IFAD Reconnaissance Mission

North East India Forestry Project

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Bamboos and Canes

(DRAFT)

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Contents

1. Introduction

Within the overall scope of the reconnaissance mission, which investigated a broad range of forestry and NTFP crops and issues concerning their development, a special study was made of the potential for development of sustainable management and use of bamboo and cane resources, particularly in Meghalaya. Consideration was given to how these particular crops fit into present and potential land-use patterns, the socio-economic situation, and the institutional arrangements. The constraints to better management of these resources, the issues that affect them in particular, and some potential avenues of intervention to address the constraints were considered on a broad basis.

2. Resource base

2.1 Bamboos

It was noted that bamboos are well adapted and highly productive in this region of India. Rainfall is sufficient for rapid and reliable growth. Soils are intrinsically good at holding water. Altitudes below 1400m have temperatures appropriate for reliable growth of high quality, productive large-diameter bamboo species.

The topography of Meghalaya is such that only small pockets of land are suitable for agricultural crops, the rest being too steep and prone to surface soil erosion. The root systems of bamboos comprise soil buttressing rhizomes and dense surface root systems. This makes them very effective in soil and soil fertility conservation. In such upland areas the most productive forms of land-use often make use of intricate crop mixtures planted according to details of micro-topography. Bamboo clumps are easy to incorporate and manage in this context of farm forestry as well as in larger scale natural stands and plantations. In addition rapid nutrient recycling in bamboos makes them an effective component of a mixed fallow crop for areas that remain under shifting cultivation.

With their natural coppicing habit and rapid growth of delicate shoots, bamboos are very well suited to sustainable management in an Asian cultural context. In addition the concepts of management for sustained yield and a mixture of products are already understood in local communities with regard to bamboos. Local planting techniques are also adapted to reduce losses from browsing damage, although current levels of freely grazing livestock are currently encouragingly low in this area.

North–east India is home to around half of India's bamboo species, giant woody grasses that thrive in warm, moist mountainous terrain. A special characteristic of the region is the wide occurrence of spreading, rather than clump-forming bamboos not seen elsewhere in India. *Melocanna baccifera* is seen at lower altitudes, while *Phyllostachys mannii* is common on the Shillong plateau. Meghalaya has a rich bamboo flora although the precise number of species is not yet known. A total of 20-30 bamboo species may be present. These currently provide for basic rural housing needs, as well as supporting the pulp mills of the region. A list of those species expected to occur in Meghalaya and the characteristics of the species actually seen are given in the bamboo inventory, Annex 1.

Moist and sloping sites below 1500m throughout Meghalaya support large bamboo populations of varying density, estimated to constitute a total area of some 3100 sq. km (all inventory figures 1990), mostly found on privately owned forest land, of which bamboos are estimated to constitute in the order of half the total area. Three species are particularly widespread. *Dendrocalamus hamiltonii* is by far the most common bamboo, the tall pendulous thin-walled culms being a distinctive characteristic of the lower river valleys leaving the state on all sides. It has been estimated that this species covers at least 1500 sq. km in Meghalaya, and it is widely exploited for its edible shoots and thin-walled culms. A shorter, spreading bamboo, *Melocanna baccifera* forms large, continuous stands further up the valley slopes. The incidence of this species increases substantially from east to west, with an estimated extent of 500 sq. km. *Bambusa* species, predominantly *B. nutans* subsp *cupulata*, are the next most common bamboos. These thick-walled species are mainly used for constructional

purposes. They are usually planted on private land to supplement the natural populations of thin-walled bamboos, giving a more dispersed coverage of around 500 sq. km.

Estimates of present stocking have varied substantially. However, it would appear that the three most common species probably constitute a standing crop in the order of 500 million sound culms. The present stock has been estimated as having a total dry weight of 2.6 million tonnes. Informal unsubstantiated guestimates of current export from the state are in the region of 50,000 tonnes. Most of the export is unrecorded, and a substantial proportion is probably moving through the theoretically closed border into Bangladesh.

Other, medium stature bamboo species are found in more restricted localities with higher rainfall. Several of these, such as *Cephalostachyum capitatum* and *Pseudostachyum polymorphum* are very high quality bamboos with particular local uses. Some have rare or threatened conservation status, and are indicators of highly biodiverse areas.

Above 1500m larger bamboos become scarcer. Forested areas and streamsides in degraded areas of the Shillong plateau have scattered clumps of small *Drepanostachyum* species, including *D. khasianum* above Shillong itself, while the spreading *Phyllostachys* species identified as *P. mannii* has been planted around cultivated land and homesteads on a substantial scale. These species are roughly interwoven and daubed with mud for house walling. *Phyllostachys* species also provides a valuable windbreak on the Shillong plateau and provides quite durable fencing material.

Other states of NE India contain similar bamboos, but in different proportions. It is understood that closer to the Burmese border, in Mizoram, Manipur and Tripura, *Melocanna baccifera* is even more prevalent, accounting for up to 80% of the standing crop. As the Meghalayan name for *Phyllostachys mannii* is Naga Bamboo, that species is probably more common in Nagaland.

2.2 Canes

Climbing thorny palms known as rattans or canes are certainly also abundant in a few areas below 1000m, although their identities, distributions and extent have never been studied. The largest species, with the highest economic importance in the North-east is *Calamus latifolius*. It forms the basis of the cane furniture industries in many areas, but it may have already been reduced substantially or eliminated in Meghalaya by over-exploitation. Up to 10 lower value species of smaller size may also be present. South Garo Hills is reported to be the district with the most cane. In Arunachal Pradesh, another large species, *Plectocomia himalayana* may also be of importance. Canes are currently almost exclusively natural in NE India, with cultivation a rare exception, because of complete or lack of experience or knowledge of propagation techniques, and inherent difficulties in managing and handling such spiny plants.

3. Development of the Resource

3.1 Developmental objective

Improving the management and use of bamboo and cane in the region to sustain basic needs and provide income for all sections of the local communities, noting IFAD's particular emphasis on improving the livelihoods of the rural poor, the need to conserve threatened biodiversity, and the poverty reduction focus of the forest policy of India.

3.2 Development potential

3.2.1 Supply Side

With a pre-existing and extensive bamboo resource base on which to draw there should be little immediate need for large-scale propagation of bamboos, although in the longer term it may be necessary to improve stocking levels, to vary the species mix to suit developing

utilisation requirements, and to re-establish stands after flowering events. This is fortunate, as there is apparently little present expertise or infrastructure available in either public, private or civil society sectors within Meghalaya to implement any such activities for indigenous bamboo species.

Although a program of planting bamboos on jhum land has been suggested in the past, there are certain problems with this. Firstly bamboos are present in such large quantities that planting more might not serve to produce the balanced diversification of crops considered appropriate given the variability in upland sites and markets. Secondly bamboos become abundant in much of the fallow jhumed areas without assistance anyway. Thirdly any establishment enterprise would have to compete with large existing supplies available more cheaply as they have no establishment costs.

The species in Meghalaya and the Northeast are eminently suitable for highly productive sustained management. The species indigenous to the region are easy to manage, with relatively open, uncongested clumps and no thorny branches. The technical aspects of bamboo management are fairly well understood throughout Asia, and Meghalaya would appear to be no exception. Removal of a fixed proportion of older culms each year or on a 2 or 3 year cycle maintains productivity, vigour and culm size. If access routes have to be made or repaired prior to extraction then removal of a larger proportion of culms on a longer rotation might be more economical. A balance is required between productivity, consistent large culm size, and cost of extraction, according to the requirements of the particular end-use. If edible shoots are being produced, then timing and the intensity of shoot removal have implications on productivity and other uses.

The present bamboo-bearing areas could apparently be much more intensively managed. The bamboos seen were only lightly exploited and not managed for maximum productivity. However the small number of areas visited was not sufficient for firm conclusions to be drawn. The total area currently holding bamboos and the high potential productivity of these species on these high quality sites would indicate a potential annual yield of around 2.5 million green tonnes without further plantings. Yields to be expected from the three most common species when properly managed in the NE would be in the region of 30-40 green tonnes per ha per year. Most of the bamboo forest elsewhere in India consists of tougher, low productivity species growing under adverse conditions of climate and heavy grazing pressure. Yields from *Dendrocalamus strictus* and *Bambusa bambos* in such forests may be as low as 2-5 tonnes per ha per year, although extraction costs would be lower on the relatively flatter sites on which they grow.

As a raw material for pulping alone this potential productivity should have a value in the order of IR 500 million per annum at the roadside. Scope for value addition is huge. As split bamboo ready for weaving and taken to the market the value apparently rises tenfold to IR 5 billion pa @ IR 5 per dry kg. Further value addition is possible according to skill levels and the amount of investment in cottage or small-scale industrial development that can be achieved. Supply of more refined products involves more complex issues specific to each potential product.

It is clear is that the biological and ecological potential to develop supply of bamboo for raw material and value-added products from within Meghalaya and the North-eastern Region is immense. Other complicated socio-economic and institutional factors are currently holding back the sustainable management and utilisation of this resource.

Sustaining supply of rattans is intrinsically much more difficult than sustaining supply of bamboos. Rattans are usually extracted along with the trees on which they find support, and they often represent a mere by-product of tree-felling operations. Management of these high-climbing, viciously spiny plants for sustained yield is rather difficult. Extraction of a single shoot of clumping species from tree branches is not easy. Some species produce just a single solitary shoot anyway, and are killed outright by harvesting. Unlike bamboos, which resprout well between jhum cycles, rattans do not have time to establish themselves and attain maximum size even in traditional long rotation jhuming, so that utilisable sizes may only be

found in undisturbed forest areas or those being well managed on a long rotation, which are currently dwindling in size.

Cultivation of rattans is nevertheless a possibility, and is practised in SE Asia and in S India. As the value of raw cane of good dimensions is relatively quite high, and a major cost in the production of furniture, the costs of raising and managing rattan plantations could be recouped. The best hope for managing rattan production is for it to be incorporated with the planting of long rotation timber crops. However, there is apparently little or no tradition of raising rattan plants in the NE region, and the amount of information available on identification, distribution and silviculture of species in the NE is extremely limited. Propagation is not a simple undertaking and seed cannot be stored. Collection of wild seedlings from the forest for cultivation elsewhere is not compatible with conservation.

Incorporation of just bamboo and rattans together in plantations is probably not feasible. Rattans require a long-term tree structure for support. Bamboos cannot provide that support, and regular extraction of bamboo culms becomes very difficult if rattans are abundant.

3.2.2 Demand side

Demand for basic bamboo pulping material in India is likely to increase greatly, subject to the future economics of the national and international pulp and paper industries. Information on this could not be obtained in Meghalaya or Delhi and further investigations are required. The pulp mills ought to provide a good market for areas with reasonable access. At an even more basic level bamboo is sometimes considered as a biomass crop for generation of electricity in some countries, with potentially unlimited demand.

Demand for bamboo poles for weaving into house walls in Bangladesh is very high indeed. Where road or river transport to the south is possible whole culms can easily be exported. Opinions differ as to the size of this market, but the price offered for unprocessed culms is low and consideration should be given to adding value by weaving prior to export.

A wide range of added value bamboo products have been suggested from previous in-depth product and market studies. A detailed and comprehensive 2 volume report of present and potential bamboo based products was prepared by North East Industrial and Technical Consultancy Organisation Ltd (NEITC) for the North East Council in 1998.

In more interior areas from where transport costs of bulky raw materials are prohibitive, several of these may be especially appropriate. The most basic conversion is the flattening of culms, followed by interweaving these into rough mats as a finished product for building construction. These steps require little skill and are immediately achievable. Weaving into more advanced mats after splitting and production of slivers requires more skill and time, but results in higher added value.

Simply woven mats, basketry and utensils for rural uses seem to bring in very low incomes and have a limited market, which is probably already saturated, as these can be made almost anywhere. One of several studies commissioned by UNDP this year prior to support interventions by UNIDO in utilisation of bamboos and canes in the Northeast found that some traditional handicraft products brought in startlingly abysmal returns for craftsmen, with incomes well below the government minimum wage for unskilled labour.

Production of higher quality woven utensils and ornaments for the tourist market is possible, but on a limited scale, subject to good design and marketing. Export of woven basketry outside India is not recommended, as the international market has abundant supplies of high quality low cost products from industrial scale operations elsewhere in Asia. Transport costs for such bulky lightweight low value items are an added problem.

Production of high quality mats as a precursor of further conversion into bonded and laminated board products elsewhere in the State has very high potential indeed, but requires considerable co-ordination of supply and demand. The market for durable construction

materials made from bamboo is very large. Aesthetically pleasing bamboo matboards can compete with timber-based plywood, and have the advantage of a green aura, coming from an environmentally sound, sustainably managed natural resource.

Preservation of edible bamboo shoots of certain species is a largely unexplored area with possibly the greatest potential for lucrative national and international marketing. Shoots are currently purchased for canning by Chinese entrepreneurs in Calcutta. Local canning facilities are already available and can be established quickly.

Demand for cane furniture is high domestically and internationally. Present skill levels are high in the region, and institutional training capacity could allow immediate expansion of small-scale furniture production units, subject to supply of raw material. NEITC, in Profiles of Tiny Sector Projects for the NE Region (1999) estimated that there was sufficient demand for the cane furniture industry to expand at 20% per annum, with an additional 40-50 units in the North East each year.

4. Issues relating to development of bamboo and cane

Clearly the potential demand for bamboo and cane products is sufficient for considerable expansion of the sector. Neither potential supply nor potential demand are constraints to the development of the bamboo resource, but increasing supply of rattans does seem to involve intrinsic difficulties in that sector.

If there is a lack of sound sustainable management and a low utilisation rate of bamboos at the present time, it suggests that there are currently serious constraints that have to be considered and addressed in the light of broader issues, relating to land use, forestry policy and administration, land ownership, HRD and economics.

Considerations such as whether India, or whether particular individual states should be exporting bamboos to certain countries are beyond the scope of this report, although they seem to be important constraints at the Central level.

4.1 Land-use… – integration on a micro-scale

The Northeast Region including Meghalaya shows considerable variation in land and land-use patterns, dictated by climatic, soil and slope, socio-economic and land tenure factors. The best climate, soil and slope conditions support permanent agriculture, intermediate areas are often managed under shifting cultivation, and the poorest areas, either too steep or too dry or with soil problems have either stayed under forest cover, or have been reduced to environmentally degraded areas.

One of the main issues in the Northeast would appear to be the widespread use of shifting (jhum) cultivation, and it has been suggested that bamboo cultivation might be a better alternative land-use. It would seem that at the present time extensive planted monocultures of bamboo are not appropriate in terms of maximising productivity and income from the highly variable sites presently under jhum cultivation. A gradual transition from jhum to more sustainable and more permanent land-use probably involves a gradual refinement of an intricate mosaic of crops. This would include bamboos within a broad package of timber, wood, non-wood and cash crops, aimed at reducing areas of arable cultivation and soil disturbance on slopes, while providing rural income generation to supplement cultivated food supplies.

Assessing which areas are appropriate for bamboos and would be better suited to other land-uses or crops on a micro-scale involves a multitude of technical decisions often best left to the stakeholders themselves. These decisions can only be considered properly on a case-by-case basis at the grassroots level. It is felt that optimising food security and income generation for the benefit of those living on the land will require an intricate mosaic of cropping patterns into which bamboo or cane would be adopted or incorporated on a micro-

scale rather than as a broad-scale prescription. This requires control over land and its use by the stakeholders, and a detailed renewable resource management plan for each area, developed at length by the stakeholders themselves, but with some external motivation and assistance. The technical feasibility of this approach is not in question. Models of transition from shifting to permanent cultivation can be followed, particularly the IDRC-sponsored model from Nagaland.

Nevertheless, bamboos seem particularly appropriate as a permanent crop on steeper slopes where surface soil erosion or minor landslides are a threat to adjacent land or infrastructure, particularly along watercourses and roads. They are also particularly appropriate on boundaries, at the margins of cultivated land and as windbreaks in some areas. On shallow soils and stony sites they are less appropriate unless moisture is not a limiting factor. If not too dense they are suitable as a fallow crop in areas of sustainable shifting cultivation as they re-establish quickly and recycle nutrients rapidly.

On areas of degraded land bamboos would only be successful if underplanted after the establishment of more resilient pioneer species such as pines, eucalypts or alder as a nurse crop, and the management and protection of the resultant mixed crop for the understorey, not the trees, which may be a difficult concept to instil.

Grazing of livestock and fire during the artificial or natural regeneration of bamboos is an issue that should be considered, as delicate and palatable plants can easily be destroyed while still young. New bamboo shoots are readily broken by livestock in the summer so that bamboos are not suitable where free-grazing is to be practised. However, if tall offsets of bamboo are planted they can be successful without fencing or protection where other palatable plants would soon be destroyed.

During replacement of jhum cultivation with more intensive, permanent forms of agriculture, re-establishment of soil structure and fertility is an issue of critical importance. Nutrients are transferred from non-cultivated to cultivated land in a spatial rather than temporal manner, and they are generally best transferred through manure from an expanded collection of stall-fed livestock. This requires cultivation or collection of fodder, often from woody plants at certain times of year, and bamboos provide one of the most nutritious and palatable forms of fodder available from any woody plant. In this way bamboos could form a valuable component of a broad-based intervention following a farming systems approach, rather than forestry alone.

Canes should be restricted to sites where long-term tree support is available, and where frequent access is not necessary.

4.2 Land tenure…. – ensuring equitable returns and encouraging better land management

Bamboos and canes are no different from other crops in that sound management is largely dependent upon security of ownership of, or at the very least formalised guaranteed long-term access to the resource by stakeholders who wish to make direct use of it. However, it may be noted that in areas where this is not achievable for certain reasons, bamboos by their natural coppicing ability are more likely to recover quickly after moderate abuse than most tree species.

At the present time it is not apparent that development of bamboos will bring large financial returns. There may not be sufficient profit in bamboo production if benefits have to be shared between landowners and tenants or landless labourers, as well as a series of middlemen, officials as well as industrial entrepreneurs and even insurgents, especially if adverse land-ownership discourages good management in the first place. As an incentive to sound sustainable management of bamboo crops and to ensure equitable returns for stakeholders, land tenure is clearly an issue of paramount importance.

It is understood that although many reports have outlined a predominantly communal ownership of land in Meghalaya, over the past decades the majority of areas rich in bamboos

have passed into individual private ownership. It is apparent that the poorer sections of the community may have not always been included in this process, and it also appears that there are no ceilings on individual land ownership. One report to UNDP this year studied problems facing groups of bamboo and cane craftspeople. It found that most of the land in each of 5 villages in Meghalaya was owned by a single person. This made it difficult for artisans to grow their own bamboo, and not surprisingly the existing bamboo and cane resources were not being managed in a sustainable manner, so that raw material supply and high cost has become a serious constraint. Other reports suggest a slightly less feudal system elsewhere, but inequitable land distribution is probably a serious constraint in most areas. The effects of this on the viability of investing in the forestry and bamboo sectors, and whether sufficient benefit would accrue to the poorer sections of the community would require careful consideration.

4.3 Integration of institutional activities

Many institutions would need to become more actively involved in broad development of sustainable management and utilisation of bamboo and cane. These institutions can be separated into those whose activities are connected more with supply, and those more involved in the use of or demand for bamboos. All the various institutions need to function in a collaborative way for ventures such as bamboo/cane to succeed. This would seem to require the overall supervision of an umbrella institution such as the NEC. Many natural resource projects require considerable infrastructural developments for them to become effective, and the inclusion of activities within an integrated development philosophy may be highly beneficial.

The demand side of bamboo and cane development is currently being addressed by UNDP/UNIDO Project IND/97/160, Cane & Bamboo Technological Upgrading and Networking, implemented through the Department of Science & Technology, with INBAR co-opted for technical backstopping. Therefore the supply side is given more consideration here.

At present there are few institutions with active natural resource extension capability in public, private or civil society sectors. The ongoing IFAD project is concentrating efforts on local grass roots capacity building at the moment, and is not likely to reach the point of involving line departments for quite some time, although the incorporation of NGOs is underway for field activities. The success of this programme and its natural resource management groups (NRMGs) is considered to be of paramount importance to improving eventual natural resource management, including bamboo and cane activities. The model of participatory natural resource mapping and planning should be the foundation for any further IFAD activities in the natural resources sector.

Involvement of truly representative and respected traditional local authorities would help to formalise such activities, at the same time giving strength to those traditional institutions. However, considerable reform of those institutions might be required, including attention to gender issues, and formalising the detailed recording of proceedings and decisions with respect to land. Although the local autonomous district councils are often considered to have authority over the bamboo forests of Meghalaya, it would seem that as most of the forest is now in private rather than communal hands, their role is currently being questioned.

Considerable institutional capacity building is evidently required, as extension activities are not presently effective. It might be helpful to incorporate the extension activities of the agriculture, forestry, livestock, and horticulture departments under one mechanism. The establishment of local natural resource centres might be considered. These could provide a one stop entry point to the currently highly dispersed services of the various line departments.

4.4 Economic… – broad scale sectoral and regional factors

At the present time pulp mills provide the main demand for bamboo in the Northeast. The economics of pulp and paper are beyond the scope of this report, but certain suspicions

require closer investigation, as by setting a value for the most basic but most widely utilised bamboo material pulp mills influence the entire bamboo sector.

Most of the bamboo forests in mainland India produce low quality culms from relatively unproductive species growing naturally with little management or input in government-owned forest, often on inherently unproductive sites. This is in stark contrast to the situation in the Northeast.

It may well be that the prices paid by the pulp mills are still artificially low, and are not representative of the real value of the resource. This certainly has been the case in the past, when concessionary rates were given to pulpmills. However, if international pulp and paper prices are particularly low for various reasons, low raw material prices might be keeping the industry viable in India.

If this were so then the industry would be subsidised in a manner that discourages any improved management of bamboos to boost productivity, and prevents profitable exploitation of privately owned bamboos, especially in less accessible localities where transport costs are higher, thus preventing owners of bamboo in more remote areas from benefiting from an important or even principal renewable natural resource. Other means of supporting the Indian pulp and paper industries such as tariffs on imports from non-sustainably managed sources of pulp and paper elsewhere in the world might be more conducive to sustaining bamboo-related livelihoods in the Northeast.

Present incentives to production in the region include subsidised transport costs within and to/from the region. Whether these are sufficient to encourage activities is a further issue. It has been reported that the subsidies are difficult to obtain in reality. For bamboo and cane as opposed to timber, transport is a particular concern as the materials and the end products are relatively light and more expensive to transport. The use of techniques to make products more compact may be important. This could involve the use of mobile chippers to reduce volume for pulping material, or the design of cane furniture that stacks well.

4.5 Socio-economic… – basic needs, equitable returns, social marketing and inward investment

Development of the utilisation of a material such as bamboo that currently supplies basic housing needs for the rural poor could have the potential to disadvantage vulnerable groups unless carefully planned. Community supplies of bamboo should be ensured before developing private exploitation of the resource.

All bamboo enterprises involve marketing and this should be arranged to maximise returns for the producers and reduce exploitation by traders. If bamboos are currently unproductive and under-utilised one reason may be that too many people expect to profit from them. If landowners, cultivators, harvesters, officials, middlemen and entrepreneurs all require their cut, then an entire enterprise can ground to a halt. Moreover, if forest produce is seen as a means of raising funds for local politics then this is another serious constraint to sound land use. On the other hand, establishing community and small scale farmers' land-ownership rights, and effective co-operative marketing can exclude some of the vested interests and allow producers to recoup more realistic returns.

Development of the use of bamboos should not be based upon a model of landless labourers dependent upon one source of employment and a resource out of their own control. One plan for production of bamboo mat board in Meghalaya suggested employment of 40,000 village weavers across the State, buying bamboo and each earning IR 75 per day, together producing 100 tons of woven mats every day for collection. With incentives and subsidies, an expected internal rate of return of more than 50% for this venture was highly attractive for the potential investors. One issue that requires consideration is whether the benefits of such an arrangement for rural populations in Meghalaya would be sufficient for them to take up such a form of employment on a large enough scale to make the venture viable. While some people

would appreciate a low cash income, others already involved in other activities might hesitate before abandoning them to become full-time weavers of bamboo mats. Sufficient mechanisation of the mat production processes might be necessary to raise daily income rates for the weavers, before they considered taking up this occupation on any scale. Even then, they might still prefer to grow, harvest and sell the bamboo for weaving elsewhere. Highly labour-intensive semi-industrial occupations are not generally appealing to hill farmers.

Production of ornamental bamboo handicrafts is well suited to assistance with design and marketing in more exclusive and lucrative markets, especially on a 'fair trade' basis. It is not clear that the market for handicrafts is unlimited however. Purchase of ornamental handicrafts by urban middle classes is often a form of charity to some extent, and such items may not form a wise basis for too large an industry.

Another issue that should be considered is that handicrafts are often reserved as an effective means to channel resources and rewards to the most severely disadvantaged groups in society. In this way for example, embryonic women's groups, those with handicaps, and more recently young prostitutes with AIDS returning to the villages have been effectively assisted through well designed and well marketed handicrafts in certain countries.

4.6 Flowering of bamboos.. – interruption of supply and regeneration

Bamboos have a characteristic habit of cyclical flowering after a period of vegetative growth lasting up to 150 years for some species. This leads to remarkably high productivity in terms of woody stems throughout the vegetative period, without wastage of growth potential on flower production. However, for some species it leads to severe interruption of production for a period of several years, both during the eventual flowering event and during the subsequent re-establishment of full-size clumps or stands from seedlings or surviving underground rhizomes. For this reason, reliance should not be placed upon one species of bamboo alone, and accurate scientific knowledge of the identities of the species cultivated and their precise flowering habits would be highly beneficial. It is not clear that such scientific knowledge exists at the present time.

It is understood that some authorities expect the spreading species *Melocanna baccifera* to flower over the next few years. It has been suggested that the availability of huge volumes of dying culms should be exploited commercially as a matter of urgency. However, large-scale utilisation of a species likely to flower in the near future might not be conducive to steady sustainable development, or making the best use of the considerable investment requirement in technology, institutional arrangements, and human resources. It might be more appropriate to channel limited public resources to a sustainably developing resource base, and to use a major flowering event as an opportunity to regenerate more widely, to plant different crops if appropriate, and to plan effectively for future management.

4.7 Research – local, regional and international

The knowledge base concerning bamboos and canes in the region is evidently a constraint to efficient management, utilisation and conservation of the bamboo and cane resource, particularly so for canes.

Precise information on matters of plant growth is dependent upon accurate identification of the species involved. Identification of bamboos and canes has been abysmal in the past and remains at best sketchy now in the Northeast. Flowering information is especially dependant upon sound identification of species, and this was particularly unreliable in historic time-periods when the last flowering events occurred. Therefore, much of our information on flowering habits of indigenous bamboos is rather unreliable. Much other technical knowledge in both production and utilisation areas is based upon situations abroad or in mainland India, and may require adaptation to the situations prevalent in the Northeast.

All areas from identification and conservation through flowering, silviculture and management to utilisation require adaptive and sometimes fundamental research inputs. However, some of these would fall outside the scope of a supply-side project. For example, it has been suggested that the most basic equipment for splitting and slivering indigenous bamboos is still not available. Imported machinery is apparently not suitable for Indian bamboos, and adaptive research is still required to provide suitable equipment to replace hand splitting, slivering and manual weaving, all of which can now be automated in China.

As stocks of large diameter cane diminish, there may be a need to incorporate bamboo components into cane furniture instead. This will require a research and design component for the hybrid furniture. Local personnel and institutions would benefit greatly from support and exposure to collaborative research and development approaches on a regional and international basis.

4.8 Training… – many aspects, at all levels

In the North-east lack of technical knowledge at nearly all levels is a major constraint to development of renewable forest resources. Important developments abroad and in mainland India are not well understood. Broad issues such as land tenure, rural development, participatory forest management, and gender seem to have received little attention. Specific knowledge among line department, local council and NGO staff is lacking on general matters such as extension or integrated land management and farming systems approaches. Detailed knowledge of matters such as bamboo and cane identification, or sustained management and propagation of bamboos and canes is also lacking. There is also a lack of training of artisans, although this is currently being addressed by a UNDP/UNIDO project. The embryonic state of the more advanced bamboo–based industries such as laminated board, flooring and structural components and bamboo shoot preservation means that training in skills relevant to these industries will also be required in the future.

Long-term reorientation, training and institutional capacity building will obviously have to be a large component of future bamboo and cane development activities in order to tackle these major constraints. Institutional development and integration is required from the grass roots through local government (which requires reform) to state government, line agencies and NGOs, before sound management and sustainable exploitation of bamboo and cane resources can be expected.

5. Suggested follow up investigations

5.1 Prior to project start-up

Investigate legal standing and jurisdiction of dorbars, Autonomous District Councils, and survey sample localities for current land ownership patterns and trends.

Undertake more detailed species and distribution inventory for forest trees, bamboos and canes, and NTFPs of the Northeast – firming up knowledge of what is here and where it grows, what can be exploited safely and what needs protecting.

Commission more detailed economic market research for expanded production of both present and new products – e.g. making sure that manufacture of bamboo and cane products is economically viable, and will bring tangible benefits by sustaining rural livelihoods, culture, and the environment.

5.2 Later investigations

A species by species investigation of the requirements and silviculture of major bamboos and canes is required.

Incorporation of these into farming systems models for the Northeast could be appropriate.

Adaptive research could involve interaction between line departments including Silviculture Wing of the Forestry Department, Agriculture Department, Livestock Department, local and regional research institutions including BSI, NEHU, as well as the international agencies including INBAR, IDRC in Nagaland, UNDP/UNIDO, and other relevant CG network members.

5.3 Terms of reference for follow-up investigations

1. Land ownership and access

- Document the historic and current legal position on land ownership and tenure in the different states of North-east India.
- Investigate broad issues concerning private and communal land-ownership, tenancies and use of land.
- Quantify approximate ownership and tenancy of lands within a selective sample of villages in Meghalaya.
- Determine any district-wise patterns and trends.
- Assess how changes in legislation have affected traditional patterns of land ownership and use.
- Compare the situation in the North-east to current land-ownership elsewhere in India and in other countries of the region.
- Consider how documentation of land ownership and tenancies at village level could help to improve security of tenure for poorer sections of indigenous village communities.

2. Timber & NTFP species & ethnobotanical enumeration

- Through village-level participation and direct investigation, document all naturally-occurring plants currently being exploited on a significant scale from forest and marginal land for timber, wood, non-wood forest products, food, medicinal value or other purposes.
- Assess the approximate relative scale of current exploitation, relative abundance or scarcity, sustainability of extraction, and economic or other benefits.
- List major species of forest trees and other non-agricultural and non-horticultural crops currently being planted, and assess their relative economic or other values.
- List species of indigenous bamboos and canes, assess approximate distribution and uses, and gather information on past flowering behaviour.
- For plants of uncertain identity make appropriate herbarium collections and deposit at BSI Shillong for later investigations.
- Collate findings in appropriate formats.

3. Market research for major new products

- Qualify national and international markets for major new potential crops and products, and estimate current market prices.
- Assess raw material and production costs.
- Calculate returns on investment under different production scenarios bringing value-addition closer to cultivation sites.
- Investigate transport elements in costs and possible assistance from regional subsidisation of transport.
- Compare returns for different existing and potential crops and products.
- Assess training requirements for producers.

6. Implementation possibilities – some possible avenues of implementation

A. District Natural Resource Centres – could be administered under NEC

- channelling inputs of credit, planting materials, supplies, to the villages through links to institutions, line departments, extension services etc.
- feedback to NEC on infrastructural needs
- feedback to institutions/line departments on credit/extension needs
- request and review forest and land-use management plans from NRM groups
- provide information on markets, prices, and transport
- refer land disputes to Autonomous District Councils

B. Village Natural Resource Management Groups – could be arranged and administered by traditional village councils and dorbars under Syiems

- map land resources
- map ownership
- record tenancy agreements
- record community rights
- review changes in land use
- produce forest and land-use management plans
- requests to District Natural Resource Centres

C. Line departments - institutional capacity building

- reorientation as required according to current perspectives
- training including regional study tours and secondment of senior officials abroad
- additional staffing as required including expatriate technical assistance
- curriculum development for national training institutions
- operational costs for additional responsibilities
- capital equipment

D. NEC

- pursuing service provision from line departments for natural resource centres
- inter-state infrastructural improvements for trade & communication within NE
- international trade & collaboration within region
- commissioning of research - fundamental adaptive & collaborative
- itself might benefit from civil service training inputs & technical assistance?

E. Research Institutions and Universities

- postgraduate scholarships
- international exchanges & travel
- commissioned research
- curriculum development

F. Tsangpo/Brahmaputra Watershed Regional Development Scheme

Develop a regional program of activities, encompassing several neighbouring territories from the Tsangpo/Brahmaputra watershed, including Nepal, West Bengal, Sikkim, Bhutan, North-east India, Tibetan Autonomous Region of China & Bangladesh. This could tap on benefits and synergisms accruing from regional/across boundaries understanding, scientific collaboration, communication and trade.

Benefits would stem from activities such as:

- improving communications and infrastructure for transport and marketing of goods
- improving knowledge base and exchange of information on agriculture, management of forests, fisheries, wildlife etc.
- scientific collaboration/exchange of experts, ideas, best practices etc.
- exchange of genetic material for tree species, bamboos, medicinal plants, canes etc.

Areas of collaboration could aim to improve land management systems for upland agriculture, forestry development, wildlife conservation and stimulation of ecotourism.

The institutional arrangements should make best use of existing international networks and institutions including ICIMOD in Kathmandu, IDRC in Delhi and INBAR in China.

Annex 1 Bamboo Species Inventories

Species enumerations

Different reports have included many different species identifications and compositions, often in a mutually incompatible or contradictory manner. Similarly, the reporting of uses and distributions has been less than satisfactory.

This is not surprising, as literature available on Indian bamboos is inaccurate, itself contradictory, and usually does not contain sufficient information for field recognition. A thorough revision of the bamboos of India has in fact not been undertaken since 1896, and the bamboos of the Northeast remain the least well known in the country. Botanical Survey of India (BSI) in Shillong was not willing to meet with the IFAD team while they were there, but they have expertise in grass taxonomy. They might appreciate an opportunity to become involved in taxonomic and ethno-botanic research on the basis of national and international collaboration. INBAR recently commissioned a Compendium of Indian Bamboos by Kerala Forest Research Institute, but although coverage of the bamboos of South India was up to date, knowledge of the bamboos of other parts of India was less detailed.

Tewari (1993) listed 63 species for the Northeast, and 33 for Meghalaya (see below). The Silviculture Wing of the Forestry Department in Meghalaya reported that they thought that 22 different species were present in the state, although they could not be scientifically identified. Forestry Department inventories have not distinguished between the bamboo species except to categorize them as clump-forming or non clump-forming ones. The plot enumeration form (PEF) requires a species name for bamboos, but without any identification guide that is evidently not possible.

The bamboos commonly planted in mainland India, *Dendrocalamus strictus* and *Bambusa bambos* (syn. *Bambusa arundinacea*) are probably not indigenous to the Northeast, and were not seen during the mission.

Species seen during brief field trips are listed in Appendix 1.

Bamboos of Meghalaya (from D.N. Tewari, A Monograph of Bamboos, 1993)

Bambusa jaintiana
B. khasiana
B. pallida
B. polymorpha
B. pseudopallida
B. teres
B. tulda
Cephalostachyum capitatum
C. fuchsianum
C. pallidum
Chimonobambusa callosa
Chimonocalamus griffithiana
Dendrocalamus calostachyus
D. hamiltonii
D. hookeri
D. sikkimensis (Garo hills)
Drepanostachyum hookerianum
D. intermedium
D. khasianum
D. kurzii
D. polystachyum
D. suberectum
Gigantochloa albociliata
G. apus (Garo hills)
G. macrostachya (Garo hills)
Neomicrocalamus mannii (Jaintia hills)
N. prainii
Phyllostachys mannii
Teinostachyum dulloa
T. griffithii
T. helferi
Yushania hirsuta
Y. microphylla

Appendix 1 Bamboos encountered during field visits

A - The three most common indigenous species

1. Dendrocalamus hamiltonii (Local name in Ri-Bhoi *Kokai*; in Nongpdeng *Seij Khlaw*)

This tall pendulous thin-walled clump-forming bamboo is the principal natural species of the outer Siwalik hills of the Himalayan range and continues through low hills of NE India, Burma and Bangladesh.

Recognition is by the matt green culms, the sparse patchy culm sheath hairs, triangular culm sheath ligule, dentate centrally arcuate culm sheath ligule, and the long leaf sheath ligule. The central branches are very large, and arise vertically from the arching culms.

Confusion with *Dendrocalamus strictus* has led to it being identified as that species in some reports. The characteristics above separate it readily from that species, which is shorter, much more erect, and has thick-walled or even solid culms.

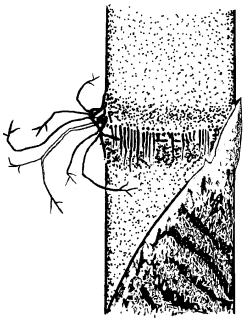
D. hamiltonii has thin walls, making it less useful as a species for construction, but good for weaving, and the shoots have the best flavour of all Indian bamboos, and are widely harvested. The large leaves are also widely used as a source of animal fodder in the winter.

A marked distinction is seen between clumps managed for culms, which have relatively well separated culms, and those managed for shoot production, which are consequently dense and congested, with no young culms on the outside.

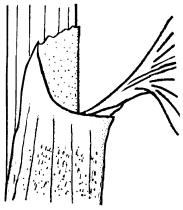
Different varieties of this species are found, some reportedly giving better edible shoots than others. Further identification is required to ascertain which particular variety or varieties are present in Meghalaya.

The variable flowering habit of this species is well documented. Gregarious flowerings over a restricted area of one or several districts occur every 30 or so years. In addition sporadic flowerings of a few culms within a clump, a single clump or several clumps frequently occur within the vegetative phase. Seed production is usually good, even from sporadic flowerings. Natural regeneration was seen in protected forest (Ri-Bhoi District).

In addition to suitability for traditional weaving, culms of this species are suitable for splitting into slivers for mat board, and the shoots are eminently suitable for preservation.



Culm and culm sheath of *D. hamiltonii*



Leaf sheath with long ligule

2. Melocanna baccifera (Local name in Nongpdeng: *Tyrlaw*)

This medium height very straight thin-walled spreading bamboo forms large stands rather than separate clumps. It is most abundant in Bangladesh and Burma.

Recognition is by the very distinctive culm sheaths, with a few large corrugations towards the top and a very large sword-shaped reflexed blade. The culm internodes are long and the branches are small and uniform in size. The rhizome has a long neck that is thinner than the culm but is thick below the base of the culm (pachymorph).

It might be confused with the other spreading bamboo in Meghalaya, *Phyllostachys mannii*, but that bamboo is generally smaller and has only two branches at each node.

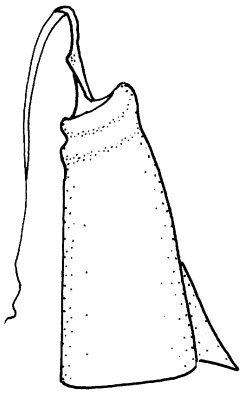
The fruits of this species are peculiar for a bamboo, being large, almost the size and shape of a small pear. They cannot be stored, and germination often takes place while the fruit is still attached to the parent plant.

M. baccifera has thin walls, making it less useful as a species for construction, but good for weaving, especially as the internodes are long and the branching is light so that the culm nodes are not swollen.

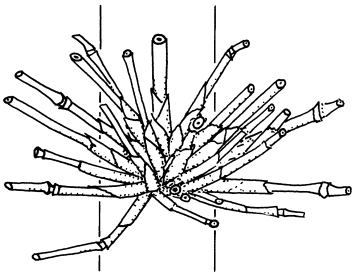
Because this is a spreading bamboo it has very upright culms. This makes it more suitable for certain purposes where the curving nature of culms from clump-forming bamboos is a disadvantage.

In addition to suitability for traditional weaving, culms of this species are very suitable for splitting into slivers for mat board. The shoots are not edible. This species is highly regarded for production of pulp for paper manufacture, and is considered the most desirable bamboo species by local pulp mills.

This species is reported to die after flowering. Estimates of the time between flowering cycles range from 30 to 60 years. Blatter reported in 1929-30 that 'the data at present available are not sufficient to justify any definite conclusions' and it does not seem that knowledge of its flowering behaviour is any better now..



Culm sheath of *Melocanna baccifera*



Mid-culm branching

3. Bambusa nutans subsp. cupulata (Local name in Ri-Bhoi *Jathi*; in Nongpdeng *Rynnai*)

This tall thick-walled clump-forming species is the principal *Bambusa* species of the entire Himalayan range and continues through the Brahmaputra Valley and down to the Bay of Bengal, and right through the low hills of NE India and Burma.

Two subspecies are known. The eastern subspecies was once described as a separate species and given the name *Bambusa teres*, but that name was hardly ever used. It has nearly always been known in the NE Himalaya and NE India as *Bambusa nutans* (other local names *Mal Bans*, *Makla Bans*), so now it is recognized as a subspecies within that species rather than changing to the name *B. teres*.

It is distinguished from the western subspecies, which is found from Dehra Dun to Malangwa in the Nepalese terai, by the large, cupped, deciduous culm sheath blades that give it the subspecies name *cupulata*. It has unfortunately been misidentified on many occasions as *Bambusa tulda*, an inferior species rarely found in the hills.

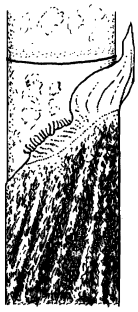
As well as having large cupped culm sheath blades, the culm sheath has jet-black hairs, and broad, rather oblong auricles with long wavy bristles. Culm nodes have white rings above.

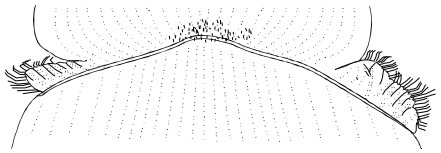
Culms of this species are quite thick-walled, but not subsolid, and the internodes are quite long and very straight. This makes it a versatile species, with culms that are strong enough for constructional purposes, but still usable for weaving rough basketry and mats for rural purposes.

This is the most widely planted bamboo of the region, cultivated around houses for constructional material to supplement thin-walled bamboos found growing naturally.

This is another excellent bamboo, which is suitable for both ancient and modern end-uses. The shoots are very bitter, however, and the leaves are small, making it less than ideal for supplying animal fodder. It tolerates drier sites than other indigenous bamboos.

Little is known of the flowering habits of this bamboo, as its identification has been unreliable in the past. It does not seem to flower sporadically and seed has rarely been seen.





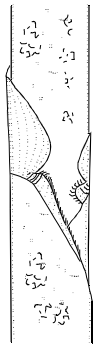
Culm sheath of *Bambusa nutans* subspecies *cupulata*

B. Other less common indigenous bamboos

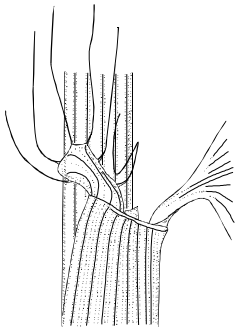
4. Bambusa jaintiana (Local name in Nongpdeng: *Shken*)

This is a smaller stature *Bambusa* species, only reaching 10m in height and 4cm in diameter, but with larger leaves than those of *B. nutans*.

Uses are not known in detail, but this is similar to the Chinese bamboo known as Weavers' Bamboo, *Bambusa tuldoides*, and this is presumably also a good species for weaving, having long internodes, straight culms, and relatively light branching. Identification is by the narrow culms without a white ring above the nodes, the culm sheath auricles, which are often very long, and the tall white bristles on the leaf sheaths.



Culm and culm sheath of *B. jaintiana*



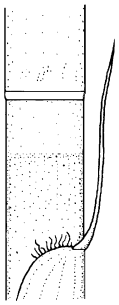
leaf sheath with tall bristles

5. Cephalostachyum capitatum (Local name in Nongpdeng: *Laa*)

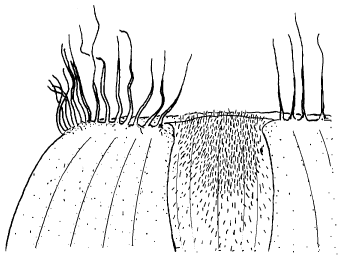
This is another medium stature clump-forming species, with smaller, thinner-walled culms than *B. jaintiana*. The culm sheath has a row of erect bristles at the top on each side, and the reflexed blade has dense hairs inside.

Culms are smooth, with very long internodes, and are readily split or crushed to make mats. This is reportedly the most desirable species for mat weavers from Assam, but it is not known how abundant the species is. As the local name in Assam for this bamboo is *Dulloo Bans*, it has usually been assumed that the species is *Teinostachyum dullooa*, but in fact that unfortunately named species actually comes from Burma, where it has a different local name altogether.

It is not clear whether this species would have large enough culms for making slivers for bamboo mat board.

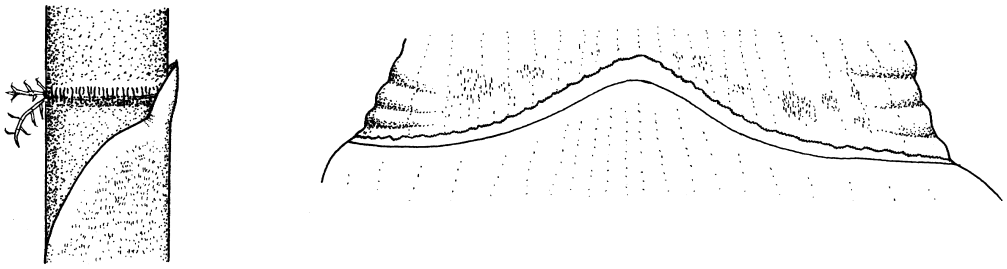


Culm and culm sheath of *C. capitatum*



C. Other important indigenous species of which only the culms have been seen (identification very tentative)

6. Bambusa balcooa ? - a strong thick-walled bamboo known as *Skong* in Nongpdeng.



Culm and culm sheath of *B. balcooa*

7. Pseudostachyum polymorphum ? – an extremely thin-walled spreading bamboo with short internodes, known as *Tyr Aa* in Nongpdeng.

Culm and culm sheath of *Pseudostachyum polymorphum*

D. Other small indigenous bamboos

A large number of smaller bamboos are found in Meghalaya including ***Drepanostachyum khasianum*** and ***Yushania hirsuta***, both of which were seen near Shillong. Such bamboos are highly localized and some may already be threatened with extinction by the deforestation of their natural habitats. Further study is required to decide the correct names for such small bamboos and whether they should be exploited or protected.

E. Non-indigenous bamboos in Meghalaya

Phyllostachys mannii – Local name *Seij Naga*. This is a spreading bamboo that reaches a height of 12m and a diameter of 4 cm, widely planted on the Shillong Plateau, especially as hedging.

Other bamboos, from China, Indo-China and Japan, planted for purely ornamental value were also seen in Meghalaya, including ***Phyllostachys nigra***, ***Bambusa multiplex*** (Cultivars 'Fernleaf', 'Rivierorum', and 'Whitestripe'), ***Bambusa striata*** (*Bambusa vulgaris* var *striata*), ***Pleioblastus viridistriatus***, ***Pleioblastus hindsii***, and ***Pseudosasa japonica***.