

Broom grass

The Broomsticks are made from panicle inflorescence of *Thysanolaema maxima*, locally called Arjun flowers, which is one of the important Minor Forest Produce of Tripura. This is used for sweeping after tying several sticks in a bundle. It grows naturally in the hilly slopes of the State. The local people meet their requirement generally from neighbouring forests and the urban population generally purchases it from the local markets. The collection season of Arjun flower is from January end to March/April every year. During this period, the forest dwellers collect Arjun flowers and sell it to the local LAMPS (Large Multi-Purpose Society), PACS (Primary Agricultural Co-operative Society), middle man and traders and final disposal is done through MARKFED (Tripura Marketing Federation). Broom sticks have profitable market in the state, outside the state and even in the international markets. Since 2010-11, the NTFP Centre of Excellence has been facilitating the marketing ensuring a fair value for the produce collected by JFMC members from their project areas.

Arjun flower used to be disposed by Forest Department to the private parties on Mahal (Lease) basis till 1985. Later, it was decided by the Govt. of the Tripura that Arjun flower lease would be worked through LAMPS and PACS of the State and the practice of leasing out of Arjun flower mahals to the private parties should be discontinued to ensure fair price to the collectors, who are mostly of tribal community living in the interior places. The Tripura Apex Marketing Cooperative Society (TAMCS) Ltd., (now MarkFed) has been enjoying the monopoly right on Arjun flower since 1985-86. In the year 1999-2000 they did not accept the lease. Certain efforts were then made to lease the Arjun flower through open tenders and final decision to charge Rs 1.00 lakh as lease rent from TAMC Ltd was taken from 2000-01 with increase of 15% every year thereafter.

Trade facilitation by NCE (excluding the figures of direct operation by MARKFED):

Year	No of Ranges	Quantity marketed (MT)	Value (Rs lakh)
2010-11	1	522.00	167.00
2011-12	9	347.20	122.32
2012-13	13	310.00	118.03
2013-14	19	459.00	226.54
2014-15 (P)	15*	428.50	310.35

* 3 Ranges were given to MARKFED to operate directly.

Orchids

Large number of orchid varieties occurs in Tripura. Jampui hills in the State are famous for its excellent climate condition, luxuriant landscape, flourishing forests and orchid varieties. Farmers could cultivate the Cymbidium variety for sale as cut flowers in Delhi/ Calcutta market with the assistance of Forest Department. It is estimated that the cultivation of 10,000 plants of Cymbidium hybrid will generate a profit of Rs 50,000 in the third year, rising to Rs 100,000 in the fifth year.

Major problems of Orchid sector in Tripura are-

- * Lack of quality planting material
- * Inadequate bulk supplying capacity
- * Poor marketing linkages
- * Unscientific post harvest processing
- * Lack of R&D facilities

The following efforts need to be taken for orchid development in the state-

- Mass multiplication of quality planting materials of ornamental orchids through tissue culture, which Horticulture Department is already doing.
- Involving small entrepreneurs under JFMCs for continuous bulk supply of desired species and its flowers.
- Developing marketing linkages.
- Research and Development in collaboration with research organizations.
- Conservation of wild orchids of Tripura.

Important Bamboos of Tripura

Sl No	Common name	Scientific name	Common uses
		Naturally grown:	
1	Muli	<i>Melocanna baccifera</i>	Roofing, mat, fence, Agarbatti sticks, edible shoots
2	Mritinga	<i>Bambusa tulda</i>	Housing, furniture, handicrafts, Agarbatti sticks.
3	Rupai	<i>Dendrocalamus longispathus</i>	Common housing, furniture, handicrafts, basket
4	Pecha	<i>Dendrocalamus hamiltonii</i>	Construction, weaving works,

Sl No	Common name	Scientific name	Common uses
			basket
5	Kailyai	<i>Oxytenanthera nigrociliata</i> Syn. <i>Giganiochloa andamanica</i> .	Construction & fencing work, basket
6	Dolu	<i>Schizostachyum dullooa</i> Syn. <i>Neohouzeaua dullooa</i>	Shiny quality Mats, Handicrafts
		Cultivated:	
7	Lata or wadu or sarail bans	<i>Melocalamus compactilorus</i>	As rope and good quality hats.
8	Barak	<i>Bambusa balcooa</i>	Structural bamboo, edible shoots
9	Kanta bans	<i>Bambusa bamboos</i> Syn. <i>B. arudinacea</i>	Miscellaneous
10	Bom or Bethua bans	<i>Bambusa cacharensis</i>	Furniture, handicraft
11	Tetua	<i>Bambusa jaintiana</i>	Fishing rods.
12	Paora	<i>Bambusa polymorpha</i>	Handicraft, Toys, Weaving, basket, Agarbatti sticks
13	Kai	<i>Bambusa teres</i>	Handicrafts, weaving constrictions.
14	Bari/Jai	<i>B. vulgaris</i>	Construction, furniture, handicraft
15	Lathi bans	<i>Dendrocalamus stictus</i>	Introduced recently, structural bamboo, pulp
16	Kanak kaich	<i>Thyrsostachys oliveri/</i> <i>Bambusa affinis</i>	Javelin, fishing rod, good quality furniture
17	Makal	<i>Bambusa nutans</i>	Construction, handicraft, fencing
18	Kanta Barak	<i>Bambusa salarkhanii</i>	Structural use
19	Hedge Bamboo	<i>Bambusa multiplex</i>	Hedge, ornamental
20	Asper	<i>Dendrocalamus asper</i>	Edible shoot, structural use
21	Buddha Belly Bamboo	<i>Bambusa ventricosa</i>	Ornamental
22	Tiger or golden bamboo	<i>Bambusa striata</i>	Introduced recently, ornamental, used for poles.

Bamboo Resources

Status

Bamboo is the principal minor forest produce of Tripura and the people of the State use it extensively for different purposes. Some of the uses of bamboo are mats, agricultural implements, fence material, scaffolding, handicraft items, woven baskets, Agarbatti sticks, umbrella handles besides its use as fuel and leaves as

fodder. It is also used for embankment, slope protection, check dams, reinforcement grids, bridges and roads. Muli Bamboos and some other species are also exported to Assam for use in Paper mill. Kanak kaich (*Thyrsostachys oliveri/ Bambusa affinis*), Makal (*Bambusa nutans*) and Mritinga (*Bambusa tulda*) are used for making of furniture. Presently, only about 2% of the total extracted bamboo is used for value addition but it holds tremendous potential for growth. It plays a very important role in the economy of the state, in its employment generation and household income.

The bamboo resource is spread over about 2397 sq km of the State forming about 23% area of the State. Pure bamboo brakes are found to occur in the state over 938 sq.km, which are approximately 9% of the forest area (Tangwan, 1995). Bamboo forests mixed with other miscellaneous trees occur over 1350 sq.km. Bamboo in small private holdings occur over 109 sq.km with Bari/Barak/Ruai/Kanak Kaich as major bamboo species. Large-scale plantation of Kanak Kaich are found in the North west area of Agartala (near Mohanpur).

About 80% of the bamboo resources of the state is of Muli bamboo, which is the only non-clump forming bamboo of the state and it finds maximum use in the state.

Average productivity of bamboo resource is 0.73 MT/ha./annum in the state, which is higher than All India Average of 0.51 MT/ha./annum but much lower than 3.97 MT/ha./annum of China (TFD, 2007).

About 6.1 million mandays per annum of employment is generated from management and extraction of bamboo (TFD,2001).

About 1.49 lakh artisans are producing crafts of sale value of Rs 35.34 crores (TFD,2001) and about 20000 artisans are engaged in Bamboo Handicrafts (website of Government of Tripura/Purbasha).

Bamboo extraction is about 184 million by stem numbers/annum with utilization in housing, supply to paper mill, handicrafts, agricultural implements and other items being about 135, 16.5, 3.2, 1.5, 28 million numbers/ annum respectively. Out of 184 million numbers/annum bamboo extraction, 110 million numbers/annum is recorded removal and 74 million numbers/annum is unrecorded removal (TFD, 2001). Thus, bamboo resource is getting depleted due to over-exploitation as well as gregarious bamboo flowering.

Considering per capita average demand of 42.76 bamboo stems, the total demand of bamboo per annum has been projected to be 117.93 million stems by numbers in the year 1995 (Tangwan,1995).

The Forest Survey of India, Eastern Zone, Kolkata had carried out an inventory of Bamboo in Tripura during 1989-90 in bamboo forest area including private bamboo area over 4417 Sq.km in four vegetative strata: Miscellaneous with bamboo (766 sq km), Bamboo (975 sq km). From the data on growing stock of bamboo (of all strata), proposed yield of bamboo in the State was found to be 180 million bamboo equivalent to 217,604 MT (by weight) per year (FSI, 1993; TFD, 2007).

Growing stock of Bamboo in Tripura and Proposed Yield

Parameters		Clump Formig Bamboo		Non-Clump Forming Bamboo	
		Nos.	Weight	Nos.	Weight
Growing stock	Average /ha.	58.95	94.93 kg`	1058.36	1255.08 kg
	Total of State	38.01 million	61230 MT	682 million	809230 MT
Yield (Taking 4 years rotation): Total Yield: 180 million/217604 MT		9.5 million	15307 MT	170.5 million	202307 MT

(Source: FSI, 1993; TFD, 2007)

State Bamboo Policy (TFD, 2001) proposes to create 50,000 ha Bamboo ANR and 10000 ha Bamboo AR in forest area and 5000 ha Bamboo plantation on private lands. However, 11,257 ha Bamboo plantation was created by Forest Department under different Schemes from 1999-2000 to 2006-07 in the State, out of which about 92% was Muli bamboo plantation.

Bamboo extraction and management:

The quantity of bamboo extracted and sold since inception of bamboo flowering other than those consumed by the local community free of cost as per the rights and concession is as given below:

Year	Recorded bamboo extraction	
	Quantity sold (in thousand MT)	Revenue realized (Rs lakh)
99-2000	172892.17	84.12
2000-01	116301.86	82.29
2001-02	118772.97	99.87
2002-03	127709.83	103.06
2003-04	143597.33	174.64
2004-05	108922.53	120.65
2005-06	114205.55	121.89
2006-07	86539.31	124.92
2007-08	91756.43	283.69

Utilization pattern of bamboo:

Year	Commercial utilization in MT						
	Construction/ structural use	Paper & pulp	Agarbatti	Umbrella handles	Handicrafts	Export to Bangladesh	Total
2004-05	76083	14820	15280	1800	940	0	108923
2005-06	91854	25360	9133	1653	330	2200	130530
2006-07	102840	17856	14183	1014	854	4600	141347

Bamboo Flowering

From the Annual Administrative Report of the State for the year 1911-12, we find that Tripura faced the phenomenon of gregarious flowering in this period but it was defined as Bamboo plague in the Administration reports of the Government of the *Maharaja*. Next gregarious flowering of Muli Bamboo in Tripura was reported in the year 1958-59. The dry bamboo culms over a very large area due to gregarious flowering were required to be extracted as these were posing the risk of fire hazard. However, control of fires in flowered bamboo area from the month of February till May reduces the fire hazard as the dry bamboo get degenerated to humus in the hot humid climate thereafter.

It was reported that gregarious flowering of muli bamboo was followed by famine in Mizoram in the past. The population of rodents suddenly increased and invaded the Agricultural field and destroyed the food crops.

Increase in rodent population from 2002-03 to 2007-08 was not reported from Tripura initially. But, later some reports of rodent damage of Jhum crop appeared in Newspapers during August/September 2008. This however may be linked to the flowering of other bamboos, whose seeds are consumed by rats and required thorough study.

Apart from the gregarious flowering in Muli bamboo, sporadic flowering has been occurring in other species of bamboo also.

Management of Bamboo Flowering

State Government has constituted State Level Monitoring Committee under the Chairmanship of the Chief Secretary. The representatives of other departments have also been included in the committee to monitor and tackle the likely problems of health and sanitation, famine and rodents. The District Level Committees were also constituted under the Chairmanship of the District Magistrates and Collector with the members from the concerned district level functionaries to maintain and tackle the problems. Beat/Range/Divisional jurisdiction has been re-oriented to make co-terminus with the jurisdiction of Block/Sub-Division/Districts for the facility of integration of works.

The Gaon Panchayats/ADC village level Committees' were formed at the Beat level to conduct field survey periodically to assess the apparent growth in the population of rodents and to estimate the level of rodent menace. The Animal Resource Development Department (ARDD) and Agriculture Department were involved at this level. Adequate stock of fumigation tablets has been built up in the ARDD stores. The stock of medicines and sanitation materials was build up in the PHCs/ Dispensaries by Health Department; buffer stock of food was maintained in the stores of the Food and Civil Supply Department.

Total afforestation area and bamboo plantation area (1997-2007):

Since 2002-03, when gregarious Muli bamboo flowering had started in the State, bamboo regeneration efforts have taken priority in the plantation activities of the Forest Department, as may be seen from the table below:

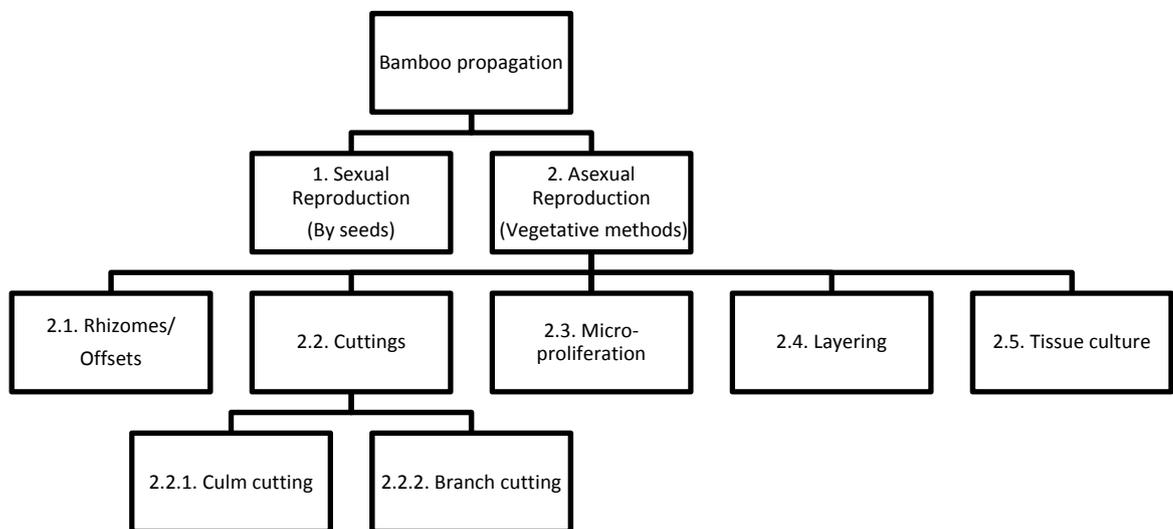
Plantation Year	Total afforestation (ha)	Bamboo plantation (ha)	Percentage share (%)
1997	4816	189	3.9
1998	5248	144	2.7
1999	4377	98	2.2
2000	3621	154	4.3
2001	5544	718	13.0
2002	4759	1214	25.5
2003	5119	793	15.5
2004	7469	1805	24.2
2005	6119	3091	50.5
2006	7798	2734	35.1
2007	10770	5907	54.8

Plantation

Nursery & cultivation techniques

There are various methods of propagating bamboo, especially at the nursery level.

Bamboo Propagation: There are various methods of propagating Bamboo, especially at the nursery level. The following methods are used for Bamboo propagation in a nursery for onward plantation on commercial basis.



Bamboo Propagation Techniques.

<Scan & link pages 31-34 from "Management of Gregariously flowered Bamboo Areas in Tripura" >

Main Diseases of Bamboo:

Name of the Disease	Causal Organism	Symptoms	Control
1. Damping	<i>Rhizoctonia Solani</i> ; <i>Fusarium monaliforme</i>	Rotting of well viable seeds and becomes greyish brown lesion. The lesion spread and become necrotic.	Preventing fungi from entering into the seed bed.

Name of the Disease	Causal Organism	Symptoms	Control
2. Smut	<i>Useilago shiraina</i> & <i>Tilletia bambusae</i> .	The fungal attack replaces the seeds with black fungal spores, causing Smut.	Control of smut is possible by planting resistant species and seed treatment.
3. Black mildew	<i>Melioia species</i> , <i>Haraea japonica</i>	Powdery black patches appears on the upper surface of matured leaves. Severe infection reduces effective photosynthetic areas of the leaves.	Opening the canopy will reduce the infection.
4. Sooty mould	<i>Capnodium sp.</i> & <i>Spiropes scopiformis</i> .	Infection usually appears on the upper leaf as a sparse, black network of hyphae or a thin, black powdery fungal coating.	To control aphids is key treatment. Protection of natural enemy such as ladybug beetle, parasites.
5. Leaf blight	<i>Bipolaris maydis</i> , <i>Bipolaris bambusae</i> .	Small spindle shaped spot appeared on the leaf surface. The spot becomes large & leaf turned into dry.	Spraying of 50% Hexaconazol.

Insect Pest of Bamboo

Bamboos are subject to injury by various kinds of herbivorous insect. Attack by those insect reduces plant vigour and the production of bamboo stands. These insect can damage bamboo in four ways.

- (i) Removing the plant fluid.
- (ii) Causing mechanical injuries from egg laying.
- (iii) Injecting toxic compounds into plants.
- (iv) Transmitting disease.

Seeds & seedlings

<Scan & link pages 35-38 from "Management of Gregariously flowered Bamboo Areas in Tripura">

Harvesting of bamboo

Harvesting of bamboo is done for shoots during rainy season and for culms during the drier months. Harvesting can start from fourth year of planting. Felling of young culms growing at clump periphery is harmful to clump health and production. Older culms are mostly in the centre part of the clumps, so to cut the older (3-4 year old) clumps; one has to enter inside the clump. All the old culms are not cut; instead a few culms distributed throughout the clump are kept for providing the mechanical strength to the remaining younger ones.

Culm harvesting and handling:

The following rules apply for harvesting culms of sympodial bamboos.

- ❖ Harvesting of mature culms may begin in the fourth year after planting.
- ❖ It is necessary to make a lot of noise to frighten snakes, which may be nesting inside the bamboo clump. Wild boar also, take shelter in the bamboo thickets near the villages and thus one has to be careful before approaching bamboo clumps for harvesting.
- ❖ The culms should generally be harvested during the dry winter season. The starch content of bamboo is lower during period of dryness. Lower starch content in the culms will make them less susceptible to attack by borers, etc.
- ❖ The cutting operations should be planned to avoid harming young culms.
- ❖ It is highly advisable to use sharp tools and disinfect harvesting tools using bleach. This lowers the risk of infecting the plants.
- ❖ The young culms should not be cut unless congestion in the clump prevents the cutting of mature culms.
- ❖ The Culm should be cut right above the first node from the ground level. This is necessary so that water is not allowed to accumulate in the protruding internodes. The accumulation of water may result in rotting and invites insects to lay their eggs.
- ❖ The entire clump should never be cut unless it has been verified to be seriously infected by a disease.
- ❖ Each clump should be provided mulch after harvesting.
- ❖ After they are cut the branches and leaves of the culm should be stripped off. These should be neatly piled around the clump to provide organic material for mulching. If the plantation is situated near a river, the culms may be allowed to soak in water for a few weeks to aid in the removal of starch and protect them from beetle attack. Otherwise the stripped culms should be hauled to an

area where they are sorted and air-dried. If preservative treatments are necessary proper methods have to be applied depending upon the requirements as mentioned in this manual.

Harvesting for Bamboo Shoot

- ❖ The emergence of new shoots begins during the rainy season of the year after planting. These new shoots should not be harvested. A small amount of edible young shoots may be harvested in the third year of the plantation, i.e. two rainy seasons after planting. Harvesting of shoots should only be done on well established clumps. A few rules apply to the harvesting of shoots.
- ❖ Shoot growing season of the species differs with species and therefore the plantation should be carefully inspected after rains for bumps that indicate emergence of bumps.
- ❖ There should be good heap of mulch around the clump. The mulch will keep the new shoots moist and retain their quality,
- ❖ The shoots should generally be harvested within one to two weeks after they appear from the ground. Shoots harvested too late will be tough and of poor quality as food.
- ❖ The young shoot should be cut using a sharp harvesting blade (resembling a large chisel). The cut would be made about 10 cm to 15 cm below the soil at the soft section where the shoot emerges from hard rhizome.
- ❖ Do not cut shoots that have grown beyond the average edible shoot size. These will be fibrous, tough and inedible and should be allowed growing into culms.
- ❖ Never harvest all the shoots of a clump. Always see to it that several shoots are allowed to grow into culms.

Miscellaneous regulations:

- ❖ Follow the rules that have been mentioned in the Working Plan.
- ❖ In the year of flowering, no culms shall be cut until after the seeds have been shed,
- ❖ After the seeds have been shed the area should be rigidly protected against fire and grazing.
- ❖ No culm of the last rain is to be cut.
- ❖ 'N' number of well grown mature culm should be retained in each clump as evenly spaced as possible subject to a minimum of 6 culms where N-number of new culms produced in the last rains. The mature culms retained shall not be more than 4 years old.

- ❖ Digging of rhizome should not be allowed except in very special circumstances and that too under orders of forest officer in writing.
- ❖ The culms should be worked out on a thinning out principle in a horse shoe pattern.

Additional regulations

- ❖ Grazing should be totally prohibited.
- ❖ Rigid fire protection measures are to be taken.
- ❖ Jhuming should not be allowed in bamboo forests.
- ❖ Plucking of bamboo shoots should be strictly prohibited.
- ❖ One year old bamboo culms may be allowed to be cut for umbrella handles stick only under the sanction order of an Officer not below the rank of D.F.O. who will allow such extraction only after inspection of forests with due regard to the principles of good silviculture.

(Ref: Book on nursery techniques of Bamboo edited by Kamesh Salam, Director and NK Deka of Cane & Bamboo Technology Centre, Guwahati with the support from National Bamboo Mission, New Delhi in the year 2007. Various prescriptions from the Working Plans of the State have also been taken).

Bamboo shoots

Among the NTFP products, most common and favourite food items are 'Muia' (bamboo sapling) and 'Karul' (bamboo shoots). Bamboo shoot is a young culm harvested at the time or shortly after it appears above the soil surface. Bamboo shoots are available in good quantity from the month of May to August. These are in good demand in Japan, Singapore, China, Thailand, Hong Kong and UK.

Bamboo shoots need to be processed because of high moisture content for increasing shelf life. Few processed products are: canned bamboo shoots in brine, in the form of curried vegetable, syrups, bamboo shoot candies, bamboo shoot chutney, fermented bamboo shoot, bamboo shoot sweet pickle, bamboo shoot beer, etc.

Average food value of fresh and dried bamboo shoots:

SI No	Name of the constituent	Amount per 100 g	
		Fresh shoot	Dried shoot
1	Moisture	87.10 g	-
2	Protein	3.90 g	25.3 g
3	Fat	-	3.3 g
4	Fibre	-	9.5 g
5	Carbohydrate	7.50 g	42.8 g
6	Minerals	1.40 g	-
7	Calcium	20 mg	208 mg
8	Phosphorous	90 mg	569 mg
9	Iron	0.10 mg	12.5 mg
10	Niacin	200 mg	3.8 mg
11	Riboflavin	-	0.09 mg

(Adapted from Bhakta (2004) & Das (1997))

Bamboo shoots species eaten in Tripura are Muli, Mirtinga, Rupai; and also Bari, Barak and Dolu.

Estimated sale of bamboo shoots in Tripura

District	Quantity (in kg) sold			Market Value (Rs lakh)
	From forests	From private land	Total	
North	6557	1657	8214	2.46
Dhalai	14386	0	14386	4.32
West	73529	65332	138861	41.66
South	14286	1143	15429	4.63
Total	108758	68132	176890	53.07