



BAMBOO SOCIETY OF INDIA

BAMBOO CULTIVATION

Bamboo a Versatile Grass for good economic returns.

I. Introduction:

Bamboo belongs to the grass family, the Poaceae (Graminea) hence it's a woody Grass of which many species grow like a tree. The larger species can reach up to 40 metres in height and can have 30 cm thick stems, while the smallest types are small bushes that are no more than 1 cm in diameter. Globally Bamboo has about 1250 species. Bamboos occur naturally in most parts of the world. India (30%), China (15%), Brazil, have the largest areas of bamboo of a global bamboo cover that is estimated to be nearly 50 million hectares. India is the second largest producer of Bamboo after China.



Bamboo, the versatile grass



bamboo bridge



interiors of a bamboo restaurant

Bamboo Forests India: As per India State of Forest Report 2022 the total bamboo bearing area of the country is estimated as 1,49,443 sq km. 125 indigenous and 11 exotic species of bamboo belonging to 23 genera are found in India. 50% of the species are found in NE India.



Bamboo forest

Characteristics of bamboo:

Bamboo grows rapidly, regenerates annually, is selectively harvested annually without harming the ecosystem or contributing to deforestation. It's very fast growing as several species grow up to 90 centimeters a day. It's Cheap as compared to

timber and is renewable as culms are produced every year and older culms of 3 years and above can be harvested every year.

It's a versatile species which grows in temperate' to 'tropical' regions and its habit ranges from clumping of rhizomes and culms to running type with rhizomes and culms placed at some space from one another . The runner type are easy to harvest. The clumping ones with compact thick clumps are difficult to harvest, especially the ones with thorns. Some bamboos are thorny and many are non-thorny. Some have side branches from bottom and some have them a few feet above ground. The thorny ones and the ones with branches arising from bottom are difficult to harvest. Bamboo is highly resilient to climate changes and natural calamities such as fire, snow, drought, flooding for short durations as it can regenerate from its subterranean rhizomes even if the bamboo above ground is destroyed.

It adapts to poor soil or climate conditions, and helps bind soil. Therefore it's an unique and effective tool to control erosion and ensure slope stability and hence it is planted along river banks and on slopes to maintain slope stability and restrain erosion. Thus it's suitable for a range of restoration and land use planning needs. Some can survive and grow slowly in degraded lands including saline/alkaline lands and those which get submerged during rainy season.

On account of its widespread rhizomes and rooting it improves water holding capacity of the watershed areas by 20% to 25%.

It significantly contributes to ecology such as improving wildlife habitats, forest hydrology, forest biodiversity, soil improvement, restoration of degraded lands and improving their productivity.

Bamboos reduce the effect of climate change by releasing 30% more Oxygen (320kg/year in case of Bambusa bulcoa) than regular trees and sequesters and store 40% more Carbon (450kg CO₂/year in case of Bambusa bulcoa) from air than regular trees and fixes it in its body as well as in soil and helps combat climate change. Therefore large scale bamboo planting is required for a polluting country to remain carbon neutral.

Though bamboo is light weight it's known as "vegetal steel" as it has high natural strength in view of higher tensile strength than steel as the tensile strength of

bamboo is 28000 pounds/sq inch and that of steel is just 23000 pounds/Sq inch. Therefore it has traditionally been extensively used for rural housing and is now extensively being used in modern construction replacing steel where ever feasible.

II. Following are some of the important Indian Bamboo Species:

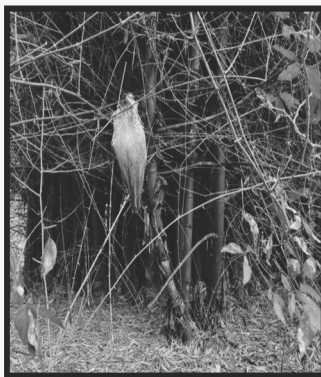
1. *Dendrocalamus strictus*:

Clumping, height 6-18m, culm diameter 2.5-8 cm, grows in dry zone, uses: by medars for making artefacts, in construction, as poles, etc.



2. *Bambusa bamboo*:

Thorny, clumping, difficult to harvest, height 20-30m, 10-18cm diameter, 20-40 cm internode length, rainfall 2000 mm, uses: bridges, ladders, Agarbatti sticks, basketry, construction, paper pulp, leaves as medicine, etc.



3. *Bamboosa bulcoa*:

Found in north east India. Very large, thick walled, thornless, tight clumping bamboo. Height: 6-23 m Diameter: 8-15 cm. Internode length: 20-45 cm. Culm wall thickness: 1.9-2.5 cm. Flowering cycle: 35-45 years. Sporadic and gregarious flowering noticed. After flowering plants die. In sporadic flowering, some culms in a clump or some clumps in flower and die.

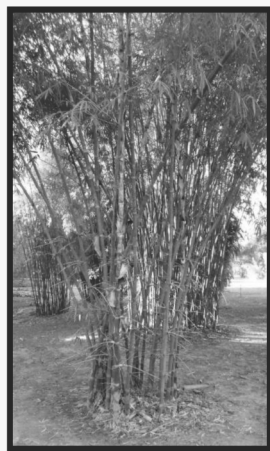


Rest remain alive and continue to yield. No seed formation in flowered plants is seen. Climate: tropical – subtropical. Temperature: Best growth 22-28 oC. Can tolerate 9 – 35 oC. Rainfall: 2500-3000 mm. Tolerates 700-4500 mm. Can tolerate dryer conditions than many other Bamboos. It is a good choice for slope stabilization. Altitude: 0-700 m. Soil: best suited are heavy textured soils with good drainage. Generally, grows on any type of soil. PH: low of 5.5, tolerates 4.5-7.5. Planting: Planting material: rhizome, culm/branch cutting and tissue culture. Spacing: 5m X 5m, 6m x 6m, 7m X 7m (for growth of bigger diameter culms). Fertilizer: Urea : DAP: 60/120/180 grams / plant for 1st, 2nd and 3rd year respectively. Mitigate of Potash: 45/90/135 grams/ plant for 1st, 2nd and 3rd years respectively. Watering: required after monsoon. Harvest: Culms mature in 3-4 years. Harvest mature clumps 6 year after planting. Average yield: 20 T/ Acre. Annual production of about 500-700 culm/acre. Average returns: 50,000-100,000 per acre per year 7th year onwards. Uses: Very strong structural bamboo, construction, pulp, Handicrafts, Agarabathi sticks, woven mats, scaffolding, woodchips, etc. Shoots: good food.

4. *Bambusa tulda*:

Known as Indian timber bamboo, dense clump, native to the Indian subcontinent, can grow 6-20 mt tall and 5-10 cm thick. Has excellent tensile strength of up to 60,000 pounds (27000kg) per Sq. inch. Tall dull green coloured turning greyish green when

mature. Has few closely growing culms. Young shoots yellowish green with powdery top. Culms covered with white bloom. Several or many clustered branches. Culms thick walls 10-20 mm. internodes 40-60 cm long. Growth: Fast. 70cm/day. Flowering Cycle: 15-60 years gregarious flowering for 2 years. Climate: Tropical – subtropical. Exposure: Prefers semi shade but also grows in full sun. Soil: Loamy and alluvial soils, fertile and well drained. PH: 5-6. Water need: Average. Altitude: 0-1500 mts. Rainfall: Moist areas. 1200-2500 mm. Temperature: 4 degree C-37 C Best: 22 C-28 C. Propagation: By seed (viability by 70%), rhizomes, culm cuttings, branch cuttings and Tissue culture. Planting distance: 5 m X 5 m / 6m x 6 m (for quality culms). For boundary screening: 3m X 3M. Harvesting: Matures 5-7 years. 3-4 years old culms are harvested. 3-6 culms evenly spread to be retained after harvesting for better growth. Average yield: about 12 Tons / year. Uses: Agarbathi, construction, Scaffolding, Furniture, Basketry, Mats, Handicrafts, paper pulp, wind break. Shoots: Edible but taste slightly bitter.



5. **Bambusa nutans:**

Medium sized elegant right clump bamboo. Plants loosely clumped, much branched above, usually unbranched below, straight, green, smooth, not shining, white ring below the node; node slightly thickened, often hairy, lower one bearing rootlets. The culm is good, strong, straight. Height: 15-20 m Diameter: 5-10 cm. Internode Length: 25 -45 cm. Wall thickness: 1.5 cm. Flowering Cycle: 35 years. Soil: Moist hill slopes and flat uplands in well- drained sandy loam to clayey loam soils. pH: 5.5-7.5, acid, neutral and basic (alkaline) soils. Elevation: from 700 - 1,500 meters. Temperature 9-32 deg C. Rainfall 700-4500mm.

Exposure: It can grow in semi-shade (light woodland) or without shade. It prefers moist soil. Plants: Seed, vegetative propagation, Tissue culture. Planting Spacement: 5m X 5m - 6m X 6m. Average yield: 12-16 T/Acre. Uses: construction, major source for paper, Poles, mats, Agriculture implements, household items.



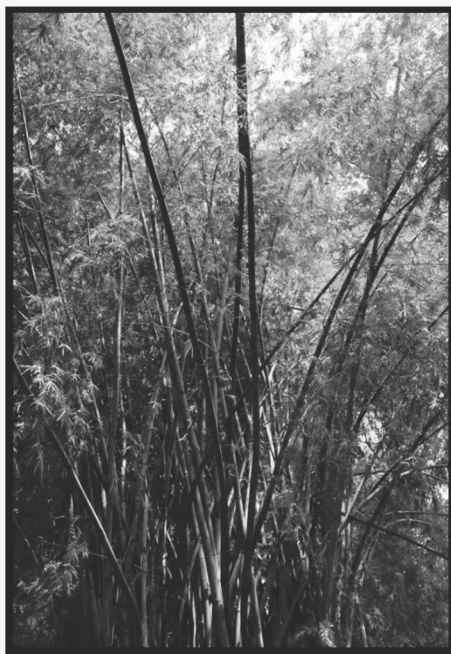
6. *Dendrocalamus stocksii*:

Thornless, mid -sized, erect, almost solid species endemic to central western ghats of India. Though it's a clumping bamboo, it has loosely spaced culms which makes harvesting easier. Height: 6-12 meters, Diameter: 3-5 cm. Wall thickness: 0.2-1.5cm. Base of pole is solid. Internode 15-30 cm .Flowering: sporadic with no seed set. Soils: deep loamy soils are best. Naturally seen in lateritic soils. But can grow on a wide variety of soils. Altitude: 0-600 meters above sea level. Weather: Humid tropics / Sub-tropics. Propagation: by rhizomes, rooted cuttings, tissue culture. Planting spacing: 4mt x 4mt or 5mt x 5 mt. Higher spacement give thicker and better quality culms. A pit size of 60x60x60 cm is sufficient for initial planting which may be filled with 5 kg compost/FYM + 100 g VAM + 15g phosphorus solubilising bacteria (PSB) + 5g Azospirillum. Average yield: 750-1000 poles/ acre per year



7. *Bambusa polymorpha*:

Bengal Bamboo, tufted bamboo with tall, clean stems Height: 25-30 m, Diameter: 15 cm; internodes gray-green, 40–65 cm, wall thick; branching only from mid-stem up. Found in Bangladesh, India (NE), Myanmar and Thailand. Uses: edible shoots, bamboo biryani case, handicrafts, house construction, pulping.



8. *Bambusa vulgaris*:

Moderately loose clumps and has no thorns. has green culms with yellow streaks. Ht: 10–20 m, Dia: 4– 10 cm, Culm walls are slightly thick, Internodes 20–45 cm. (another popular ornamental variety has lemon-yellow culms with green stripes and dark green leaves). Flowering is not common, and there are no seeds. Uses, stems as fuel and the leaves as fodder, small construction, paper making, handicrafts, medicine, etc. Working and machining properties of the stems are poor, as they are not straight, not easy to split, and not flexible, but they are thick- walled and initially strong.

Because of high carbohydrate content, stems are susceptible to attacks from fungi and insects such as powder post beetles. . Its shoots boiled in water are sometimes used for medicinal qualities. Among all bamboos, only shoots of *B. vulgaris* contains taxiphyllin (a cyanogenic glycoside) that functions as an enzyme inhibitor in the human body when released, but degrades readily in boiling water. It is highly toxic, and the lethal dose for humans is about 50–60 mg. Hence not advised to be used as edible hoots.

9. *Dendrocalamus brandisii*

A very large (tallest), evergreen, tufted, thornless, dense clumping bamboo with large leaves. Culms have an ashy-gray to greenish-gray color. Nodes are slightly swollen with rootlets showing on the lowest nodes. Young shoots are dark-gray with a dark-brown shade. It's been growing well in Kodagu, Westernghats. Hight: 20-33m.

Diameter: 13-20cm. Internode: 30-60 cm. Wall thickness: 1.7-3cm. Flowering Cycle: 45-50 years. Climate: warm moist tropics. Propagation: Seed, rooted cuttings, tissue culture. Seed viability only 2-3 months. Planting: Spacing: 7m X 7m / 6m X 6m (larger spacing yield better quality culms). Altitude: 0 – 1300 m. Soil: Found on calcareous rocks but also grows well on well drained loamy soils. PH: 4.5-7.5. Exposure: full sun or part shade. Water: normal to moist. Irrigate after monsoon. Harvesting: Culms mature in 3-4 years. Culms older than 3 years to be harvested. 6th year onwards. Cut below 30cm above ground and just above 2nd node. Average yield: 20 T / Acre / Year. Uses: Construction, basketry, paper pulp, furniture, farm implements, baskets and other woven wares and handicrafts. This is one of the strongest and largest bamboos for construction purposes. Shoots: Good food.



10. *Dendrocalamus asper*:

It is found commonly in India, Sri-Lanka, Southwest China and Southeast Asia. It's a giant bamboo is an evergreen, clumping bamboo with a short, thick rhizome and densely tufted, erect stems. Height: 25-25 m .Diameter 8-12 cm. Internode: 40-50 cm. Wall thickness: 1.1 – 2.0 cm. Elevation: up to 1,500 meters, though it grows best at an elevation of 400 – 500 meters. Temperature: grows best in 20 - 27°C, but can tolerate 15 - 34°C. Rainfall: range 1,800 - 3,600 mm, but tolerates 1,200 - 4,500 mm. Soil: grows better on heavy soils with good drainage, Sandy clay loam, latent Soils mixed with fine sandy clay. Also succeeds in any type of soil of at least moderate fertility. pH: 5 - 6.5, tolerating 4.5 - 7.



Propagation: Seeds, rooting of cuttings, Tissue culture. Average yield: 20 T/Average. Uses: Poles, Pulp, laminated boards, furniture, musical instruments, chopsticks, household utensils and handicrafts, musical instruments, paper. Shoots: Young shoots are sweet and a delicious vegetable.

11. *Dendrocalamus longispatus*:

It is an evergreen, clump-forming bamboo. Culms are green with white blooms when young, which become greyish-green when dry. Young shoots are yellowish-green in color with shiny black hairs. Culm is straight. Branches spread out from the midculm to top. Aerial roots reach up to few nodes above the ground. Height: 8-10 mts. Diameter: 6-10 cm. Internode: 25-50 cm. Wall thickness: 0.7-1.2 cm. Climate: moist, lowland tropics and subtropics. Altitude: up to 1,000 meters. Temperature: It best in range 20 - 27°C, but can tolerate 15 - 34°C. Annual rainfall: 1,800 - 3,600 mm, but tolerates 1,200 - 4,500 mm.

pH: 5 - 6, tolerating 4.5 - 7. Exposure: best in full sun or light shade. Flowering Cycle: 30-35 years.

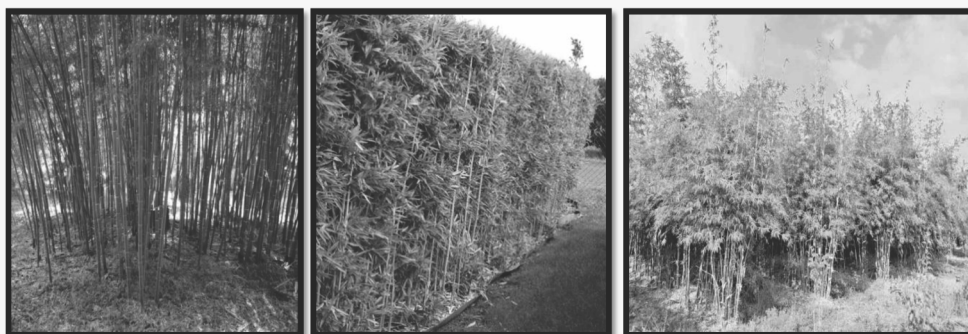


No. of Seeds per Kg: 55,000. Planting material: seed, Vegetative methods. Seed - have a short viability of 2 - 3 months. Sow in containers in a lightly shaded position and provide cover. Germination rates of 33 - 50%, starting to sprout within 2 - 8 days. Planting: 140- 160 Plants / acre. Spacement 5m X 5m or 6m X 6m. Uses: Landscaping, temporary construction, agarbathi, tooth picks, baskets and containers, furniture, mats, etc. This species is generally used as a source of pulp for the manufacture of paper.

III. Bamboo Plantation:

Initial expenditure for 1st year would be about 1lakh /acre. Subsequent years the maintenance expenses could be on an average Rs 20,000/- per acre, per year. Plantations may be raised from rhizome offsets (most common traditional method for Stocksii) or rooted cuttings (macro and micro propagated). A pit size of 60x60x60 cm is sufficient for initial planting which may be filled with 5 kg compost/FYM + 100 g VAM + 15g phosphorus solubilising bacteria (PSB) + 5g Azospirillum. As plant protection measure 0.5 per cent Chloropyriphos solution is added to avoid termite

and ant attack. Best time for planting is June. In general each clump may be supplemented with Nitrogen 60/120/180 gms Urea (Nitrogen) 60/ 120/180 gm Phosphorus, 50/90/140 gm Potassium during 1st , 2nd and 3 rd year's respectively along with 5 kg of compost/FYM in two split doses one in Monsoon and 2nd after 15 th January immediately after winter season and there after every year @ 100 gms dose per culm in each clump a mixture of Urea: DAP: MoP @ 3:4:3 proportion in two split doses . Watering: regularly after monsoon compulsory for first three years and it's better to continue for lifetime for better yields . First year twice in a week and subsequently once in 15 days. Harvesting: from 5th year onwards. Culms should be 2-3 years old for harvest. Retain 50% mature culms for better growth after harvesting. Time of harvesting: Nov- May. Average yield: 5-10 poles/ clump per year.



Bamboo culms (poles) have short growth cycle (3 to 5 years) with normally 3 year old ones being harvested. Bamboo is self-reproducing as new rhizomes emerge every year monsoon season despite older ones being harvested. This quality makes it financially viable with regular income from 7th year onwards when the investment made begins to break even. Also another specialty of bamboo is that it is low cost in maintenance and regeneration with relatively less pests and diseases. Plant protection measures may be required as and when pests or diseases appear. Moreover harvesting can be done at the owners convenience unlike vegetables and fruits which can't wait. Summer temp should not be below 15 oC. Cold winds are harmful to leaves. Though loamy soils are best suited, some bamboo species are highly versatile and grow in almost all soils including degraded, alkaline/saline soils. However yields in such problem soils are low. Best soil Ph requirement for bamboo growth is 4.5 to 6. However even if soil has higher pH, in time with addition of biomass by way of fallen leaves, roots and rhizomes, the pH reduces. Spacement varies from 4x4 mt to 8x8 mts depending on species. Higher spacing will help grow thicker and better quality bamboos. Some nursery people are advocating close

spacing for energy plantations @ 1000 to 2500 plants per acre. From our feedback from farmers, by and large closer spacing with high density planting is a failure and farmers have reported incurring losses. However detailed studies are required to understand the economics and yields of such plantations and the market demand for thin shorter bamboos that such plantations yield. Without such study results farmers should not take up high density plantations.

By and large proper studies are required for deciding optimum spacing for maximum yield for each bamboo species. Further proper species recommendations and package of practices for cultivation need to be researched and recommended for different agroclimatic regions of the country so that wrong species with wrong spacing are not planted wasting expenditure of farmers. Spacing of more than 5mx5m give thicker bamboos of quality which fetch higher value. Also it would be good to plant some tree species such as Teak, Rosewood, Mahogany, Sandalwood, Melia dubia, etc replacing bamboo here and there with such trees at a spacing of minimum 30 mt between such trees. Semi shade helps taller growth of most bamboos.

It would be best to plant bamboo on agricultural field boundary which will give additional income to the crops being grown. Irrigation is required for best yields @about 20 lit/plant/day after monsoon season. Plant protection interventions requirement is minimal. Initial years sucking pests should be controlled.

Yields can go up to 10-20 Tons /Acre/yr, 5-10 bamboos of 3 years maturity can be harvested from each clump every year from 7th year onwards till maturity which varies from species to species. Harvested poles are placed in flowing water for 10-20 day and then air dried for 1.5-3.5 months for durability. Bamboo is also chemically treated for durability and with proper treatment the bamboo poles last in construction for 15-20 years.

Net Returns from well managed plantations could be from Ra 50,000- 100,000/- per year from 7th-8 th year onwards. Farmers should take up bamboo plantations only after ascertaining marketing tie up for sale of bamboo, especially since many are evincing interest in raising new plantations in view of good returns and low maintenance.

IV. Versatile Uses of bamboo:

Bamboo has over 1500 uses and applications and hence has great potential for providing opportunities for livelihood development of the rural poor.

No part of the bamboo plant is wasted.

Shoots are harvested for food; branches for poles; main bamboo pole for fibers/pulp/ charcoal production, lower trunk for construction uses or flooring and engineered bamboo products. Traditionally bamboo has been used for scaffolding, basketry, food, musical instruments, etc. However presently it's being used for several purposes such as furniture, decor, beverages, engineered bamboo products, activated bamboo charcoal, cosmetics, medicines, tea, chemicals, bamboo textiles, organic pesticides / fungicide, paper, ornaments, toys, bio- plastic granules, replacement for plastic, construction including schools, resorts, hotels, houses, architecture , interior decoration, Decoration in vehicles, spectacles, helmets, etc., in post- disaster housing earth quake areas, coastal areas Innovative uses -heavy duty drainage pipes and wind turbines. Ecology environment: combat climate change, phytore mediation, Agro forestry, live fencing, dry bamboo fencing, leaf compost.

For more information please contact

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