

Silviculture and Management of *Dendrocalamus Strictus* (Salia Bans)

(With particular reference to Orissa State)

* JALIL AHMED,

I. SILVICULTURE

Distribution and Ecology :

Gamble enumerated 115 species of bamboos occurring in India, Pakistan, Burma and Malaya. In other words they are found in tropical and sub-tropical regions of the World specially in Asia and South America, irregularly distributed in the Tropics a few occurring in Sub-Tropical and Temperate Zones. In present India there are about 136 species of bamboos (Raizâda and Chatterjee 1956).

Dendrocalamus strictus, also called male or solid bamboo, grows better on hill slopes, well drained soils and stony river banks. Author has measured girths upto $9\frac{1}{2}$ inches along nala banks and on deep well drained soils in Koraput District. This species occurs throughout India in moderately damp to fairly dry localities in the planes and on hills upto 2,000-3,000 feet. In brief *D. strictus* can grow on any type of soil if it is not waterlogged. It attains large sizes and thrives well on coarse grained, fairly porous and well drained sandy loams. Yadav after detailed study of site and soil characteristics of bamboo forests found out that under *Dendrocalamus strictus* pH value varied from 5.0 to 6.5 and the nature of soils under this species were "poor, coarse grained, well drained dry soils and stony soils on hill side, avoiding poorly drained and moist heavy clay soils."

In Orissa State Male or Salia bamboos are found in moist deciduous, dry deciduous and dry scrub type of forests. The tree associates of salia are *Sal. pterocarpus*, *marsepum*, *Terminalia* spp., *Adina cordifolia*, *Lagerstroemia parviflora*, *Dillenia pentagyna*, *Diospyros melanoxylon* and *Anogeissus*

latifolia. Some writers have mentioned *Cleistanthus collinus* as one of the associates of *D. strictus*. Writer of this article after visiting forests of Berhampur, Ghumsur, Rayagada and Kalahandi Forest Divisions has come to a conclusion which is contrary to other's ideas. Salio culms persist as long as *Cleistanthus collinus* has not grown to the same height as bamboos. But as Karda tree (*Cleistanthus collinus*) gains height and its crown starts competing with those of bamboos, growth of the latter drops down, top shoots become stunted and the culms do not look happy. In many cases bamboos are seen dying and becoming extinct. This curious phenomenon needs a closer study and research. It is probable that either the roots or leaf litter of Karda is detrimental to the growth of bamboos. In the opinion of the author calling *Cleistanthus* an associate is not quite correct. Instead of being friendly towards salia, it behaves like an ouster and enemy. This is dissociation and not association.

Nature and behaviour of Salia clumps :

Density of stocking of bamboo clumps appears to be dependent on climatic, edaphic, physiographic and biotic factors. Clump size largely depends on the locality factors and nature and intensity of fellings.

There seem to be certain conditions under which production of new culms will take place. It appears likely that under favourable climatic conditions over a period for storage of food in the rhizome and for the formation and growth of buds, production of new culms will ensue. Ample soil moisture and therefore good rainfall are the main requisite of the period during which food is being

*Forest Officer, M/s. Straw Products Ltd., Jaykaypur, (Orissa).

stored. The length of time required for the culm rhizome to store sufficient food reserves to launch a period of quick growth depends partly upon the degree to which the reserves were consumed during the previous flush period and partly on the capacity of the plant to manufacture food, which may be dependant on the significant factors of environment both above and below the ground. Growth of new culms drains off the food reserves and then it takes two to three years for sufficient replenishment to induce production of new culms. It has been observed that in normal conditions, production of new shoots takes place in alternate years.

If the clump is properly and regularly worked leaving enough culms well distributed, the clump will thrive well and its vigour maintained. In such clumps, new culms usually develop on the periphery. These culms emerge in the beginning of monsoons and continue growing till September-October which is the 'main' growing period in Orissa. During summer when moisture content falls, rhizomes remain dormant and no new shoots are given off. In dry areas under scanty precipitation and less favourable conditions, stocking may be 15-20 culms per clump. But under favourable conditions 550-110 culms or even more are developed. Culms of *Dendrocalamus strictus* may attain heights of 25-50 feet and measure 1"-3" in diameter. They are solid in dry localities but tend to be holloy under moist conditions and deep fertile soils.

Phenology :

In Orissa State *Dendrocalamus strictus* flowers from January to May and the Seeds ripen in May-July. Flowering is generally preceded by leaf fall and after flowering and seed formation the culms die. Generally all the culms of a clump flower simultaneously but there are instances when only few of the lot have flowered and died and nature has temporarily spared the lives of others.

Symptoms of flowering :

Although all symptoms of flowering are obscure but by experience one can roughly describe the apparent changes that a culm undergoes. Following are some of the important points :—

1. Branches tend to be bushy and stunted.
2. Generally, production of new shoot stops.

3. Colour of the stem becomes dull and all freshness and vigour disappears.
4. In several cases yellow/whitish vertical streaks develop on the stem.
5. Leaves tend to brown and fall.

Exact reasons for the death of the flowered culms are unknown but it is assumed that death ensues due to sudden loss of all the stored food which is consumed in flowering and fruiting, resulting in sheer exhaustion of the culms. It is probable that flowering is enhanced due to disturbance in the balance of the environmental factors. It is a common belief that drought and famine conditions and large scale bamboo flowering go together. We have laid out a few plots to study the causes of flowering and find if by carrying out some cultural operations, we can delay flowering. It will take some time before arriving at a definite conclusion. We are also trying to study the progress of bamboo flowering.

Two types of flowering are noticed :—

(1) **Gregarious flowering :** Where large areas or the entire forest flowers. This type of flowering usually occurs after long periods of 20-70 years. Deogaon has mentioned 40 years in U.P., 21 years in M.P. and 28 years in Madras. This sort of flowering is bad for the lease holder as due to this a number of complications arise from management point of view. This will be dealt with in detail under Management.

(2) Sporadic flowering :

Patchy flowering where scattered clumps flower and die. Periodicity of flowering for *D. strictus* may differ from locality to locality. It has been reported that sporadic flowering occurs frequently on dry coarse grained soils than on fine grained moist soils. Sporadic flowering is good for the well being of the forest as it helps in gradual enrichment of the existing forests by patchy regeneration. Type of management plays an important role in the establishment of naturally regenerated seedlings.

In some of the bamboo felling series leased out to M/s Straw Products in Orissa State, it has been noticed that satisfactory regeneration of bamboo seedlings has taken place due to sporadic

flowering and in some places they come profusely. As far as establishment is concerned it can only be made sure with proper protection against fire, grazing and other biotic factors. In the absence of these measures most of them succumb to death and only a few survive.

In the beginning natural seedlings prefer shade but as they grow bigger they need more light and space and least competition. It has been seen that clear felling of a forest results in profuse natural regeneration of bamboos but unless some cultural operations are carried out future prospects for good quality and adequate supply are bleak.

Artificial regeneration :

Not much work of bamboo plantations has been done in Orissa State but with the increasing demand of bamboos for various purposes with special reference to paper industry, the Forest Department is undertaking bamboo plantations wherever possible. At present bamboo has become such an important specie that there is need for the creation of a special section of the Forest Departments which should devote to research for the betterment and enrichment of the existing bamboo forests and give a hand to nature for increasing the production potential of the poorly areas throughout India.

Bamboo plantations can be raised by seedling planting, rhizome plantings, off-set planting and by direct sowing. Artificial regenerations from seeds has shown better results and is preferred to rhizome planting. Off-set and rhizome planting is risky as they are liable to flower when parent culm flowers.

Planting out of the bamboo seedlings is to be done carefully. Too deep planting is to be avoided as this given bad results. Six to eight inches deep planting has given good results. A spacing of minimum 18 feet within and between the rows is considered desirable.

II. MANAGEMENT

Management is one of the most important aspects in forestry. The aim of management of Bamboo forests is perpetual sustained yield. Every forest has its own individuality and should be treated accordingly. One cannot force nature to

act as one wishes, but can give a helping hand in what the nature intends to achieve. In the management of any type of forests preconceived ideas and foregone conclusions are of great risk and should always be avoided.

Felling cycle :

The felling cycle of bamboo forests is 3-4 years. This period of 3 or 4 years is for convenience of administration and execution of the prescriptions in the field. In author's opinion same period should not be fixed for every forest as there are no two forests any more than two faces exactly alike. Similarly felling cycle and felling rules of various bamboo felling series should not be built on the same pattern. The period of felling cycle depends upon a number of considerations such as condition of the crop, environmental and biotic factors. In areas where shifting cultivation is prevalent it will be better for one to think in terms of shortening the felling cycle so that the forests are visited and worked at short intervals.

In areas where illicit fellings are prevalent similar felling cycle may reduce the intensity of such fellings. The conclusions of all India Bamboo Experiments reveal that the quality and quantity of culm production is in no way hindered by 3 or 4 years felling cycle.

Felling rules :

No hard and fast rules can be applied in forestry and in case of bamboo forests also it is impossible to adhere to strict rules. It will be mistake to suppose that the same felling rules can be enforced in bamboo forests which are adjacent to each other. Actually best way of managing these forests is to keep in view the importance of locality factors and the clumps should be worked according to their composition and growth. Following are some of the rules which should be kept in mind at the time of fellings :—

1. No culms of the last two rains shall be cut.
2. In each clump apart from culms of first two seasons growth, atleast six older culms shall be retained. *** These culms should be well distributed over the entire clump and one sided felling should be avoided.**

3. Clumps containing less than 10 culms shall not be worked excepting removal of dead and dying culms.
4. Felling of leading culms of the periphery should be avoided as far as possible.
5. Flowered clumps should be clear felled after the seeds have been shed. In such clumps, culms should be cut as low as possible taking care that the rhizomes are not uprooted as this will loosen the soil which is liable to be washed away during rains.

Field observations by the author :

1. In unworked clumps—Poor or no regeneration. The quality of new shoots is poor. They are thin lanky.
2. In well worked clumps—Good regeneration. The quality of new arrivals is as good or even superior to that of parents. The development of new shoots in well spaced.
3. In badly worked clumps—Poor regeneration. If working of clumps is one sided, no regeneration on the side of felling. Some new shoots near the few culms left on the opposite side of the worked culms. The shape of the clump changing from circular to oblong.
4. Green high stumps did not produce new shoots.

Management in the Event of Flowering :

Sporadic flowering may be beneficial if the seeds of the flowered clumps are given a chance to germinate and establish by protecting them against various hazards. During summer, fires may destroy majority of the seeds shed and the remaining seeds are either washed away by rains or those which luckily escape calamities and germinate may succumb to death by next seasonal fires.

Stock mapping of the fairly large flowered patches and then treating them as small units of plantation and cultural operation will help to restock the area.

Under favourable environmental conditions both above and below the ground, regenerations of

bamboo seedlings is profuse. These seedlings should be thinned and spaced out to form undependant clumps. Advantage should be taken of the spare seedlings for restocking the blanks.

In case of gregarious flowering, problems of management take a different shape and if not controlled in time, they go on multiplying. Problems of gregarious flowering include :—

1. Increased risk of fires and insects.
2. Unexpected large scale fellings may disturb staff position. Difficulties are also likely to arise for arranging sufficient number of felling labourers.
3. Transportation may become difficult due to sudden availability of large number of bamboos and rates of transportation may go up.
4. Storage of bamboos is likely to cause a headache. Generally no industry will be ready to meet such a situation and hurried arrangements are to be made.
5. If all the felled over material is not removed before rains then during first year 2% of the total stock is likely to go waste and if it is not removed for another 2 years 5-10% of the stock may rot. Percentage of wastage will also depend on the size and number of the stacks and the method of stacking.

All felling operations will be stopped till the culms have shed their seeds after which they will be clear felled. This massacre of dead flowered clumps need not be confined to the coupe of the current year. Hurriedly prepared stock maps of the flowered areas will be of immense use under these conditions for better Organisation.

Regeneration of flowered areas :

If biotic factors are kept under control more often than not natural regeneration of bamboos will come up in abundance after gregarious flowering. There may remain blanks which are to be filled up either by direct sowing or by planting. Natural seedlings in their first 4 years need much

attention and are to be kept free of weed competition. Soil working, application of fertilizers and manures will give them a boost and they will be able to form independent clumps, ready for yielding fair quality bamboos within 10-12 years.

Though it may not be possible in all cases, yet wherever it can be managed, artificial regeneration of gregariously flowered areas by using rhizomes or seeds of different stocks and mixtures of various species will ensure perpetual sustained yield. Clumps of different stocks and mixture of different species will not flower simultaneously and the problems emerging at the time of flowering will be less complicated.

Management in the event of frequent fires :

Fires are one of the most destructive agents no matter whether they are ground fires or crown fires. *Dendrocalamus strictus* is a fire tender species and even minor fires may cause discolouration of the culms in which case bushy branches are produced at the nodes and the growth of the culm is retarded. In more severe fires culms may be severely scorched and the rhizomes may die. In case of areas where flowering is taking place, scorched culms may not produce fertile seeds and after shedding of seeds no regeneration may ensue.

In order to protect the bamboo forests from fires, working plans should have special fire plans for such areas and in addition Annual Fire Plans are to be prepared describing in detail the areas which are more susceptible to seasonal fires and the measures to be adopted to ensure protection. Main fire lines should be cut around the coupe and the coupe should be divided into small sections by cutting and burning of intermediate fire lines. In deciding the main and intermediate fire lines use can be made of natural features such as rivers and perennial streams, continuous rocky out-crops and artificial features such as roads, rides and foot paths etc.

Apart from fire lines, protection of the felled over material from fires is also necessary. To ensure better and economical fire protection :

1. The cut stock should be removed during the season of felling.

2. Old stocks should be stacked in the form of large depots after clearing and burning the rubbish of the depot site. For large depots, fire watchers may be engaged during dry season but in case of small and scattered depots it will be difficult and uneconomical to maintain fire watchers. Knowledge of proper location and frequent visits by the staff will reduce fire losses.

Management in the event of illicit fellings and podu cultivation :

A close and strict watch of the entire forest is necessary to reduce if not completely prevent these evils. Shortening of felling cycle may reduce the intensity of illicit fellings and podu cultivation. Other remedial measures may include :—

1. Provision of bamboos to the local consumers at cheap rates at depots created near the villages.
2. Settlement and rehabilitation of the podu cultivators with the provision of land and other necessary facilities.
3. Education of the people.

Illicit fellings render the forest worthless in the form of numerous high stumps and congested clumps. These areas should be treated as units of cultural operations and all the congested clumps should be worked to ease off congestion.

Podu cultivation results in gregarious growth of bamboos but unless some cultural operations are undertaken, the size of bamboo produced is like fishing rods. Complete protection against grazing, fires and illicit fellings will ensure better growth and yield of good quality bamboos.

Bamboo yield and its regulation :

In a normal forest which has been worked regularly and systematically annual yield can be calculated from formula (a)

$$Y = \frac{N_1 + N_2}{2} \times A \dots\dots\dots (a)$$

where N_1 = Number of one season old culms
 N_2 = Number of two season old culms
 A = Area of the Forest

But more often than not bamboo forests may not be normal and may not contain regular series of age gradations and age classes due to one or more of the following reasons :

- (i) No previous working of the forests.
- (ii) Bad working.
- (iii) Damage due to fires and animals.
- (iv) Illicit fellings.

Under such circumstances a formula was devised by the author which may be used to regularise the condition of the forests.

$$Y = \left[\left(\frac{N_1 + N_2}{2} \right) \pm (x) \right] A \dots\dots\dots (b)$$

where Y = Annual yield
 N_1 & N_2 = One and two season old culms

X = A variable factor depending upon the condition of the crop. If the clumps are generally congested and over stocked then X (number of old culms to be removed or retained in excess) which can be

arrived at by sample enumeration can be added to the average increment

ment $\frac{N_1 - N_2}{2}$ per clump or per

unit area which will mean realising of excess than normal yield. But if the bamboo forest is understocked and in general there is shortage of old culms which are needed to facilitate development of the clumps and to provide support to the young culms then by sample enumeration one can find out as to what number should be added to the increment to bring the forest to normal.

Before bringing this paper to a close it must be mentioned that in India little importance to the bamboo forests is given in the working plans and this stepmotherly treatment adversely affects these forests. There is a need for more attention and research in case of bamboo forests which at present is lacking. Bamboos are the chief raw material for paper pulp in India. We must direct our efforts in producing enough and good quality paper to meet the International standard and this can be possible only if we are able to have a sustained supply of the raw material cheaply.

Acknowledgements :

Sincere thanks are due to the Management for kindly allowing publication of this article.