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## CULTIVATION OF BAMBOOS IN PAKISTAN

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### INTRODUCTION

The bamboos are perennial gigantic grasses which are versatile and graceful group of plants and are of multiple utility. About 14 million hectares of the earth surface is covered by bamboo forests with 80 percent of their total area falling in Asia. They are well represented in all continents except Europe and their distribution extend from 15° North latitude in Japan to 47° South latitude in South Argentina in the areas of Tropic of Cancer and Tropic of Capricorn. The altitudinal range is from just above the sea level upto 4000 meters. The natural distribution of bamboos all over the world follows the distribution of rainfall. However, temperature also affects it to some extent. The total number of bamboo species worldwide is 1250, out of which Asia has 900 species. Almost all countries of Asia have either natural forests or man-made plantations of bamboo. In Asia the widespread distribution of some bamboo species parallel man's past migration. Bamboo may also have travelled along the several ancient maritime spice routes between China, Indonesia, Sri Lanka and India.

The culms are the main parts of a bamboo plant utilized for various purposes by man since the prehistoric age. The major uses of bamboo are in the manufacture of pulp, paper and rayon, house construction, scaffolding, ladders, poles and posts, furniture and fancy goods. Items of every day use which are made of bamboos are; handles, brushes, pipes, fans, umbrellas, toys, kites, musical instruments, spears, lanceshafts, bows, arrows, torches, caps, baskets and wicker works. Shoots

of some varieties are eaten in boiled form or as pickles. In fact it is known as **poor man's friend**, **poor man's timber** and **green gold**. Bamboo has many in born qualities. The fast rate of growth has made it very popular in the areas suffering from wood famine. It is in this context that bamboos assume special significance, particularly due to the following reasons:

- i. Bamboo is a fast growing plant among woody species (8-35 m in 2-3 months), attaining harvestable maturity in less than five years.
- ii. Plantation technology for large scale cultivation of bamboo is known. It seeds very rarely. However, standard planting practices have been developed with culm cuttings of mature stems.
- iii. Bamboo plant produces a number of culms year after year and no planting is needed after cutting.
- iv. Despite its vigorous and invasive growth habit, it is "environmentally friendly" in comparison to some *Eucalyptus* species.
- v. Highly elastic, allows to resist wind pressure and spring back when the stress is over.
- vi. Straight and cylindrical stem, light, hollow but hard and strong.
- vii. Stems of different diameter (1.0 - 25 cm) and wall thickness (1.0 - 1.63 cm).



- viii. Possesses long fibre (2.3 - 3 mm) with maximum amount of cellulose.
- ix. Excellent splitting ability in straight lines.

### Growth Habits

The bamboos are characterized by woody pointed stems, commonly called culms, arising from their rhizomes, which are also woody. Generally rhizomes are densely clustered so that culms grow in clumps. The growth of culm is very rapid, 7.5 to 40 cms or 3 to 16 inches per day depending upon the species. A clump usually bears 30-100 culms. Before rainy season, about 10 large and 30-50 small culms appear. Bamboo does not acquire girth as it grows; the new sprouts emerge with full diameter. It also reaches full height in 60-90 days. The culms are smooth, hollow and have transverse septa at nodes. Fully mature culms may have upto 30 cms or 12" girth.

Most species with large natural ranges are genetically likely to be variable. Such variation may be present in the following categories:

- geographic variation
- sites with in provenances
- stands within sites
- individual plants within stands

Most crop plants have long history of selection and domestication and thus have restricted genetic base. Forest trees especially bamboo on the other hand have only recently or never been domesticated, selected or bred. The above variation in bamboo can be used for their productivity improvement.

The bamboos flower once in their life

time, and die out soon after flowering. Flowering usually takes place at 25-50 years interval. Once a species starts flowering, all the plants belonging to that family will flower in the whole of the locality. The indication of flowering to start is that the clumps do not add any new culms in the year prior to flowering, which depends upon both age of clump and on climatic conditions. Its seed germinates readily and seedlings can be transplanted easily.

Ordinarily culms do not bear any branches for considerable height above the base. But the culms of *Dendrocalamus hamiltonii* and *Oxytenanthera albociliata* have very large and prominent branches. *Bambusa arundinacea* and *Bambusa tulda* also have branchlets, which are arranged in dense clusters.

### Natural Occurrence of Bamboo in Pakistan

*Dendrocalamus strictus* is a tropical bamboo species. It is extremely rare and is known to have occurred naturally only at few places in Pakistan. It was recorded in the past in the Margalla Hills, Chattar, eastern Salt Range, Shahpur and Mirpur upto an altitude of 800 meter. A few clumps of this species were also growing naturally in Ambela, Maskipur and Bagra in Buner at about 800 meter elevation. The first two spots lie on raised stream banks with some damp soil and the third on a field border. These were the only known remnants of natural bamboo in the country. This record extended the western geographical limit of this bamboo from Margalla Hills to lower Buner.

All these sites lie at the lower most altitudinal limit of Chir pine at 700-800 m. This indicates that bamboo used to grow as a scattered undergrowth in forest zones, lying immediately below the chir pine forests, occupying altitudes between 350-800 m, which



is now much degraded and modified. The bamboo was, therefore, much more widespread in the country in olden times than it appears today.

It appears that people in Pakistan were unaware of the utility and importance of bamboo, so the natural groves were cut and removed. Fire also played a part in its elimination, supplemented with grazing and increasing drought. Whatever be the reason, bamboo suffered greatly at the hands of man, his agents and drought. However, it indicates the prospects bamboo has in the country.

Efforts were made in the eighties to introduce different species of bamboos from Bangladesh, China, Sri Lanka and Thailand into Pakistan. Some of them are well adapted to climatic conditions in Punjab. 21 species were introduced from Bangladesh and 4 species from Thailand and China. Some of the most outstanding species in this regards are; *Dendrocalamus giganteus*, *Dendrocalamus strictus*, *Bambusa arundinacea*, *Bambusa tulda*, *Dendrocalamus hamiltonii*, *Bambusa vulgaris*, *Dendrocalamus longispatus* and the ornamental species *Phyllostachys aurea*. About 8800 ha were planted with bamboo upto 1986.

#### Description of Some Species of Bamboo Introduced in Pakistan

According to available records, the following bamboo species have been introduced in Pakistan over the years to a variable extent. Some species, such, *Dendrocalamus hamiltonii* have been planted on a large scale by the farmers while others grow in small scattered patches in gardens, orchards, homes, etc. all over the country. Their identification is rather difficult.

#### 1. *Bambusa arundinacea* (The thorny Bamboo).

A tall, thorny bamboo, with a thick central root stock, bearing bright green shining culms, 24-30 m high and 15-18 cm in diameter. It generally flowers gregariously, once in about 30 years. The clumps then die out after producing an abundant crop of seed. The species is wild throughout the greater part of India, Sri Lanka, Thailand and Myanmar (Burma). Two forms of the species have been recognised on the basis of geographical location. These are:

- i. Tall handsome large culm type
- ii. Dwarf, thick-branched and very thorny small culm type

It grows rapidly, with a growth rate of about 50.8 cm per day. This bamboo makes a close, almost impenetrable hedge, on account of its interlacing thorny branchlets and closeness of new culms. This is one of the major commercial species in India, Thailand and Indonesia. It is mainly used for constructional purposes and manufacture of pulp and paper. Split culms are also used for mat-making, basket work, etc.

#### 2. *Bambusa polymorpha*

A large evergreen edible bamboo with gray to grayish green culms, 15-24 m high and a diameter ranging between 8.6-17 cm. It occurs in mixed forests of east India, Indonesia and Myanmar. In Myanmar, it is a popular bamboo for roofing and flooring because of its outstanding mechanical properties and durability. Sometimes it sheds leaves in dry season. Clumps of *B. polymorpha* are clean, with white scurfy appearance when young, nodes thickened, lower ones fibrous-rooted, internodes 38 cm to 61 cm in length, much branches above and curving outwards. The culms have moderately thick walls and large cavities. It can



be used for pulp and paper, sticks for agarbattis, fibre board, etc.

### 3. *Bambusa tulda*

A clump forming, evergreen or deciduous, gregarious bamboo, branching freely from nearly all the nodes, the branches from the lower nodes being thin, nearly leafless and more or less horizontal. It is a native of Assam, Thailand, Bangladesh and Myanmar. The culms are green or glaucous when young, and gray-green, when older, sometimes streaked with yellow, 6-9 m height, internodes 0.3 to 0.6 m long, 5-10.2 cm in diameter, walls 0.76 to 1.27 cm thick. It has aerial roots on first 9 or 10 nodes. Tender shoots are used for making pickles. Commercially used for scaffolding, pulp and paper, toys, mats, screens, baskets and fishing rods.

### 4. *Bambusa vulgaris* (The Golden Bamboo)

It is a moderate sized bamboo. It attains a height of 6 to 15 m and grows in diameter from 5.6 cm to 11.2 cm. Culms have yellow or green strips, growing separate from each other. It occurs wild in warmer parts of India, Myanmar, Sri Lanka and Malaysia. In Sri Lanka, it is a valuable species much used for scaffolding, roofing, fencing and handicrafts. It was introduced in Pakistan from Bangladesh, has low commercial value and is mostly used for ornamental purposes.

### 5. *Dendrocalamus strictus*, Nees.

*Dendrocalamus strictus* is the best known, and most widely distributed in the Indo-Malayan zone, in Thailand and Myanmar. The hardiest of all bamboos, which is deciduous, middle sized, densely tufted and thick-walled or solid culms varying in size according to locality. It is found in India, Myanmar and Pakistan in

hilly areas ascending to 800 m. It reaches a large size with hollow culms in wet localities but is small and has nearly solid culms in dry localities. The culms are variable in size according to climate, 6 to 15 m high, 2.54 to 7.62 cm in diameter and green when young. The seed of *D. strictus* is similar in form to and about half the size of unhusked wheat. Its flowering habit is irregular, i.e., a few culms in a clump or a few clumps in a grove flower at irregular intervals. In India, it is used for manufacture of pulp and paper and for construction purposes.

Depending upon the environmental and geographical source, three growth forms of clumps, which are more or less inherited through seed, are recognized.

#### Common type -

Met with everywhere ordinary form producing medium sized hollow to solid culms.

#### Large type -

Practically has no side branches to a great height and seldom shows sign of congestion. The culms are big with long straight and smooth internodes.

#### Dwarf type -

This type is of a small size and only exceptionally forms clumps.

### 6. *Dendrocalamus hamiltonii*

A large tufted bamboo, sometimes growing tall and erect, but more often sending out its stems at an angle or curved downwards.



It forms impenetrable thickets, the inner stems of a clump are often upright and clear of branches, somewhat resembling *Dendrocalamus giganteus*. The species is very easily identified by its panicles of bright purple-red-flowers, and when out of flower the grey-stems, and straggling habit cause it to be easily recognized. Culms attain sometimes a length of 24 m and are white when young, soft and thin-walled. Internodes 30.5 to 50.8 cm long, 10.2 to 12.7 cm in diameter, walls 0.9 to 1.27 cm in thickness. Presently, believed to be most commonly planted in the Punjab. It is naturally found in India, Bhutan and Bangladesh. It is used for scaffolding, construction, basket making, mats, etc.

#### 7. *Dendrocalamus longispathus*

A large handsome tufted bamboo with leaves born only on the upper branches. A species recognised at once by its long fragile papery sheaths and by the large panicles of small flower heads and blunt spikelets. It comes nearest to *D. hamiltonii* in its general characters, but is easily recognised from it. Culms grow upto 18 m, nearly white when young, lower half naked, often with a ring of rootlets at the nodes, internodes 45.7 to 76.2 cm long, 7.6 to 12.7 cm in diameter, and walls 0.88 cm thick. It is found in India, Myanmar and Bangladesh and is used for making baskets. It is mainly cultivated as ornamental.

#### 8. *Melocanna bambusoides*

An ever-green bamboo with single culms arising at a distance of 0.6 m apart from a ramifying underground rhizome. It is a typically gregarious bamboo, handsome and one of the most valuable and important bamboos, found in eastern Bengal, Myanmar and Chittagong, Bangladesh. Culms distant, green when young,

straw coloured when old, 12 to 21 m long, the lower two-thirds bare of branches, sometimes with a few short branchlets at the lowest nodes, internodes 25.4 to 55.9 cm long, 2.5 to 7.6 cm in diameter, smooth and wall thin. It is used for building houses, for making woven ware, pulp and paper, tabashir, toys, mats, screens and umbrella sticks.

#### 9. *Phyllostachys aurea*: (Fishpole or Golden Bamboo)

Fish pole bamboo is a medium sized hardy bamboo, native to China but cultivated in Japan and introduced in other countries including Pakistan as ornamental species. Culms are 9 meter high, have one or more variously shortened internodes in the basal region, sometimes with nodes obliquely inclined, which occasionally form attractive designs simulating a tortoise shell pattern. A pure planting of *P. aurea* can be identified with ease and certainly by the culms with these odd characters. Fishpole bamboo withstands temperatures down to 0°F.

#### 10. *Phyllostachys aureosulcata* (Yellow Groove Bamboo).

This is a hardy bamboo native to China. Culms are upto 10 meter high and 3.8 cm in diameter at the base. Leaves, usually two or three on a twig, are upto 15.3 cm long and 1.9 cm wide on new culms but much smaller on older ones. In early spring, the species is easily recognised by the pale-green culm sheaths with many slender whitish stripes. It is useful as an ornamental plant.

#### 11. *Phyllostachys pubescens*: (Moso Bamboo)

Moso bamboo is the largest and handsomest of the giant hardy bamboos and is native to China. It was recently introduced in



Pakistan through seed. Culms sometimes reach heights of 22.5 meter or more and have basal diameters upto 20.3 cm in China and Japan. Culms are a little larger in diameter for their height and more tapering than those of most bamboos, the internodes are gray-green. The leaves are very small, usually 5 to 7.6 cm long and about 0.95 cm wide but somewhat larger on young culms. The foliage is more feathery and attractive than that of any other species of the genus. Culm sheaths are hairy, greenish smokey, and densely spotted with brown. The new shoots appear in early spring. Because of the large size of shoots ultimately produced in a well managed grove, the Moso bamboo ranks as one of the most valuable of the hardier bamboos for the commercial production of shoots in China and Japan. This species is hardy down to about 3°F, and is very difficult to propagate vegetatively as it fails if best site and climate is not available.

#### 12. *Bambusa nutans*

A medium-sized graceful bamboo. Culms 6-15 m high, 5-10 cm diameter, loosely clumped, much branched above, usually unbranched below, straight, green, smooth, not shining, white-ringed below, the nodes slightly thickened. It seems to flower only at long interval. It is naturally growing in India between 600-1500 m elevation. It is commonly cultivated in India, Bangladesh and Thailand. It is a graceful bamboo worth growing as ornament. It is also commonly used as raw material in paper industry. Its culm is good, strong, straight and used as poles.

### Bamboo Cultivation in Pakistan

Almost all requirements of bamboos of Pakistan were met upto 1971 from their natural forests in East Pakistan, now constituting Bangladesh. These supplies stopped after creation of Bangladesh and acute shortage of bamboo was felt. Consequently, the prices of the goods manufactured from bamboo became very high and the need for cultivation of bamboo was acutely felt to meet its demand.

Bamboos grow well under hot and humid conditions with sufficient soil moisture and nutrients. For fast growth, it needs a lot of water at initial stages of its establishment. Therefore, the bamboos cannot in general be grown in dry tracts of Pakistan. However, the farmers in the irrigated tracts of Punjab and Sindh took up cultivation of bamboo on a large scale in late seventies and early eighties. According to estimates made at that time bamboos were cultivated over about 8800 ha area by 1986. They received very high financial returns for growing bamboos because of scarcity of this commodity in the local market at that time. For this reason, more and more farmers started growing bamboos thus flooding the market within a short period of time causing low return on their cultivation. The government also allowed import of bamboo which may have contributed to the lowering of their price in the market. The import data since 1980-81 is given in the following table, which shows considerable reduction in quantity and increase in prices over the years indicating a rise in bamboo prices in international market.



### Import of Bamboo in Pakistan

Year	Quantity (tonnes)	Value (Rs.in million)	Price (Rs./tonne)
1980-81	10,318	16.7	1,619
1981-82	11,048	22.2	2,009
1982-83	14,514	29.1	2,005
1983-84	11,562	22.6	1,955
1984-85	8,424	15.9	1,887
1985-86	8,769	15.0	1,711
1986-87	3,238	5.4	1,668
1987-88	1,926	3.9	2,025
1988-89	2,388	6.4	2,680
1989-90	1,887	7.3	3,869
1990-91	1,555	6.0	3,859
1991-92	4,491	20.4	4,542
1992-93	2,421	15.8	6,526

Source: Foreign Trade Statistic of Pakistan 1980-81 to 1993-94 Published by Federal Bureau of Statistics.

For a number of reasons, in the past, some farmers stopped bamboo cultivation and had to incur considerable expenses on uprooting and removal of clumps and rhizomes of bamboos from their farms. However, the situation is improving and farmers have started planting bamboo again.

#### Research Studies on Bamboo Cultivation

A number of experiments were conducted by the Pakistan Forest Institute on vegetative propagation of bamboos to standardize bamboo nursery and plantation operations and to determine method and

time of planting, optimum spacing, and inter-cropping operation for bamboo species. It was found that rhizomes and cuttings of bamboos planted during the month of July under partial shade of trees or covering polythene sheet gave the best rooting e.g. 83% in case of rhizomes and 74% for cuttings. Shoot cuttings are most frequently used method of bamboo cultivation in Pakistan. For maximum production, these should be grown as pure crop at 2 x 2 m spacing. However, agricultural crops can be grown for some years if plant spacing is kept greater than 2 x 2 m. The following exotic species of bamboos have been successfully grown at Peshawar.



S. No.	Species	Origin
1.	<i>Dendrocalamus longispathus</i>	Bangladesh
2.	<i>Dendrocalamus hamaltoni</i>	"
3.	<i>Bambusa tulda</i>	"
4.	<i>Bambusa nutans</i>	"
5.	<i>Bambusa arundinacea</i>	Kerala (India)
6.	<i>Bambusa strictus</i>	Local

The productivity of bamboo can be measured in various manners. The following data of foreign origin gives an indication about the stocking, and annual yield of bamboo (*Dendrocalamus strictus*).

No. of clumps/ha	No. of culms/clump	Annual yield/ha (tonnes)
61	Old 7.239 New 2.01	0.173
121	27.00	0.618 to 1.235
61	27.02	0.658 to 1.952

Culm Height, Diameter and Number Per Air Dry Metric Tonne (ADMT)

Average culm dia. (cm)	Average height (3)	Number of culms/ADMT
2.6	4.6	1235
3.2	6.7	658
3.2	4.6	752
2.4	4.7	1389

The relationship between green weight and air dry weight for *Dendrocalamus strictus* has been recorded as under



Green weight (kg)	1	2	3	4	5	6	7	8	9	10
Air dry weight (kg)	0.620	1.230	1.850	2.47	2.58	3.77	4.38	4.94	5.55	6.67

Relationship between total height and consumable length was recorded as under:

Consumable length (m)	4	5	6	7	8	9	10
Total length (m)	6.65	7.38	8.18	9.04	9.87	10.70	11.53

The yield of bamboos varies considerably depending upon the species, intensity of stocking and varies between 0.2 to 4.0 tonnes per hectare. The financial viability of bamboo is dependant on environmental condition, management practices and market conditions.

Strength properties of locally grown bamboos were also determined as it has a higher strength to weight ratio as compared to other materials. Strength, therefore, plays an important role in their utilization. The results showed that *Dendrocalamus strictus* has the highest strength properties followed by *Bambusa tulda*, *Bambusa nutans*, *Dendrocalamus hamiltonii* and *Dendrocalamus longispathus* in descending order. There was also some variation in fibre morphology of these species. *Dendrocalamus hamiltonii* was found to be most suitable for manufacture of pulp and paper while studying suitability of different species of

bamboo for this purpose.

#### Survey of Bamboo Growing Areas

Considering the importance of bamboos in the rural economy of irrigated plains of Punjab, a survey of major bamboo growing districts was carried out from 13-11-1994 to 24-11-1994. Information regarding present status, management, processing, economics, marketing and future prospects were collected from Kasur, Sargodha, Jhang, Khoshab and Mandi Bahauddin districts. Bamboos are grown in these districts for commercial purpose by progressive farmers who can afford to forego crop yields during the first few years of their establishment. However, in Chunian subdivision of Kasur district small farmers have also successfully established small bamboo groves of 4-10 acres area. It is also being raised as a homestead with other fruit and tree crops. In Jauharabad irrigated forest plantation, few



bamboo plantations of 1 to 2 acres are also growing but their growth is not good due to low supply of irrigation water in the plantation.

It was difficult to obtain true extent of bamboo plantations in these areas. However, the farmers reported that bamboos are grown on ten to twelve thousands acres. Additional area is expected to be brought under bamboo cultivation in future as economic returns on this activity have improved and their price is stable.

### **Bamboo Propagation and Management**

At present cultivation of bamboo in the country is done with nursery raised planting stock. Seeding years in bamboos are rare, therefore, propagation by offset is carried out. Offsets usually consist of a lower portion of old culm with its roots cut off above a joint and with the rhizome axis basal to it. The new shoot grows from dormant buds on the shoot. The offsets are first planted in the nursery. Farmers prefer two years old nursery raised seedlings for out planting. The average number of plants per acre ranges from 80-150. However, the best spacing according to the farmers is 20'x 20' or 100 plants/acre. Great care is required when the seedlings are transplanted because they are likely to wither if their roots are exposed to the Sun. Protection of bamboo plantation is most vital because seedlings are dug out by wild boar who eat their tender rhizomes.

Other methods of propagating bamboo are rhizome planting, whole culm cutting, layering, culm or stem cutting, branch cutting, etc. However, bamboo cultivation is expensive due to high cost of labour for excavation, transportation and planting of propagules as these are bulky and heavy. Moreover, propagules are not available in large quantities. Elsewhere in the world, micropropagation and

tissue culture techniques are used for this purpose.

Management of bamboo is based on the physiologic development of the clumps. New culms are produced from the rhizome generally along the periphery of the clump. Although the culms may attain maximum size in one year yet they lack strength and are, therefore, not utilizable. The best harvestable age of bamboo is 4-5 years after their establishment. Further, for proper development of new culms and to provide support to them, a certain number of old culms have to be left growing in the farm. Thus, although bamboos appears to be an annual crop, still, it is not appropriate to harvest all the culms annually. Felling cycle and felling intensity are major considerations for the management of bamboo crop. The length of felling cycle is determined by the maximum age at which the culm becomes harvestable, age of full maturity of the culms and life of the culms. A short felling cycle brings about the deterioration of the clump and a long felling cycle may result in overcrowding.

Detailed statistics regarding the relationship between new culm production and the number of old culms are not available. Casual observation and discussion with farmers revealed that at every clump, new culm increased towards the periphery in geometric ratio which means that for each one culm felled, two new culms will grow. Selection cutting is followed in Kasur areas while clear felling is resorted by farmers in Sargodha- Faisalabad region. As a general rule, immature culms of less than one year age should not be cut. The height at which the culms are cut should not be below the second node and not more than 30 cm. Felling should not be done during the months of active growing season of bamboo, i.e. July to September. October to December is the



best season for felling and processing.

### Economics of Bamboos on Farmlands

An economics analysis was also carried out in order to know the contribution of bamboo to farm income. Farmers in Kasur, Faisalabad, Sargodha, Mandi Bahauddin and Jhang districts of Punjab have raised bamboos for commercial purposes. An attempt was made to compare the opportunity cost of raising bamboos with wheat/cotton, sugarcane and Kinnow/Guava orchards. Farmers growing orchards and bamboos were interviewed informally. The information thus obtained was pooled together. Since *Dendrocalamus hamiltonii* (Kala Bans) was the predominant and most preferred species, the study results for

financial comparisons are confined to this species only. A 20 years rotation was studied in this regards because the farmers remove the bamboo crop or replace it with a new crop after this period. The technique of Equivalent Annual Income (EAI) was used because it combines all costs and returns into a single annual sum that is equivalent to all cash flows during an analysis period spread uniformly over the whole period. EAI is useful in comparing investments that yield a periodic return with those that yield an annual return (e.g. agricultural crops). Sum of Net Present Value (SNPV) was also calculated for comparison since this is another measure for net benefits in absolute terms. The following table summarizes SNPV and EAI of different crop alternatives compared with raising of bamboos for a period of 20 years.

**SNPV and EAI of Bamboos, Kinnow (Citrus), Guava, Wheat + Cotton, and Sugarcane in Punjab at 12% Discount Rate**

(Land unit = 1 acre)

Crop	SNPV for 20 years	EAI
Bamboo (Kala Bans; <i>Dendrocalamus hamiltonii</i> )	134,372	17,989
Wheat + Cotton	32,521	4,354
Sugarcane	23,879	3,197
Kinnow ( <i>Citrus</i> spp.)	36,270	4,856
Guava	20,214	2,706

It may be pointed out here that the statement that an acre of bamboo crop can yield a net income of about Rs.18,000 rupees could prove a sufficient stimulant to induce growers to give up all agricultural crops in favour of bamboo cultivation. However, the

economics of marketing a product is more or less a set mechanism. There comes a stage where the product and the price reaches a peak. This means that a particular product has to be produced to a certain extent; beyond which its price starts coming down. How to determine



that equilibrium point between supply and demand for market clearing price, depends upon a number of factors and need to be investigated through extensive field trials and by employing specific economic tools.

It appears from the above table that the average annual income from bamboo is almost 4-7 times higher than for food and cash crops in the region. Therefore bamboo is a suitable land use in the irrigated areas. The result of this analysis are very interesting. Wheat and cotton are assumed to be grown on the same piece of land annually for 20 years continuously but their adjusted annual income is 4 times less than that of bamboo. Similar is the case with sugarcane as a biannual crop. Kinnow and Guava are frequently grown in the area but their equivalent annual income is also less than bamboo.

It may be pointed out here that the statement that an acre of bamboo crop can yield a net income of about Rs.18,000 could prove a sufficient stimulant to induce growers to give up all agricultural crops in favour of bamboo cultivation. However, the economics of marketing a product is more or less a set mechanism. There comes a stage where the product and the price reaches a peak. This means that a particular product has to be produced to a certain extent; beyond which its price starts coming down. How to determine that equilibrium point between supply and demand for market clearing price depends upon a number of factors and need to be investigated through extensive field trials and by employing specific economic tools.

### **Bamboo Processing**

Diesel oil is used as solvent for a chemical powder called Gero forming a waxy

substance. Bamboo stems are pasted with this substance and then heated in the fire place of an open kiln. This treatment destroys the starch within the parenchyma cell making the stem resistant to fungal attack. It also makes it possible to straighten the stem. The heated stems are placed in a small hole of special wooden structure and the bends are straightened by the labourers manually. The waxy coat is wiped off the stem thoroughly with a coarse cloth before it hardens. The straightened stems are tied in bundles and dried in a well ventilated shaded area. The labourers are paid on the basis of the output usually for 100 stems. 2-4 persons per kiln are employed by the purchaser. Treatment expenses depend on stem size and roughly ranges from Rs.2/- for small size of 10-12 feet, and Rs.7/- for larger size of 36-40 feet length.

### **Price Trends**

Since bamboo is freely traded in the market, price depends upon its supply and demand. In periods of constructional boom the price generally goes up while economic depression in the country lowers the prices. At the farm site the average price for Grade 1 bamboo is Rs.55/- per piece, Grade II Rs.15/- and grade III Rs.3/- per culm. In most cases farmers sell their whole standing crop to a trader who installs a kiln at the farm where the bamboos are graded, treated and straightened.

### **Constraints in Bamboo Cultivation and Marketing**

**1. Market Monopoly:** The farmers are of the view that certain big traders in Mandi Bahauddin were monopolizing the market of bamboos and are therefore, getting low returns for their produce. The traders on the other hand, argued that the lower price trend is due



to lower exports of tent industry to the Gulf States and liberal bamboo import policy of the government. They also revealed that aluminum and plastic pipes are now increasingly used as substitute of bamboos in the tent industry.

**2. District Tariffs and Octroi Charges:** Farmers in Kasur district complained that district exit tax of Rs.10/- per stem has not only lowered the on-farm price of bamboo but the traders are also reluctant to purchase the stock. This is basically an institutional problem and could best be solved by local district councils.

**3. Water for irrigation:** Bamboos are very heavy user of irrigation water which is a scarce commodity in the arid irrigated plains of Pakistan. They compete both for water and nutrient with agricultural crops. However, sufficient water is usually not available from canal systems and the farmers have to supplement it with tubewell irrigation which is very expensive. Since the returns from bamboos are usually not available upto five years, subsistence farmers lack resources for the purchase of additional water. This in turn results in low yield from bamboos and small farmers are skeptical about their cultivation.

### **Future Prospects of Bamboos Cultivation**

The bamboo industry in Pakistan is not well developed and its cultivation is done on limited area in the country inspite of the fact that the strength of bamboo culms, their straightness, lightness combined with hardness, range in size, easy propagation and comparatively short rotation make them suitable for a variety of uses. It can also be used for hedges and for improvement of landscape of gardens, as windbreak and a good soil binder to control soil erosion on account of its root system. In tropical countries millions of tonnes

of quality paper and pulp are produced from bamboos. However, in Pakistan this has never been tried. This is due to scattered and inadequate supply of bamboos which is not sufficient for a paper mill. On the other hand bamboo may lose to aluminium and plastics in its traditional uses because the substitute products can be mass produced economically without decline in their quality and with new efficient design and performance. However, if innovation, quality control, mass production and attractive pricing are fixed to bamboo products, then one could expect bamboos to make a strong industrial base. This is where research has an important role to play.

### **Bamboo Research Priority Areas**

Although economically bamboo is very important in certain areas of the country it does not receive enough attention from the government. Therefore, research activities have been limited and sporadic. All the research activities so far represent generally sidelines and the country has never developed full-fledged expertise on the biology and technology of bamboos. The available information is far from adequate to serve as guidelines for proper management. The following areas of research need to be explored:

1. **Survey:** A survey should be conducted to determine the actual extent and distribution of different species in different parts of the country.
2. **Taxonomy:** A number of unidentified bamboo species grow in the country and thorough and satisfactory taxonomic studies on identification and preservation are needed.
3. **Phenology:** Most bamboos flower once in their life time. Moreover the period of flowering differs by species. Some



bamboos produce seeds that germinate readily, while other produce sterile seed. Seeding periodicity, flowering etc. needs to be investigated.

4. Propagation method: Present system of propagation is by asexual means e.g. culm cutting, rhizome cutting and layering. Therefore, propagation by seeds should be tested.
5. Tissue culture: This advanced technique offers great promise for rapid propagation on a large scale for species of desirable characteristics.
6. Fertilization and irrigation: The farmers have reported large yield increase due to fertilization and irrigation. These measures have to be standardised.
7. Research in preservative treatment of bamboos and their use in rural housing.
8. Research on management techniques and economic evaluation.
9. Research on the effect of age of culm on the quality of its product.

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