Good practices, success stories and lessons learned on implementation of the UN Strategic Plan for Forests and the Global Forest Goals

Input received from INBAR - International Network for Bamboo and Rattan

- Reforestation using bamboo in Chishui, China
- Comparing the eco-cost of bamboo, teak and acacia charcoal in Ghana
- Bamboo for land restoration in India
- Bamboo charcoal in Tanzania

Reforestation using bamboo in Chishui, China

Bamboo is a key part of the Chinese government's flagship reforestation programme in Chishui, Guizhou.

Goals and targets addressed

UNFF Global Forest Goals 1 (**Reverse the loss of forest cover worldwide**), 2 (**Enhance forest-based economic, social and environmental benefits**), 3 (**Increase the area of protected forests worldwide**), 5 (**Promote governance frameworks to implement sustainable forest management**)

Background

Launched in 1999, China's Conversion of Cropland into Forest Programme (CCFP) was a response to a number of ecological crises and growing environmental challenges. Its main aim was to restore degraded farmland into forests and provide a number of ecosystem services, particularly soil and water conservation. Predictably, the scale of the project was huge: by 2014, the programme had invested some RMB 450 million and involved more than 32 million farming households.

Although technically a grass, bamboo was a key plant for the implementation of the CCFP in certain areas of China. China boasts a large number of native bamboo species, and certain species possess features which make them a particularly useful tool for reforestation, environmental protection and livelihoods (see box).

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Restoring degraded land. Bamboo has extensive root systems, which can measure up to 100 kilometres per hectare of bamboo and live for around a century. This underground biomass makes bamboo capable of surviving and regenerating, even when the biomass above ground is destroyed.

Raising water levels. When properly selected and well managed, bamboo species can help raise the groundwater table level significantly and reduce water run-off. Bamboo is tolerant to both floods and droughts.

Restoring soil health. Bamboo quickly reduces the acidity of soil, increases soil nutrients and makes it less compact, allowing it several crucial ecological functions to be quickly restored, including water regulation and nutrient recycling.

Carbon storage. Bamboo lives for a long time, and because it grows quickly it can be used to make a lot of goods – effectively storing carbon in the plant, but also in many durable products. Over a period of 30 years, one hectare of bamboo plants and their products can store up to 600 tonnes of carbon, more than certain species of tree.

A source of livelihoods. Fast growing and easy to manage, bamboo already provides a crucial source of income for tens of millions of people in rural communities around the world, as well as a clean-burning source of renewable energy.

Action taken

The benefits of using bamboo for land restoration are particularly apparent in Chishui, Guizhou province. Guizhou is one of the poorest regions of China, and Chishui is one of its poorest areas. Over the years, unsustainable cultivation practices have contributed to long-term land degradation and subsequent reductions in productivity and farmer income in Chishui. However, Chishui also boasts over 300 species of bamboo.

From 2001 to 2014, the local Chishui government invested RMB 40 million into restoring sloping and unproductive land with bamboo. Targeting a massive area, the afforestation programme covered 14 townships and almost 51,000 households. By 2015, Chishui boasted over 87,000 ha of bamboo forest. Moso (*Phyllostachys pubescens*) bamboo alone covered 35,000 ha of land by 2014, a substantial increase from its previous coverage of 24,000 ha. Because of the CCFP, Chishui ranks number one in China for its per capita bamboo forest.

Outcomes and results

Environmental impacts of bamboo planting

Chishui's bamboo afforestation effort has had an important impact on reducing soil erosion, conserving water resources and increasing carbon sequestration, with research showing that:

- Compared to sweet potato farming lands, the average water runoff for bamboo plantations is 25 per cent less, and the average soil erosion quantity is reduced by 80 per cent.
- One 13,000-ha bamboo plantation in Chishui was shown to reduce over 350,000 tons of soil erosion that used to flow into the Chishui River annually, and conserved some 6000 m^3/ha water resources per year (see Figure).
- The increased bamboo stocks sequestered almost 200,000 tons of carbon annually.

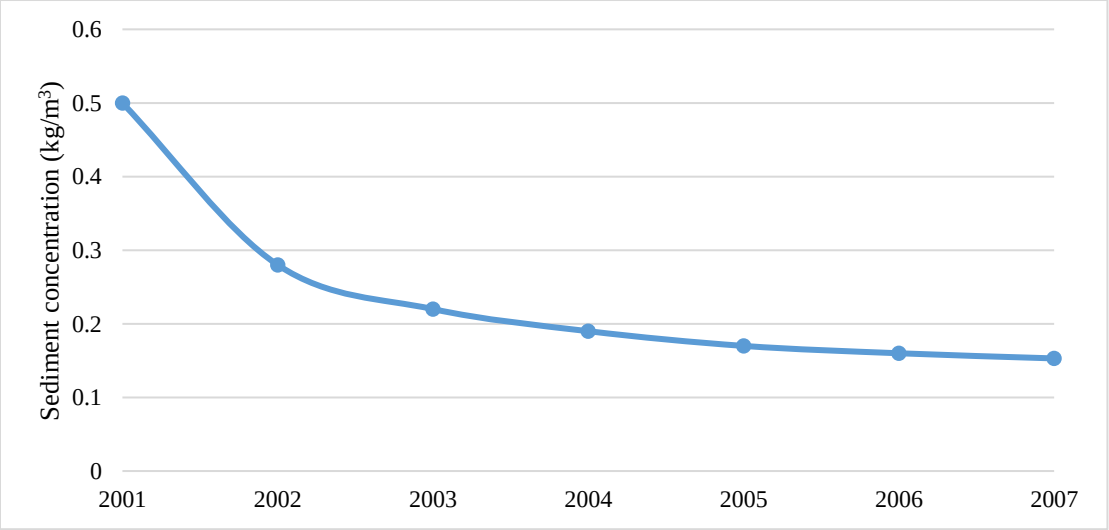

Figure. Sediment concentration in Chishui River from 2001 to 2007 (kg/m^3) (Data source: He 2009).

Supporting local livelihoods

As well as its environmental benefits, bamboo has played a key role in supporting the economy of Chishui. The annual per-capita income for farmers involved in Chishui's land restoration project was under 1900 RMB in 2001, with an additional income from bamboo of under 600 RMB. By joining the afforestation programme, the annual per-capita income from bamboo increased to 2900 RMB. This is in large part due to the development of Chishui's bamboo sector, and rigorous training, which has enabled more than 30,000 farmers to shift from primary industries to secondary industries. An eco-tourism industry is also emerging and is attracting more and more investment in infrastructure and capacity building for service provision. Five out of six famous tourist spots in Chishui feature bamboo.

One fascinating result of the project is the return of migrant workers to Chishui. In recent years, a large number of migrant workers have been returning from Guangdong to Chishui – a third of whom are now working in the bamboo sector. This result is testament to the increase in opportunities afforded by a robust bamboo supply chain.

Due to its success, as part of the new phase of CCFP in 2014, the Chishui government has planned to restore thousands more hectares of degraded land using bamboo by 2020, and increase the value of bamboo sector to RMB 10 to 20 billion. The local government is also encouraging the transfer of bamboo forest management rights from individual farmers to cooperatives and companies, to help improve the management and utilisation of these forests, and is investing in building roads: a key concern if bamboo poles are to be harvested and sold.

Lessons for others

Although no two areas are the same, future initiatives can learn from the success of the CCFP bamboo project in Chishui.

Several factors contributed to the success of this restoration programme. Firstly, the replanting project realised the importance of choosing local bamboo species. There are over 1600 species of bamboo, each with very different properties and uses. In Chishui, specific species were chosen which ensured the maximum industry potential for harvested bamboo, and provided relevant ecosystem services. Secondly, the project made careful plans for the long-term development of the bamboo value chain. This included support for the establishment of a bamboo paper pulp factory, Chitianhua Bamboo Paper Pulp Co. Ltd, in 2003, to makes 20,000 tons of pulp per year using 80,000 tons raw bamboo. The company now offers direct employment to more than 500 people and has created a lucrative value chain of bamboo farmers, who supply the raw material to the factory. Indirectly, the factory supports thousands of people involved in the value chain, including lumberjacks, bamboo chip makers and drivers.

Bamboo is not only grown in China, and there are over 30 million hectares of bamboo spread across Africa, Asia and South America. Similar replanting activities could restore millions of hectares of degraded land across the world, while providing livelihoods support to those rural communities which need it most.

This study was compiled by the International Bamboo and Rattan Organisation, based on Li Yanxia and Oliver Frith, 'Chishui', in INBAR (eds) 2018, Bamboo for Land Restoration. INBAR Policy Synthesis Report 5. INBAR: Beijing, China.

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Comparing the eco-cost of bamboo, teak and acacia charcoal in Ghana

New research shows how bamboo has the lowest environmental impact of alternative biomass sources to wood charcoal in Ghana – providing a potential sustainable source of bioenergy for many countries in Africa.

Goals and targets addressed

UNFF Global Forest Goals 1 (**Reverse the loss of forest cover worldwide**), 2 (**Enhance forest-based economic, social and environmental benefits**)

Background

The rise in wood fuel consumption, particularly of charcoal, has been associated with increased deforestation across many countries in Africa. A number of biomass sources are being promoted as an alternative to traditional wood fuel. However, while many of these species have comparable charcoal quality, there is little information about the environmental impacts associated with each one. Recent research has assessed that bamboo is the most environmentally sustainable fuel alternative in Ghana, with an 'eco-cost' of over 100% less compared to two other commonly promoted forms of biomass: acacia and teak.

Background

Deforestation is a serious problem in Ghana, with a deforestation rate estimated at over 2 per cent per year, or an average annual forest loss of 115,000 ha. Part of the problem is the logging of forest wood for fuel. Similar to many parts of Africa, wood fuels currently provide 71 per cent of the total annual energy demand in Ghana. With rising household energy demands, rates of

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deforestation and resulting negative environmental are set to increase, unless alternate sustainable pathways are developed.

Bamboo could provide part of the solution to deforestation for timber in Ghana. Although bamboo is underutilized in Ghana, there are currently more than 300,000 ha of bamboo. Indeed, some estimates suggest that bamboo charcoal could potentially replace 64 per cent of the country's wood consumption for charcoal production.

This study quantified and compared the cradle-to-gate environmental impacts of producing charcoal from bamboo, with two other commonly used forms of biomass: teak (*T. grandis*), acacia (*A. auriculiformis*) and bamboo (*B. balcooa*). Bamboo, acacia and teak charcoal have "roughly comparable" calorific values, but the environmental cost of producing charcoal from these three sources has not previously been estimated. To make the most informed decisions about bioenergy policy, policymakers in the forestry sector in Ghana need to be fully aware of the 'eco-cost' of each form of biomass.

Actions taken

The study was conducted in accordance with the International Standardisation Organisation's 14040/14044 standard, an international procedural framework for performing life cycle analysis. The standard looks at the varying stages of a plant and product's 'lifecycle', and shows how to calculate the 'eco-cost' of each stage: from biomass production and harvesting to transportation and carbonisation into charcoal. The resultant eco-cost of a specific product is an expression of the amount that would need to be spent in order to make the product 'sustainable'. It includes a number of areas in which the product can be unsustainable, in terms of human health, ecosystem preservation, resource depletion and global warming.

Outcomes and results

The results showed that the total eco-cost (comprising human health, ecosystem impacts, resource depletion and global warming) of a cradle-to-gate production of 1 MJ of charcoal is lowest for bamboo. In fact, the eco-cost will be 113 per cent higher with acacia charcoal, and 140 per cent higher with teak.

One of the major positives of bamboo charcoal, as opposed to acacia and teak, is its ability to be easily included in farm intercropping systems: a method which improves soil fertility and crop production, as well as providing a source of energy. Bamboo is already being promoted for intercropping in Ghana, and is already a key part of agrobiodiverse farmlands across the country.

Moreover, as teak and acacia use comparatively large quantities of pesticides, weedicides and fertilizers while they grow, they contribute more to challenges including high acidification, ozone depletion and global warming. These eco-costs during their growing stage accounted for approximately 85% of their total.

Overall, the study results suggest that bamboo plantations are the most environmentally viable option for charcoal production in Ghana. The result should be of interest to all policymakers involved in the forestry sector across Africa countries where deforestation for energy is a pressing problem. Indeed, with the help of the International Bamboo and Rattan Organisation, in 2018 alone Ethiopia, Kenya and Uganda started to work on national strategies and action plans to integrate bamboo into their land use and livelihoods work.

This summary was compiled by the International Bamboo and Rattan Organisation, based on research by Partey S.T., Frith O., Kwaku M., Sarfo D.A. 2017. Comparative life cycle analysis of producing charcoal from bamboo, teak and acacia species in Ghana. International Journal of Lifecycle Assessment, 22, 758–766.

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Bamboo for land restoration in India

Bamboo has restored severely degraded soil to its agricultural potential in Uttar Pradesh, India

Goals and targets addressed

UNFF Global Forest Goals 1 (**Reverse the loss of forest cover worldwide**), 2 (**Enhance forest-based economic, social and environmental benefits**), 5 (**Promote governance frameworks to implement sustainable forest management**)

Background

In the 1980s, land degradation had negatively affected the lives of millions of people living in Allahabad, Uttar Pradesh in the north of India, was far from unusual. In the 1960s, land-owning farmers in the area had leased their soil to brickmakers. While this brought some income to land-owning farmers, by the 1980s it had also resulted in the removal of its topsoil. The resulting soil contained few nutrients and left farmers unable to grow crops (Figure 1a); frequent dust and cyclonic storms in the region also affected nearby areas (Figure 1b); air pollution levels reached new highs and access to water became an issue as the water table dropped. The social, environmental and economic degradation resulting from the topsoil removal in the region needed to be reversed.

In 1997, the Utthan Centre for Sustainable Development and Poverty Alleviation (Utthan) began working on a project with the International Bamboo and Rattan Organisation (INBAR) to restore degraded land and reverse the decline in local farmers' livelihoods in Allahabad, Uttar Pradesh, using bamboo. Following an initial survey which assessed the potential for bamboo cultivation to revive and restore the degraded land, a pilot project was established on approximately 5000 hectares (ha) of land. This included land in the Kotwa-

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Rahimabad area, which 1997 was experiencing high levels of poverty as a direct result of unsustainable land use practices.

(a) (b)

Figure 1. (a) The extent of topsoil excavation and (b) dust storm in village (INBAR 2003).

Action taken

INBAR and Utthan selected six bamboo species, the seeds of which were then cultivated and placed in bamboo nurseries. Once the bamboo plants were old enough, they were integrated into existing farming systems, and farmers were trained in how to manage them.

A large focus of the project was on using bamboo to provide a source of income to farmers. Through training programmes, villagers were able to develop the necessary skills to produce various products out of bamboo including scaffolding, baskets and agricultural implements. Some products such as incense sticks, matchsticks and pencils were made and sold via Utthan in Allahabad. Utthan also connected bamboo consumers such as estate developers and enterprises that use bamboo as raw material (e.g. pulp and paper industry) with the producers. Attention was also given to activities which could improve the resilience in farming techniques such as using bamboo leaves to make compost to save money on fertiliser purchases.

Participation was an important aspect of the project, and project developers worked directly with members from civil society groups, farmers' groups, a women's group and the *panchayat* (village councils of both Kotwa and Rahimabad). Engagement included discussions to raise awareness, and training in bamboo management and uses (see Figure 2).

Outcomes and results

The outcomes of the Kotwa-Rahimabad project demonstrate how remarkably successful restoring degraded land with bamboo can be. Between 1997 and 2000, the project exceeded all its social, ecological and economic goals. Even more important is the ongoing sustained improvement up to 2016. This case study shows a real turnaround story in terms of land degradation and poverty alleviation through the strategic incorporation of bamboo into agroforestry models for communities. The results are best summarised in a table, below:

Table. Kotwa-Rahimabad Area Project Facts and Figures

	Indicator	**1996: facts and figures**	**2000: facts and figures**	**2016: facts and figures**
1.	Water table in 5 wells	40 m deep	33.5 m deep	30.2 m deep
2.	Water in reservoir tanks	Dry tanks by January end	Water remained till June	Water remained all year round

3.	Greenery	Only 19 trees in 106 ha	The total area is lush green	The total area is lush green
4.	Production and economy	Practically no production	Each family earns a minimum of Rs 30,000/- a year from its holdings	Each family earns a minimum of Rs 70,000/- a year from its holdings
5.	Poverty level	80 per cent of people below poverty line	All families above poverty line	All families above poverty line
6.	Migration of male members in search of jobs	All youths and adults used to migrate to other places in search of jobs	About 70 per cent of male members have returned to their villages	About 95 per cent of male members returned to their villages
7.	Micro-climate	Frequent dust and cyclonic winds	Practically no storms	Area is free of pollution

In a field visit by an INBAR team in August 2017, the cascading effect of the project was seen in the entire belt of the Kotwa-Rahimabad area. The fact that the entire area of approximately 5000 ha looks green with improved livelihood opportunities and economic security is standing proof of the tangible outcomes of the project. With greenery all round, the whole area continues to brim with activities, feeding the hopes and aspirations of people living there.

Importantly, Utthan has become an active champion of afforestation in the region, and similar projects have been implemented by Utthan using knowledge learned from the Kotwa-Rahimabad project. As a result, about 100,000 ha of degraded land in 600 villages in the states of Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Bihar, and Jharkand has been reclaimed, benefitting over one million people economically and socially.

Figure 2. (a) A training session with farmers. (b) Bamboo and tree nursery and (b) bamboo and agricultural crop (INBAR 2003).

Lessons for others

To be successful, a bamboo land restoration project has to do more than plant bamboo. The project identified a number of important areas.

- Training and participation by local stakeholders is crucial. The success in Allahabad showed that development projects can become extremely successful if ‘effective’ and ‘lasting’ partnerships are forged with local governments, NGOs, the stakeholder communities and especially the farmers. Furthermore, empowering local partners - through the principle of ‘leading/guiding from behind’ - is key to ensuring interventions are sustainable.

- In a similar vein, incorporating local knowledge and wisdom when developing agroforestry models with bamboo can result in improved outcomes.
- Training, in this project and others, was a prerequisite for the local community to benefit from sustainable income-generation opportunities.
- A focus on the economic potential of bamboo was very important to the success of the project, and the goal of "doubling all farmers' incomes" undoubtedly played a role in raising the general awareness and knowledge of the villagers.
- Soil-species matching, and market potential analysis, is necessary to ensure the right species of bamboo are chosen.

The project results showed that, with effective promotion and marketing, the trading potential for bamboo and bamboo-based products can expand significantly, not only in the domestic market (India), but also in the whole of South Asia.

This study was compiled by the International Bamboo and Rattan Organisation, based on K.P. Eashwar, 'India', in INBAR (eds) 2018, Bamboo for Land Restoration. INBAR Policy Synthesis Report 5. INBAR: Beijing, China.

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Bamboo charcoal in Tanzania

Bamboo is native to Tanzania, and a community-driven bamboo bioenergy project has helped protect forests.

Goals and targets addressed

UNFF Global Forest Goals 1 (**Reverse the loss of forest cover worldwide**), 2 (**Enhance forest-based economic, social and environmental benefits**), 5 (**Promote governance frameworks to implement sustainable forest management**)

Background

Degraded land has serious adverse effects on community livelihoods and the environment in Tanzania. It was estimated that between 2001 and 2009, the cost of land degradation in East Africa was approximately USD 18 billion. Over the years the Tanzanian government has tried several ways to reduce the country's dependence on unsustainable charcoal production, including the imposition of a heavy tax on charcoal, and restrictions on inter-regional charcoal trade.

Bamboo could play an important role in replacing tree charcoal to meet bioenergy demand. This quick-to-mature grass plant can be made into charcoal briquettes which burn with a similar calorific value to other common forms of energy, but grow back much faster. Bamboo charcoal is also clean burning, providing a safer source of charcoal for use inside the home.

Since 2009, the International Bamboo and Rattan Organisation (INBAR) has worked with the Tanzanian government to promote the use of bamboo instead of trees for biomass energy, handicrafts and other product creation in the Mbaya District of Tanzania. The

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overall aim of the initiative is to reduce deforestation and land degradation, while also creating job opportunities and income for the community.

Action taken

The project established a bamboo plantation on 40 hectares of degraded soil, as well as micro-level bamboo plantations on over 800 homesteads and along farm boundaries. Householders planted bamboo for many purposes including for feed, fodder and biomass, and the micro-level plantations provided households with biofuel and feed for homestead cattle (through collecting bamboo leaves).

To improve the management of existing (and new) bamboo resources, and to encourage participation, communities were engaged in activities such as staffing new bamboo nurseries, as well as training through the establishment of a Farmers Field School, which played a key role as a 'bamboo knowledge centre' for other farmers from adjoining villages and districts.

A crucial aspect of the project was its emphasis on the economic potential of bamboo, and a lot of effort was spent promoting the establishment of bamboo enterprises. In practice, this meant a lot of training and technical support to individuals, including for the establishment of bamboo charcoal briquetting enterprises. Individuals were provided with the necessary infrastructure, technologies and coaching to learn how to make charcoal briquettes. Community training culm production centres were also set up to develop skills and transfer technology for bamboo treatment and processing, and how to create bamboo furniture and handicrafts.

Outcomes and results

According to those running the project, the initiative has led to tangible improvements in participants' incomes, and has contributed to certain changes in households' livelihood choices. One important change is a renewed interest in rearing animals, based on the easy availability of bamboo leaves as animal feed. Through making bamboo furniture and handicrafts, training participants have now gone on to provide jobs earning USD 100 to USD 200 per month for over 250 people. Across the community, the added value of creating charcoal briquettes from 10 megatonnes harvested bamboo has risen to approcimately USD 25,000 to 30,000. The project has also motivated households to plant bamboo in their respective homesteads and remnants patches of degraded land or farm boundaries, specifically to make charcoal. As a result of the project, similar initiatives are now being extended to adjoining villages and other projects in the region, including Madagascar and Ethiopia.

(a) (b) (c)

Figure 10. (a,b) Making bamboo handicrafts and (c) bamboo charcoal briquettes (source: INBAR project).

Lessons for others

Some of the key lessons resulting from the project were as follows:

- Linking land restoration with economic and income generation activities was crucial to the project's success. Setting-up community-driven enterprises was a driving force to promote land restoration with bamboo plantation.
- Awareness raising was essential for the successful implementation of the project. At the start of the project, government officials and local people showed limited interest in using bamboo for land restoration or increasing economic opportunities. Raising awareness of the potential of bamboo was coordinated by the lead department, which conducted training showcases on the capacity of bamboo for land restoration using local language leaflets and posters.
- Land restoration should be carried out under clear land tenure and ownership rights. Planting activities should not be conducted in places where there is land use conflict or unclear tenure rights, as this discourages people from buying into the initiative, and often leads to the neglect of the bamboo planted there, as nobody feels it is their job to maintain it. As such, this project focused on community land and homestead farmland.

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