CAPTURING CARBON WITH BAMBOO

FAST AND EFFECTIVE IN MANAGED STANDS

Bamboos are woody grasses that grow in the tropical, subtropical and temperate regions of the world. They occupy over 3% of the world's forests, and provide incomes, subsistence or life-goods for an estimated one billion people. Bamboos are often touted as the fastest growing plants on the planet, so do they have the potential to help mitigate climate change?

Recent research and growth modeling by the International Network for Bamboo and Rattan (INBAR) has shown that **managed bamboo can be an effective carbon sink**, and performs **better than Chinese Fir and Eucalypt** growing under similar conditions. Managing bamboo involves the annual, sustainable and selective harvesting of stems which are turned into products which can hold carbon for many years. The increasing popularity of durable bamboo products ensures that for the foreseeable future, productive bamboo systems can be considered a carbon sink.

Two types of bamboo

The rhizomes of most temperate and subtropical bamboos (eg *Phyllostachys pubescens* – "Moso" bamboo) grow horizontally through the soil, with stems emerging from buds behind the tip to form groves of widely spaced poles. These are known as "monopodial" bamboos. Rhizomes of most tropical bamboos (eg *Dendrocalamus latiflorus* – "Ma" bamboo) grow horizontally only for a very short time and then turn upwards, with the stem growing from the bud at the tip, forming discrete clumps of bamboo. These are known as "sympodial" bamboos.

Above: Moso bamboo (Phyllostachys pubescens) is one of the most widespread and commercially valuable subtropical bamboos in the world – and managed forests remain fully productive for many decades.

Left: Ma bamboo (Dendrocalamus latiflorus) is representative of one of a dozen or so large Dendrocalamus bamboos with significant commercial value in the Asian tropics. Throughout much of Latin America, Guadua bamboo has a similar role.

Both young and mature bamboo plantations capture more carbon than equivalent tree plantations

INBAR's modeling indicates that the carbon content of newly-planted Moso bamboo stands increases more rapidly per unit area than Chinese Fir (*Cunninghamia lanceolata)* stands growing in similar conditions for about the first six or seven years.

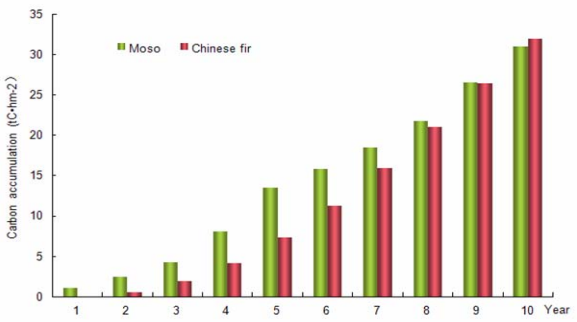

Figure 1 above: Carbon accumulation in new Chinese fir and Moso plantations (t C/ha)

Managed subtropical Moso plantations are predicted to sequester over 20% more carbon than Chinese Fir forest after 60 years, (i.e. two rotations of Fir cut after 30 years).

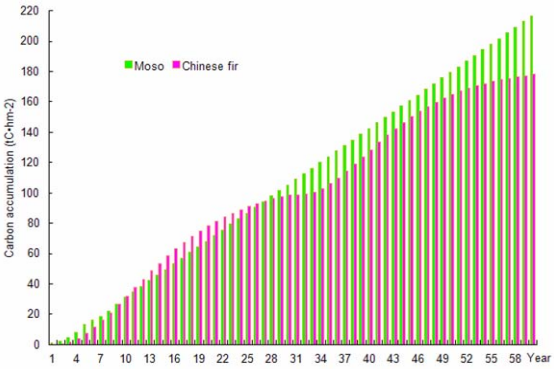

Figure 2 above: Predicted accumulation of carbon stock over a 60 year time period with regular harvesting practices (t C/ha)

Over ten years, managed tropical Ma bamboo is predicted to accumulate 10% more carbon than Eucalypt.

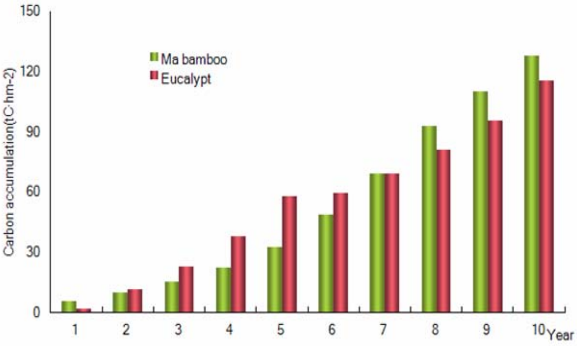

Figure 3 above: Predicted accumulation of carbon stock over ten years in t C/ha (with Eucalypt on a five year rotation).

Carbon stock in bamboo and other forest ecosystems

A well-managed bamboo ecosystem, like other forests of other fast growing species, is likely to have a lower carbon accumulation than natural forests, but the data for such comparisons are still scarce, and more research is needed. The differences may in part be due to higher levels of soil carbon in natural forests, as can be seen below (*t C/ha*$^{)}$).

Parts / Forest	Plants	Litter	In soil	Total	Reference
Mature managed Moso forest	26.2	0.5	139.6	166.3	Xiao, 2007
Pinus elliottii at yr. 19	86.8	8.9	26.3	121.9	Tu, 2007
Chinese Fir at yr. 15	53.6	3.4	93.2	150.9	Xiao, 2007
Deciduous broad-leaved forest	47.8	5.9	208.9	262.5	Zhou, 2007
Tropical forest	110.9	3.0	116.5	230.4	
Evergreen broad-leaved forest	73.7	5.4	257.6	336.7	

The table below indicates that bamboo stands hold equivalent or higher levels of plant-carbon than comparable Eucalypt stands (*t C/ha*$^{)}$).

Location	Plantation	Carbon stock	Reference
Eucalypts			
China	*E. grandis* at yr. 6	30	Zhang, 2005
China	*E. urophylla* at yr. 7	56	Luo, 1999
China	*E. caphylla* at yr. 5	58	Lin, 2003
China	*E. caphylla* at yr. 10	72	Wen, 2000
Tropical bamboos			
China	Mature *D. hamiltonii*	71	Yang, 2008
India	*D. strictus* at yr. 5	37	Singh, 1999
China	Mature *D. affinis*	78	Su, 1991
Colombia	*Guadua angustifolia* at yr. 6	54	Riaño, 2002
Mexico	*Bambusa oldhami* at yr. 7 (aboveground carbon only)	*52*	Castaneda, 2005
Ethiopia	*Yushania alpina*	*55*	Embaye, 2005
Indonesia	*Gigantochloa atter* at yr. 6	*38*	Christanty, 1996

Carbon increase in new biomass of non - managed bamboos is almost equal to that lost due to natural decay and death of old bamboo stems, so the net flux of carbon in and out of the system is zero. Therefore, after it reaches its maximum carbon holding capacity following establishment (8 years for Moso, 5 years for Ma and other large tropical bamboos), a bamboo forest can only perform as a sink if it is managed.

Carbon storage in bamboo products

As with tree plantations, the bamboo forest system can only be considered a sink if the pool of derived products is growing, and if they store carbon for a considerable length of time. While until recently most of the bamboo was used for low value, short-lived products, now an increasing amount is being used for high value, long-life products such as boards, which have life expectancies of several decades.

Permanence and leakage of bamboo products are determined on a case-by-case basis but are not expected to differ significantly from timber-wood products. Different processing methods are used for bamboo and wood, but the energy intensity is roughly equivalent.

Bamboo, CDM, REDD and REDD+

Due to the high rates of carbon sequestration in the first years of plantation, Moso, Ma and other similar bamboos could be strong potential candidates for inclusion in CDM Afforestation and Reforestation projects and the voluntary market.

Under a REDD agreement, the potential of bamboo to substitute for tropical timber and energy needs merits urgent exploration, and if changes in forestry management practices are considered as under REDD+ proposals, the inclusion of managed bamboo forests to sequester more carbon would seem highly promising.

In conclusion

Managed bamboo stands are fast and effective sequesters of carbon, and will provide a harvest of woody biomass for durable uses on an annual basis. Given the strong potential of bamboo for poverty alleviation in rural areas and in helping communities adapt to climate change, the expansion of managed bamboo stands, coupled with the production and development of a broader range of durable products, could address mitigation without compromising development objectives.

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*The **International Network for Bamboo and Rattan** (INBAR) is an intergovernmental organization dedicated to improving the social, economic, and environmental benefits of bamboo and rattan. INBAR connects partners from the government, private, and not-for-profit sectors in over 50 countries to define and implement a global agenda of sustainable development through bamboo and rattan.*