The Climate Change Challenge and Bamboo Mitigation and Adaptation
International Network for Bamboo and Rattan (INBAR)

INBAR is an intergovernmental organization established in 1997 to define and implement a global agenda for sustainable development through the use of bamboo and rattan. INBAR connects partners from government, private enterprises, and non-governmental organizations (NGOs) in over 50 countries to improve the well being of producers and users of bamboo and rattan, particularly in regions of extreme poverty and within the context of a sustainable resources base. INBAR’s headquarters are in Beijing, China. It also has offices in Ecuador, India, Ghana and Ethiopia.

The Climate Change Challenge and Bamboo

Mitigation and Adaptation

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The challenge presented by Climate Change has been succinctly described as a MAD Challenge, one which requires simultaneous action on Mitigation, Adaptation and Development, and bamboo is ideally placed to contribute. Three forestry projects harnessing carbon sinks are being implemented under the first stage of the Kyoto Protocol, and in the lead up to the COP 15 Conference in Copenhagen there has been closer examination of the ways in which vegetation, especially forests including bamboo, could and should be brought further into efforts to avoid high levels of atmospheric carbon, with REDD+ emerging as a likely mechanism.

Mankind's use of bamboo goes back millennia. It has been a source of both shelter and nutrition, and innovation and inspiration. It is often an integral part of agricultural systems, and widely used for construction and in countless other forms, products and applications.

Mitigation: Recent research has shown that managed bamboo stands can sequester higher amounts of CO₂ than natural bamboo forests and plantations of comparable fast growing tree species. Bamboo produces more biomass when managed intensively, and modelling suggests that managed bamboo will sequester more carbon than fast growing tree species such as Chinese Fir and Eucalyptus.

Adaptation: Hundreds of millions of people plant bamboo to protect riverbanks and hillsides from washing away, build houses with it that survive storms, bind it together to make boats, weave it to make containers to transport and store food, and benefit from the resilience of bamboo, for example in the case of extreme weather events.

Development: The development benefits of bamboo are already well known, with significant potential to reduce poverty, empower women and help ensure fairer trade.

In its living and harvested forms, bamboo can address each aspect of the MAD challenge, and as a widely available resource could make an important contribution to coping with Climate Change. INBAR aims to improve the role that bamboo has in the Climate Change Challenge through collaborative research with partners and help communities become more resilient through its projects in the field.

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1 John Schellnhuber, April 2009, Copenhagen
Although bamboos have long been thought to have higher-than-average carbon sequestration abilities due to their fast growth rates, there has been little information available to support this. Recently INBAR examined research findings in order to predict how important bamboo could be in mitigating climate change, and how carbon sequestration varies according to different conditions of growth.

In order to establish how good bamboo is at sequestering carbon, it is important to examine the rate at which its biomass changes, as well as the rate at which carbon returns to the atmosphere through natural processes (such as decay) and human-controlled processes (such as harvesting).

Bamboos grow very fast and establish rapidly. They grow both in natural forests and in managed stands or plantations, and a mix of the two is particularly common in the bamboo forest landscapes of southern China and north-eastern India.

The Carbon Cycle and Bamboo

Bamboo Carbon Cycle
Natural or unmanaged bamboo stands

The natural life of stems (culms) of non-managed bamboos is about a decade. As a result, an unmanaged bamboo forest does not store high levels of carbon, as the carbon accumulated during the rapid growth also returns relatively quickly to the atmosphere as the culms decay.

Managed bamboo stands

When a bamboo forest is managed properly - by selective, annual harvesting of mature culms - it can sequester much more carbon, especially if the harvested culms are turned into durable products. Bamboo produces more biomass when managed intensively, and INBAR’s modelling suggests that managed bamboo will sequester more carbon than fast growing tree species such as Chinese Fir and Eucalyptus. Mature bamboo culms are removed before they decay, so the net amount of carbon sequestered by the system increases. Unlike tree species which are clear cut, the annual and selective harvesting of bamboo culms doesn’t kill off the system or release the carbon stored in the rhizome layer back into the atmosphere.

Storage of carbon in bamboo products

The carbon sequestration potential of managed forest ecosystems also depends on the use and lifetime of the harvested material. As long as the volume of bamboo products produced keeps increasing, then the bamboo system is a sink, as the rate of extraction is higher than the rate of carbon release. The longevity of the products is also important, as the sink is larger for long-lived products than short-lived products.

Bamboo is used for over 1500 applications, and new ones are being developed all the time. Until recently the life span of most of these products was not very long, meaning that the carbon stored in many products would degrade and enter the atmospheric pool quite quickly. However, improvements in processing bamboo have enabled many more durable products (such as housing components and furniture) to enter the market, which last longer and can store carbon for longer periods of time.

Substitution of energy-intensive products

Substitution by bamboo of energy intensive products can indirectly reduce carbon dioxide emissions - producing bamboo products usually needs much less energy than comparable fossil-fuel based products.
Bamboo and REDD+

REDD+ attempts to reduce emissions from deforestation and degradation (REDD) by providing financial incentives for countries to retain carbon stocks in terrestrial pools (primarily forests). The ‘+’ refers to the follow-up text from the so-called Bali Action Plan: ‘and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries’. There remain a number of issues which need to be addressed and agreed upon, including the extent of REDD coverage, its financing, and its implementation.

For bamboo, the ‘plus’ (+)’ issues are most relevant, as deforestation and the degradation of natural bamboo forests is not a particularly prominent issue compared to other natural forests.

However, managed bamboo forests can potentially sequester higher amounts of carbon than equivalent tree plots, and provide a harvest of woody biomass on an annual basis.

Additionally, given the strong potential of bamboo for poverty alleviation in rural areas, the expansion of managed bamboo forests and plantations, coupled with the production and development of a broader range of durable products, could address mitigation without compromising development objectives.

As such, bamboo fits well within the REDD+ framework, and there is a strong case that it should be made eligible under REDD+ or future CDM LULUCF rules.

Global distribution of bamboo
Many millions of people in Asia, Africa and South America rely on bamboo to fulfil their daily needs and provide livelihoods. It is one of the most versatile natural resources, and its strength, flexibility, light weight and hardness have led to its use in a wide range of products and applications, some of which can help us adapt to climate change.

Providing Resilience

It is estimated that up to one billion people rely on bamboo in one form or another. Throughout the sub-tropics and the tropics, rural populations live in bamboo houses, build their agricultural infrastructure and tools from bamboo and sleep on bamboo mats. Bridges and boats which allow rice farmers to tend to their paddies are made of bamboo. Bamboo baskets are used to winnow husks, store grains, and crates are used to transport produce to markets. Bamboo poles are used to keep houses above flood level, prop-up fruit trees and fence-in animals and crops. Bamboo shoots provide nutrition and sustenance.

Bamboo is already being used to provide resilience for the millions of people exposed to violent climatic events. In typhoon–battered parts of the Philippines for instance, traditional bamboo housing has been designed to include features which make the structures resistant to high winds and floods, and local builders know how to join components so that they provide maximum strength. As this knowledge can disappear rapidly, it is important to retain it and incorporate it into local adaptation planning through building guidelines and codes. Similarly, bamboos’ light weight and strength make it suitable for use in disaster situations for shelters, rafts and bridges.

Bamboo has many specific attributes that lend it to higher levels of resilience and adaptive capacity.
Forestry and Cultivation

For those who derive their livelihoods from bamboo cultivation, bamboo offers a number of benefits and has relatively high levels of growth and income security.

1. Quick growth = short rotation
Bamboos grow very fast, with speeds of up to 1 m in 24 hours. Productive groves can be established from scratch in 10 years and individual culms harvested after 3-6 years (depending upon species). The benefits of this short rotation time include lower levels of exposure to outside risks such as fire, and flexibility to change management and harvesting practices relatively quickly when facing climatic changes.

2. Short rotation = low financial outlay, quick recouping
The fast growth and early maturation of bamboo culms means that a bamboo stand can be selectively harvested - extracting older culms and leaving younger ones to grow - without decreasing total stand biomass. Annual harvesting of bamboo generates a regular income stream that gives bamboo farmers a quick return on their investment and an important annual safety net.

3. Plant-it-and-leave-it
Bamboos don’t need much tending once planted. They self-mulch by continuously shedding their leaves, and don’t need lots of fertilizer to grow. If not sold to provide part of the family’s income, bamboo culms can be used for farming and utilitarian applications (housing, fencing, implements).

4. Plant anywhere
Most bamboos can grow marginal lands, such as degraded land and steep slopes, leaving better land for more demanding crops.

5. Easy harvesting
Although harvesting bamboo is labour intensive, it is relatively easy and is usually done by hand. Bamboo is very suitable for women to process because the culms are lightweight, and easy to split by hand.

6. Multipurpose
The broad range of uses to which bamboos are put means demand remains high. Culms are widely used in agriculture especially in low income countries, and where processing is possible production of a large range of bamboo products become viable. Bamboo’s ability to replace high demand wood-based products such as furniture, housing and fuel are of particular relevance in tackling climate change.

<table>
<thead>
<tr>
<th>Category of Services</th>
<th>Type of services provided by bamboo</th>
</tr>
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<tbody>
<tr>
<td>Support services</td>
<td>Nutrient cycling, primary production</td>
</tr>
<tr>
<td>Provisioning services</td>
<td>Food, fuelwood, fiber, biochemical, genetic resources</td>
</tr>
<tr>
<td>Regulating services</td>
<td>Climate, water regulation and water purification</td>
</tr>
<tr>
<td>Cultural services</td>
<td>Spiritual and religious, recreation, aesthetic, inspirational, educational, sense of place, cultural heritage</td>
</tr>
</tbody>
</table>

*Bamboo provides many of the ecosystem services (in white text), as classified by the Millenium Ecosystem Assessment*
Providing resilience to other systems

Bamboo offers important ecosystem services, making it an important plant for agroforestry.

1. Erosion control
Bamboo is very good at holding soil together to reduce erosion due to its extensive rhizome system, particularly in areas prone to high amounts of runoff like steep slopes, river banks or degraded lands. Bamboos are evergreen plants and the thick canopy and soil cover provided by dead leaves reduces splash erosion and enhances infiltration.

2. Windbreaks and shelterbelts
Bamboo culms are very elastic - they bend in high winds, but usually do not break – so they are often used as windbreaks to protect cash crops, particularly in coastal areas where high winds are frequent.

3. Rehabilitation of degraded lands
Planting bamboo can help speed up the conversion of degraded lands into productive and economically viable systems by reducing erosion and raising the water table, helping improve the productivity of other, commercial and food, crops grown on the site.

4. Bioremediation of contaminated systems
Bamboos are likely to be able to help remediate polluted lands – their role in filtering animal waste to prevent nigh nitrogen effluents is being tested.

At an action research site outside Allahabad, India, bamboo was introduced on land that had been heavily degraded by topsoil removal for brick-making. After five years of growth, the land supported a diverse agroforestry system of agricultural and medicinal plants and fisheries mixed with bamboo, the water table had risen by 7 meters, and the dust storms which originated from the area subsided. See INBAR’s ‘Greening Red Earth’ for more detail.
Decreasing Sensitivity through Supply Systems and Products

Bamboo provides a local, reliable and resilient source of shelter, energy and food for millions of people.

1. A light and strong material for construction and infrastructure

Bamboos have been popular and common housing material for centuries. Although bamboo houses are sometimes thought of as only suitable for poor people, new designs and production techniques coupled with shifts in perception mean modern high quality houses that combine safety, durability and aesthetic criteria are being produced, whilst remaining affordable. Similar innovations have produced other bamboo structures such as bridges and housing components equivalent to those of other materials.

2. Providing a renewable biomass fuel

Bamboo can help reduce deforestation by replacing trees as a source of biofuel. In Ethiopia bamboo charcoal helps meet the energy demands of rural and urban-dwellers, and in Manipur, India, household-operated drum-kilns provide reliable sources of bamboo charcoal that provide both household energy and employment for local communities.

Pro-Poor Bamboo Urban Housing in areas vulnerable to Climate Disasters

Permanent: The effect of climatic disasters can be reduced by improving the bamboo houses inhabited by the lowest-income and most vulnerable segments of populations in areas at risk.

Temporary: Bamboo housing can be used to provide solid, and easily constructed houses following natural disasters. After the Sichuan earthquake of 2008 in China, semi-permanent pre-fabricated bamboo shelters were used to accommodate hundreds of people – shelters that could equally well be used after climate-change based disasters.
3. A food source
Bamboo can help provide food security in both human and livestock diets. The shoots of many species are edible and nutritious and they are a common ingredient in many dishes, whilst bamboo leaves are common sources of fodder for livestock and feed for fish.

<table>
<thead>
<tr>
<th>Chemical Composition of 100g of Phyllostachys edulis shoots</th>
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<tbody>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Fat</td>
</tr>
<tr>
<td>Fibre</td>
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<tr>
<td>Protein</td>
</tr>
<tr>
<td>Carbohydrates</td>
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<tr>
<td>Ash</td>
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Bamboo can sequester more carbon if managed than if left in its natural state, and can sequester more than comparable fast-growing tropical and sub-tropical trees.

The longer lifespans of modern bamboo products will help ensure that sequestered carbon does not return to the atmosphere.

Bamboo’s potential contribution to mitigation relies on the fact that it combines continued biomass production with annual extraction - a significant portion of the culm biomass is extracted on a yearly basis, while leaving the standing carbon stock more or less unchanged.

Increasing the cultivation and use of bamboo will help improve the resilience of rural and some urban populations to events brought on by climate change, such as extreme weather. Bamboo is easy to grow and maintain, and can provide additional food, energy and income security to the rural poor, as well as a range of environmental services and uses in its growing and harvested forms.

But although we know many of the ways that bamboo can help, more work is needed to fully quantify, understand and develop the potential that bamboo offers, particularly for the millions of people living in areas considered especially vulnerable to the effects of climate change.

The MAD challenge is perhaps the most significant opportunity for the future of the planet in modern times. Ensuring that bamboo can take its rightful place in addressing climate change will require research, development and application in areas hitherto unaddressed by bamboo - mitigation and adaptation – and INBAR will work to achieve this.