TECHNICAL ADVISORY NOTE (TAN)

Diffusion of Value-Adding Technologies for Livelihood Enhancement: Bamboo Charcoal Briquetting

INBAR
INTERNATIONAL NETWORK FOR BAMBOO AND RATTAN

INTRODUCTION

In Tamenglong District, Manipur, India, an ARS programme, established by INBAR in 2002, has successfully developed processing technology, which enables rural communities to produce bamboo charcoal briquettes. The technology uses modified oil drum kilns to produce powdered bamboo charcoal, which is then mixed with binders and moulded into briquettes. The project benefits rural communities in 68 villages, covering four blocks in the District (Tamei, Tousem, Tamenglong, and Nungba). These communities meet space heating and cooking energy needs using the briquettes, which burn for an average of 2½ hours and have a calorific energy value of 26-29 MJ/kg.

At the local level, the Tamenglong Bamboo and Cane Development Centre (TAMBAC), an INBAR-established, Indian, section 25, non-profit company, implement the project. The Centre for Indian Bamboo Resource and Technology (CIBART) and the Indian Institute of Technology, Delhi (IIT) are also project partners.

The Context

INBAR introduced bamboo charcoal technology in Tamenglong as a means of generating sustainable livelihoods for the local population, numbering 111,493 people in 2001. At present, 86% of workers in Tamenglong depend on agriculture for their livelihoods, with around 70% of the population estimated to live below the poverty line. In recent years, returns from agriculture have diminished due to a combination of factors, such as sustained population growth and continued reliance on slash-and-burn farming techniques. Therefore, it is crucial that rural communities develop off-farm markets to increase income-earning opportunities.

This action research focuses on developing sustainable bamboo-based biomass fuels because of the Tamenglong's current dependence on firewood and wood charcoal. Present consumption in Tamenglong is highly unsustainable and causes significant deforestation. Over-consumption of wood biomass fuels results from the region's poor access to electricity and relative isolation. Tamenglong is 1,290 m above sea level, with natural forests covering 88% of its land area. Because of its hilly and forested nature, Tamenglong's road network is highly underdeveloped, with only 2 motorways accessible throughout the year. There are no railways, while the nearest airport is 153 km away. Only 48% of local villages have access to intermittent electricity.

Given these conditions, solutions to widespread rural poverty and energy shortages need to come from the area's natural resource base. In Tamenglong, there are substantial bamboo resources, with 563 sq. km of bamboo forest and 1.5 billion bamboo culms covering the district. Therefore, this action research has focused on developing bamboo charcoal as a sustainable alternative to wood-based biomass fuel. Bamboo charcoal production was not feasible in Tamenglong before the action research commenced as local awareness and technical capacity were lacking. Traditional forms of slash-and-burn agriculture meant that social attitudes to bamboo cultivation were often negative. In addition, limited social and institutional networks were in place, making coordination of complex supply chains almost impossible.

The process: Bamboo Charcoal Production


Splitting and cutting Bamboo


Sun drying cut bamboo


Metal oil drum kiln mounting


Initiating pyrolysis


Phased addition of bamboo


Flaming drum closed


Reducing air intake for carbonisation


Fully closed for carbonisation


Carbonised bamboo charcoal


Carbonized charcoal pulverizing


Sieving powdered charcoal for impurities


Adding clay in 3:1 ration


Loading bamboo charcoal/clay mixture into manual briquette mould


Making briquettes using manual mould and pressure from a hammer


Sun drying bamboo charcoal briquettes

Drum kiln photos courtesy of Mr. Jeevanandhan Duraisamy, Community forestry officer, FAO Mozambique – Aug 200

Main Technical Components of the Research Programme

- Successful development and field-validation of bamboo charcoal briquette production technology.
- Training of CSO trainers and small producers from the rural community.
- Equipping two CFCs with brick moulders and drum kilns to act as bamboo charcoal training and production centres.
- Creating marketing links to local markets through the establishment of community-based SHGs.

Scope for Replication

***Scaling-up*:** At present, 24,000 households in Tamenglong consume an average of 35 kg of wood charcoal per month. Removal of wood from natural forests to meet local energy needs for heating and cooking is becoming increasingly unsustainable. Therefore, great potential exists for up-scaling INBAR's current action research. Bamboo charcoal briquette is ideally placed to compete with wood charcoal in local markets, as it is produced from a fast-growing, sustainable resource base – bamboo can be harvested every 2-4 years. In addition to its sustainable nature, bamboo briquettes are also competitively priced against wood equivalents. One bamboo briquette costs INR 5 (US$0.13). Bamboo briquettes can also compete with wood charcoal in terms of quality due to their high calorific content and long burning times. Finally, production technology for bamboo charcoal briquettes is relatively low in cost and requires minimal technical skill to operate. One production unit requires start-up funds of around INR 20,000 (US$500), with sales revenue generating annual net-profits of around INR 90,000 (US$ 2,250). Through sharing costs across a community, i.e. establishing cooperatives/SHGs, the rural poor can often meet these initial start-up costs. However, new micro-financing systems are required to enable rural communities to gain greater access to credit. Training requirements for building the capacity of rural producers are usually restricted to a single 2-3 month training course.

***Scaling out*:** In addition to Tamenglong, large markets for wood charcoal can be found across India. According to a study by the Food and Agriculture Organization (FAO), India produces around 2 million tonnes of wood charcoal per year. Given that India's Supreme Court has enforced a commercial logging ban since 1996, large shortages of timber are now driving up the price of wood products and leading to shortfalls of charcoal in states such as Gujarat. Therefore, considerable opportunities exist for out-scaling bamboo charcoal production to other Indian states – particularly the Northeast Indian states such as Nagaland, Sikkim, and Meghalaya – where bamboo resources are widely available and demand for charcoal is high. Besides India, bamboo charcoal production can also be adaptively replicated in a number of developing countries in Asia and Africa, where dependence on biomass fuels is widespread. For example, in Ghana and Ethiopia, over 90% of the population are dependent on wood biomass fuels to meet household energy needs. INBAR has already successfully transferred production technology developed in Tamenglong to the Philippines, Ethiopia, Ghana, Mozambique and Tanzania.

SECTION ONE: THE INSTITUTIONAL CONTEXT

- Bamboo charcoal enterprise development is one of several activities developed by the action research programme in Tamenglong district of Manipur, India, developed under INBAR Livelihood and Economic Development Programme (LEDP), with the support of IFAD grants TAG 518 and TAG 774.

SECTION TWO : THE PROGRAMME IMPLEMENTATION

Target Groups and Outputs

Target Group: Women aged between 20-60 years old, who had previously been practicing slash and burn agriculture, earning incomes below, or slightly above, the poverty line.

Current outputs from the project include:

- Bamboo charcoal briquette technology has been successfully developed and field-validated by TAMBAC, in collaboration with INBAR.
- TAMBAC
- Bamboo charcoal briquettes are now being sold commercially in the district market.

Tangible Impacts

Impacts on the human capital:

- Three hundred people, predominantly women, trained in bamboo charcoal briquetting.
- Thirty-seven charcoal briquetting enterprises established.

Impacts on the social capital:

- Formation of community partnerships between TAMBAC and women SHGs.
- Equipping two CFCs with charcoal kiln and briquette moulding technology.
- Creating links to local markets, where briquettes are sold by the SHGs.

Impacts on the natural capital:

- Nearly 500,000 saplings of *Dendrocalamus hamiltonii* were raised and planted in community plantations over an area of 1,241 ha.
- More than 400,000 seedlings of *D. hamiltonii* were planted on homesteads and farmlands by individual farmers.

Intangible Impacts

- One full-time worker in a charcoal-producing SME is able to produce 50 briquettes per day, earning a daily net profit of INR 170 (US$4.25); over 300 producers are benefiting, although many are working part-time.

Constraints Faced During the Programme Implementation

Internal:

- Rural communities' production capacities are poor, as they lack access to new technology and training.
- Institutional systems are underdeveloped, resulting in producers have limited access to raw materials and end markets.
- Rural communities cannot access market information or conduct market research.

External:

- Poor transport network makes accessing regional and national markets very difficult.
- Limited access to credit financing mechanism for community producers.
- Local perceptions towards bamboo trades are often unfavourable.

Accessibility

Because of TAMBAC's linkages with CIBART and INBAR, technical and research outputs from the programme are available for replication at both the national and international level. In India, institutional linkages are established through CIBART, which manages four Indian ARS programmes (Tripura, Tamenglong, Himachal and Konkan). Internationally, action research from Tamenglong can also be adaptively replicated across INBAR's network of 34 countries. In addition, research outputs are available at low or no cost to individuals and community groups operating in INBAR member countries.

Institutional Sustainability and Degree of Farmers' Involvement in the Research Programme

The programme is run by TAMBAC, a community-based NGO, which was established by INBAR in 2002. Community stakeholders (master trainers and local development professionals) play an active role in decision-making, with external partners (INBAR) providing technical and logistical support. Community ownership of TAMBAC ensures that the organization remains directly rooted to the local area, thus ensuring continuity and sustainability.

TAMBAC is supported by a vast village extension network, with 112 officers providing rural communities with training and technical support at the field level. In addition to field-staff, TAMBAC has also established 35 village development councils, which play an active role in determining ARS activities. 58 Joint Forestry Committees, responsible for management and development of the local resource base, have also been established. Finally, production is coordinated through two TAMBAC managed CFCs and 37 SHGs.

The Gender Dimension

Women have played a prominent role in the action research, with the majority of charcoal production being coordinated through TAMBAC-established women's SHGs. Women are directly responsible for managing supply chains, with a number of women entrepreneurs now emerging in the sector. This research programme has directly benefited large numbers of women, whom are able to engage in charcoal production as part of a home-based enterprise. Production requires minimal physical exertion, and can be done on a part-time basis. As TAMBAC has also built up the local bamboo resource base (45 villages have direct access to bamboo homesteads and plantations), this has also significantly reduced travel times for collecting bamboo. Owing to these factors, the sector is highly accessible to rural women. Many women are now making sustainable incomes from bamboo charcoal production, which has contributed to reducing gender inequality and empowering women. In addition to providing additional incomes for their households, women have also benefited from having a sustainable source of energy to meet heating and cooking needs.

Dissemination Pathways

Communication strategies at the village level:

- CFC-based training courses led by master trainers
- Face-to-face meetings
- Village extension system training and awareness raising events
- SHG/JFM Committee/VDC meetings and workshops
- Quarterly newsletter

- Communication strategies at the national and international levels:
- Product workshops and trade fairs
- Technical reports and publications

Future Research Needs

- Encourage private-CSO partnerships to enable rural communities to access working credit funds, such as bank loans. This will assist community enterprises in meeting growing working capital needs, based on their positive cash flow and annual growth.
- Expand training programmes to more local women and youths.
- Develop inter-state markets to aid up scaling and replication.
- Conduct biological studies on bamboo flowering in the region to reduce risks to the natural resource base.

ANNEX 1: DATA BOX

The Research Programme

The research programme helps rural communities develop technologies and processing techniques for local bamboo resources, thereby generating enhanced livelihood and income-earning opportunities. At the local level, the programme is implemented by TAMBAC, a community-based NGO. TAMBAC focuses on developing bamboo products and business models for community enterprise. The programme has two CFCs in the district, which operate as bases for community training, production and marketing. Participatory approaches are consolidated through a village extension network, where members of the community act as local trainers and policy implementers.

Bamboo charcoal briquette production: Briquetting technology was introduced by TAMBAC, in collaboration with INBAR, through a grant from IFAD. The technology works using bamboo culms, which are converted into chips. The chips are loaded into a modified oil drum kiln (pyrolyser) and set on fire. More chips are added in batches to ensure that the burning is controlled, thus ensuring complete combustion. Once the kiln is full, it is sealed using a water seal. After smoke stops issuing out of the kiln's chimney, the chimney outlet is also sealed using clay. Complete pyrolysis usually takes 4 hours. The resultant bamboo charcoal is cooled, powdered and sieved to uniform size. The powder is then mixed with binders and moulded into briquettes, which are sun-dried and stored.

Costs: Establishing a briquette producing SME requires initial start-up capital of INR 20,000 (US$500). This capital covers costs for building an 18.6 sq. m shed (INR 11,000) and purchasing equipment (INR 9,000). The annual operating cost for an enterprise is INR 129,665 (US$3,242) with labour costs, which go directly to rural producers, accounting for the majority of this. The annual sales turnover for a production unit is INR 300,000 (US$7,500). Over a 7-year operating period, this equates to an annual net profit of about INR 90,000 (US$2,250).

SECTION THREE: USEFUL INFROMATION

Keywords:

Bamboo, Manipur, Tamenglong, artisan, charcoal, housing, village cluster, enterprise

Useful links:

www.inbar.int

www.inbar.int/livelihood/ldmain.htm *INBAR's Livelihood Development Programme*

http://www.cibart.org/tribac.asp

References:

Year of Publication: 2007

Contacts:

INBAR

Dr. I.V. Ramanuja Rao
Programme Director
Beijing, China
E-mail: rrao@inbar.int

IFAD

Dr. S. Mwanundu
Senior Technical Adviser Environment\NRM
Rome, Italy
Email: s.mwanundu@ifad.org

Acronyms:

ARS	: Action Research Site
CFC	: Common Facility Centre
CIBART	: Centre for Indian Bamboo Resource and Technology
CSO	: Civil Society Organization
FAO	: Food and Agriculture Organization
IFAD	: International Fund for Agricultural Development
INBAR	: International Network for Bamboo and Rattan
JFM	: Joint Forest Management
NGO	: Non-governmental organisation
SHG	: Self-help group
SME	: Small and medium enterprises
TAMBAC	: Tamenglong Bamboo and Cane Development Centre
VDC	: Village Development Council