently being harvested comes from natural stands, most bamboo producing countries favour their own native species. Interest in bamboo plantations has been growing and several countries, including the large producers such as India and China as well as Latin American countries, have started to develop such operations.

Asia is by far the biggest producer of bamboo products, with China as the biggest exporter. The main markets for bamboo products are the US and Europe. All trade statistics for bamboo have to be viewed critically as the underlying data is often incomplete, due to a lack of reporting standards.

In a world where the protection of natural forests and concerns over sustainable timber supply are growing, demand for bamboo as an alternative to hardwood is expected to grow further and lead to substantial future demand for bamboo.

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Glossary

Alluvial Plains	Plain formed from the deposition of sediment by one or more rivers
Biocapacity (or Biological Capacity)	The capacity of an area or ecosystem to generate an ongoing supply of resources and to absorb its wastes
Boric Acid and Borax	Compounds mixed to create a preservative for the treatment of bamboo poles
Culm	Individual bamboo 'stem'
Degraded Soils	Land where improper use has caused a decline in natural land resources
Genus (Pl. Genera)	A taxonomic rank used in biology to classify living and fossil organisms, i.e. a family of organisms.
Internode	A segment of the bamboo culm
Invasive Species	A non-indigenous species whose introduction does or is likely to cause economic or environmental harm or harm to human health
Marginal land	Land of poor quality with regard to agricultural use, and unsuitable for housing and other uses
Mesquite community	Native American communities in Nicaragua
Monoculture	Repeated cultivation of a single crop on a given area of land
Monopodial (or "Running") Bamboo	The rhizomes of these types of bamboo grow horizontally and fast
Morphology	The form and structure of organisms, such as plants
Moso bamboo (Phyllostachys heterocycla var. Pubescens)	Type of bamboo which is popular in China
Productivity of a plant	Rate of generation of biomass
Pyrolysis	A process which involves heating biomass to drive off the volatile matter, leaving behind the black residue known as charcoal
Rhizome	A horizontal underground stem of bamboo that sends out roots and shoots from its nodes
Sympodial (or "Clumping") Bamboo	The rhizomes of these types of bamboo stay close to the mother plant
Transplanting	The act of moving seedlings from nursery to final plantation
Vegetative propagation	Process by which new plants arise without production of seeds or spores, e.g. by using cuttings from a mother plant