# role of bamboos in forestry and industry

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Nature does never create a singlestoried forest. Bamboo grows along with understory plants of great utility. Understory again removes imbalance in soil. Bamboo, being highly productive, grows in wider range of climate. The notion that the bamboo hinders the growth of the timber species is wrong. Well-worked bamboo forests are a source of sustained supply of mature culm, besides ensuring appreciable growth in a 3-4 years cycle.

There is no reason to be perturbed by sporadic flowering of bamboo, although flowering,—sporadic or gregarious,—affects the availability of bamboo yield. The solution is in the systematic regeneration of bamboo from different flowering zones. Plantation of bamboo along with other pulpable wood should be adopted in principle by the industry.

In its free form, nature never created a single storied forest. Some understorey plants such as seasonal grasses, short-lived herbs and shrubs or perennial woody species, including bamboos, have always associated with the tall trees. Thus, in moist and deciduous tropical and sub-tropical forests, a portion of top soil nutrients is consumed by the shallow rooted understorey plants of different species. These species, in return, with their shallow and spreading root system, invite conditions favourable for more infiltration of rain water, add humus as well as Microbial activities and help in minimising soil erosion. Importance of such an understorey, in the light of all foresaid, hardly needs any more emphasis. Thus, an understorey is a pre-requisite for maintaining a balanced nature of forests. But most of the prevailing understorey species have not recorded any utility so far. Thus, from an angle of useful productivity it is a sheer waste of nutrients and space occupied by most of them. Can that not be utilised for some better cause, while preserving and safeguarding all their protective values? Surely bamboos will be an answer to this.

In a Forestry, like ours, which leans heavily upon the natural regeneration of forest species for maintenance of sustained supplies of forest produce, the need for up-keeping the balance of nutrients into the soil, can hardly be over emphasised. A glimpse through the composition of soil will reveal that it is a combination of three forms viz. solid, liquid and gases. Solid form comprises of inorganic and organic matter, liquid state contains soil moisture and soluble salts and the gaseous form lets in soil air. The extent of liquid and gaseous ingredients are obviously dependent upon the amount of coarse and fine particles present in the soil mass, which determine the soil texture and hold great importance in the germination, survival and growth of young seedlings. Depending upon the nutritional requirements of the plants, all the constituents of the soil mass must be held in equilibrium for maintaining a sustained development. But in a vast country, like ours, with limited resources, it is highly inconceivable for a number of decades to come that the annual loss of soil nutrients, utilised for the development of vegetation, unlike agricultural fields and orchards, can be made good by the application of inorganic matter like fertilisers. The concept of maximum sustained yield, upon which the scientific forestry is based and practised over the entire world, has to be focussed upon the maintenance of site fertility, till perpetuity through the continuity of nutrient cycle caused by the decomposition and decay of its own leaf litter and other organic matter, so rich in the essential elements of inorganic matter like Nitrogen, Phosphorus, Potash, Calcium This alone can enable the forest to live and etc. grow year after year for good. The fertility of wet tropical forests is due to the natural addition. decomposition and decay of about 100 tonnes of organic matter per acre/year. Thus, a Forester has to manage forest soils as a living biological unit. dynamic in nature, constantly undergoing physical

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and chemical changes in some or the other form through forest vegetation, biotic effects and silvicultural treatments thereupon. over exposed In the soils after devastation of vegetation, and for that matter, heavily worked forests, loss of plant nutrients through intensive leaching and constant removal of organic matter follows automatically. Under such circumstances, the importance of an understorey, as a prominent soil cover, so less translated in the present day applied forestry, cannot be over stressed. It is at this stage that a forester is called upon to play an intelligent and vital role for the augmentation of forest wealth.

# ROLE OF BAMBOOS IN FORESTRY :

Unlike so many unproductive shrubs and small sized woody trees, like Holarrhena, Strobilanthes, Indigofera, Nyctanthus, Ixora, Lantana, Carrissa, Embelia, Helicteres, Grewias, Flacourtia, Acacias, Dodonaea. Pogostemon, Clerodendron and grasses like Imperata, Eregrostis, Heteropogen, Themeda, Saccharum Schima etc. etc., bamboos are a highly productive plant of the lower canopy. Bamboos also grow in a wider range of climate, 40°F to 120°F and 30" rainfall to over 80" annual precipitation and thriving over a variety of rock formations such as quartzite, Gneisses, sand rock, Deccan trap, Schists, sand stones, conglomerates etc. They are drought and frost hardy as well. Though under dense and permanent shade, bamboos have feeble clump development, yet under pepper pot, like light holes (density of timber species below (6), they have got good chances of forming an adequate density understorey crop, both in moist and dry deciduous tropical and sub-tropical forests. In fact there is no state in India, where bamboos do not or can not grow. Evidently, with such firm inherent qualities, bamboos hold better chances of forming a stable type of moderately dense understorey capable of holding the undermentioned unfathomable advantages over any other associates, like annual-perennial grasses and shrubs forecited :---

### (i) BAMBOOS—as an aid to national regeneration :

Moderate growth of bamboos eliminates grasses and other shrubs which cast a low and dense shade, repulsive to the germination of seeds and establishment of seedlings of timber species. Recognition of bamboos as an aid to the natural generation of timber species has been recorded from time to time in the past by eminent forest officers. The belief needs to be strengthened further with the progressive fild observations and investigations. Some illustrations are given in the ensuing paras.

## (ii) BAMBOOS—as treasure of humus :

Most of the grasses and low crowned shrubs become dry by mid of February and invariably fall prey to uncontrollable forest fire. Thus, the whole mass of leaf litter along with a small proportion hanging on the diminutive sized shrubs are reduced to ashes, exposing the soil surface to the uncomfortable effect of scorching sun rays of the ensuing summer. Thus, thereby apart from losing an enormous amount of organic matter, there is incalculable loss of moisture from the soil and sub-soil in the subsequent drought period. More fires result in encouraging more grasses and more grasses mean more fires. With this complementary process repeated year after year, it is a matter of common observation that moist species are gaining ground in the previously wet areas, dry species invading the moist areas and still drier species appearing in the so-called dry forests. To quote an example of under stunted growth, but with fairly good density of moist sal (sherea robusta) forests, it is not uncommon to see deep formation of gullies, bearing secondary growth of dry type vegetation comprising of species like soymida febrifuga, Boswellia serrata, Eulaliopsis binata, Wood-fordia, Fruticosa, Acacias, Ixora parviflora, Chloroxylon swistenia, Dalbergia paniculate, Byctanthus arbotristis, Zizyphus spp, with the gradual disappearance of former associates like Adina, Gmelina, chera, Dillenia, Ougenia, Eugenia, Bauhinias, Grewias etc. Instances of this type bearing conspicuous transformation of moist type of vegetation into a xerophytic one with no change in the annual amount and distribution of rain fall, creeping in several forest areas, need a close analysis by the foresters. In fact, it is the personal observation of the writer that what was growing yesterday in our forests, is not present today and all that exists today is faced with an uncertain tomorrow. The notion that forest is an inexhaustible treasure of nature, held firmly in the public mind, is most unfortunate one. Well-balanced sense of exploitation, followed by an equal amount of regenerating artificially or naturally a forest, can alone ensure continuance of the forest resources for ever. Owing to the adverse and drier conditions creeping in, day in and day out resulting in deterioration of soils, the natural regeneration and establishment of important

species are slowly receiving marching orders in our deciduous forests, yielding way to more hardy species like Anogeissus, Diospyros, Stereospermum, Lannea, Boswellia, Cochlospermum, Semecarpus, Butea, Acacias, Holarrhena, Byetanthus, Woodfordia, etc. which are of less value. Thus, there will be deviation in the productive value of the forests, adversely affecting the national economy. The situation is very grave indeed.

This trend of degradation and retrogression in the vegetational environment and its consequent declining productive curve, is apparent everywhere. It is the personal observation of the author that in such dry and moist type of forests in states like Orissa, M.P., Bihar etc. bamboos can play a vital role against the fast depleting situation of forest wealth. The reasons for this are obvious. Although leaf fall under bamboos like any other deciduous species is more during summer season, but is certainly not confined to a short span only. Quite a good bit of it is spread over the remaining part of the year too and it is a matter of routine observation in the forest. Some observations on litter accumulation under bamboos recorded at F.R.I., Dehra Dun (B.G. Dabral and Ram Swarup) are reproduced in table 1.

Apart from that, despite forest fires, because of the greater height of crown of bamboos compared to other grasses and shrubs, part of bamboo leaf litter will be available to the soil during fire-free season and will help formation of humus, the seat of complex microflora and fauna and the store house of sizable amount of plant nutrients, both ash and non-ash ingredients. It is also not rare to observe that under bamboo forest, unlike other grasses and shrubs, continuity and spread of fire is broken owing to patchy leaf deposition. Evidently, part of the soil surface escapes burning. Hence, the intensity of burning heat and its damaging effect on regeneration of timber species will not be uniformly the same everywhere. It will be surely less in case of an understorey of bamboos.

(iii) BAMBOOS—as a means for moisture conservation :

Although no conclusive statistical results are available on the effect of soil moisture in areas under bamboos and grasses separately, but under the existing influence of wild forest fires, it can be presumed that even after severe fires, bamboos hold a more beneficial effect for conserving moisture due to their spreading and shady leaf foliage, by sheltering the soil against desiccation. The importance of conserving moisture and keeping moderate temperature favourable for helping growth of seedlings in deciduous forests, is amply understood by lovers of forestry.

(iv) BAMBOOS—as an understorey plant:

In tropical and sub-tropical zonal distribution of vegetation, bamboos broadly occupy a cosmopolitan habitat in nature as against other grasses and shrubs, which vary considerably from locality to locality. Evidently, bamboos are more stable in character and are capable of governing a wider sphere of distribution as understorey plant, particularly true of *dendrocalamus strictus* and *Bambusa tulda*.

(v) BOMBOOS—as a soil protector :

In fire-burnt forests, bamboos afford a better protection to soil against hazards of erosion from rain water particularly conspicuous from the "drip" of broad leaved species and upkeep the dignity and faith reposed in the vegetation.

Soil is natures' greatest wealthy gift In no case be allowed to drift From place of origin to distant lands With the mighty forces of vegetal hands.

(vi) BAMBOOS—as a source of cellulosic raw materials :

Lastly, bamboos being the only long fibred material for pulping in tropical vegetation kingdom and indispensable for Indian pulp and paper industry, progressing by leaps and bounds deserve to be propagated artificially as an understorey without disturbing the timber species, at the suitable places and space now occupied by useless grasses, shrubs and scrubs of little value to human race and economy of the country.

3. A CONTROVERSIAL NOTION ABOUT BAMBOOS :

Many Forest Officers believe that bamboos have progressively strangled the timber species, and, therefore, valuable timber species can be revived and preserved only by throwing away the former.

# TABLE NO. 1. REPRODUCTION FROM FOREST RESEARCH INSTITUTE, DEHRA DUN REPORT. (R.G. Dabral & Ram Swarup, 1960-61) Litter Weight (Kg./acre) collected at weekly intervals, wet week (R)

·····		Dendrocalamus Strictus		Bambusa Tulda	
S1. No.	Date.	Fresh Weight	Air-dried weight	Fresh weight	Air-dried weight.
1	16.12.60	3.8	3.7	4.9	4.6
1.	23 12 60	6.1	5.3	9.0	7.7
2.	20.12.60	20.9	13.9	28.1	22 <b>.4</b>
3.	50.12.00	20.J 45 1	36.3	91.9	57.2
4.	7.1.01	45.1	80	35.9	30.5
5.	13. 1. 61	9.4	0.0	19.9	16.8
6.	20. 1. 61	10.5	9.0	21.1	18.4
7.	27. 1. 61	22.6	10.0	21.1	121.8
8.	3.2.61 (R)	168.3	88.3	207.3	156.8
9.	10. 2. 61 ( <b>R</b> )	244.6	114.3	287.3	28.5
10.	17. 2. 61	23.0	17.4	33.8	20.5
11.	24. 2. 61	38.1	35.4	41.5	20.3
12	3, 5, 61	242.5	179.4	213.0	171.4
13	10. 3. 61	68.5	59.3	69.5	64.3
13.	17 3 61	75.5	69.5	230.2	216.8
14.	24 2 61	134.2	128.2	221.3	114.9
15.	24. 5. 01	65.9	55.8	103.3	<b>99.7</b>
16.	51. 5. 01	158.6	122.8	186.2	176.3
17.	7.4.61	6476	200.3	1110.1	623.2
18.	14. 4. 61 (R)	047.0	505.5	2247	215.9
19.	21. 4. 61	152.6	140.1	224.7	360.4
20.	28. 4. 61	234.1	222.1	J/1.J 195.2	169.6
21.	5. 5. 61	154.1	132.4	105.5	212.0
22.	12. 5. 61 (R)	30.7	27.3	434.7	240.6
23.	19. 5. 61	17.5	15.7	253.1	240.0
24.	26. 5. 61	33.7	33.0	312.5	308.9
25	2.6.61	28.4	25.5	58.1	57.0
26	9.6.61 (R)	14.4	12.7	23.1	21.6
20.	16 6 61	21.3	21.3*	61.3	61.3*
27.	23.6.61 ( <b>R</b> )	56.3	42.0	119.7	96.1
20.	20.6.61	18.2	17.2	14.3	12.5
29.	$7761(\mathbf{P})$	49.2	33.9	68.1	46.8
30.	7.7.01 (K)	37 2	24.5	98.7	43.6
31.	14. $7.01$ (K)	16.8	11.0	90.9	63.0
32.	21.7.61 (R)	10.0	19.6	164.2	122.1
33.	28. 7. 61 (R)	27.9	10.0	227.1	217.2
34.	4.8.61 (R)	29.9	17.9	174 9	851
35.	11. 8. 61 (R)	20.6	13.4	1/4.0	70.2
36.	18.8.61 (R)	7.5	3.2	143.1	160.2
37.	25. 8. 61 ( <b>R</b> )	22.0	15.1	234.5	2067
38.	1.9.61 (R)	43.9	25.3	268.5	200.7
39.	8.9.61 (R)	45.0	24.3	87.9	84.0
40	15.9.61 (R)	61.8	38.0	148.9	76.2
41	22, 9, 61	24.7	12.8	71.1	39.9
41.	29 9.61 (R)	25.1	11.1	236.5	69.5
42.	6 10 61	27.3	15.6	81.0	50.9
45.	1210.61 (P)	14.7	12.5	69.3	48.5
44.	20.10.01 (IN) 20.10.61	13.9	8.8	28.1	18.4
45.		10.1	79	26.1	22.9
46.	27.10.01	12 2	267	840	62.1
. 47.	3.11.61 (K)	43.3 10.1	30.2 7 0	\$ <b>î</b>	67
48.	10.11.61	10.1	1.0	0.2 0 <b>r</b>	62
49.	17.11.61	4.3	5.7	0.J E A	0.2
50.	24.11.61	3.3	1.5	5.4	2.7 1 0
51.	1.12.61	6.4	5.2	2.6	1.0
52.	8.12.61	9.1	7.1	5.6	4.9
Total	including (R)	3300.6	2323.5	7289.2	5333.8

\* Date for air dry weight missing, hence fresh weight substituted.

The writer feels that this is merely an elderly sentiment in favour of the latter and real scape goat are not the bamboos, but the mismanagement of bamboos. Even where the sentiment is less partial, it springs out from a misunderstanding about silviculture of bamboos. After the phenomenon of flowering of bamboos, gregarious or sporadic, natural thinnings in the natural thickets of bamboo regeneration and their miraculous transformation into well-spaced clumps after 10-12 years automatically (if protected against fire and grazing), is a testimony to the fact that bamboos are not born furious. They tend to be violent under the mismanagement or otherwise maltreatment of human axe and then only form impenetrable masses, jeopardising the regeneration of timber species. Thus, it is the sin which needs to be looked down upon and not the sinner.

At this stage, it will not be out of the way to trace out an account in brief about the theory of plant succession. The dynamic concept of vegetation, founded on the principle of "Universality of change", realised by the Botanists as back as 1895, with different schools of thought thereafter, underlines the following fundamental ideas :—

Vegetation is a complex organism, and like other organisms originates, grows, reaches maturity and ultimately dies. Intermediate or successional progress is due to the combined action. reaction and coaction between the plant organism and complex factors of the habitat which themselves change, both in space and time. Thus plant community is inherently and inevitably progressive in character, culminating in a climax stage, based upon the climatic factors of the locality. So, forest vegetation evolves in accordance with positive biological laws and is not an accumulation of trees and other plants, brought together merely by chance.

Evolution of soil and site under favourable conditions cause disappearance of the earlier colonisers followed by arrival of new set of species which are more shade tolerant. The entire sere may thus be considered as an aggregation of a number of such stages, each stage superseding and substituting the preceding one as a result of site evolution caused by the earlier one. Our bamboos, with which we are more concerned at this moment, form a stable type understorey, evidently a stage much above the primary sere within the influence of climatic climax, sub-climax or edaphic climax of dominating timber 'species.

It is felt that at some stage of the succession of species, bamboos took shelter of the timber species for their growth and development as shade tolerant understorey plant, but the converse does not appear true by any stretch of imagination. So evidently, the timber species are born powerful with their root system anchoring much deeper into the sub-soil. The notion that shallow rooted and self thinned bamboos can mar the regeneration of timber species is not backed by the concept of origin and succession of vegetation. It is common thing to visualise that under favourable conditions of soil and moisture, some flora comprising mainly of shrubs and grasses, must form the ground cover under tall timber trees. Then why not to encourage bamboos, a perennial grass with all its advantages. over all other co-ranking undesirable ecological associates? Well worked bamboo forests are a source of sustained supplies of mature culms and appreciable revenue at short intervals of 3-4 years cycle on one hand, and aid to natural regeneration of several timber species on the other. Then why to worry so much when :---

Nature provides protection to one and all, Irrespective of Selection if big or small.

4. Benevolent illustrations: Bamboos have played a commendable role in regeneration of teak in areas of semi-moist and moist teak forests of M.P. (Tackle and Majumdar, 1956). In these areas, under the patronage of bamboos, teak is slowly but steadily increasing in low and medium quality forests. In these forests, bamboos have aided to preserve the moisture conditions, so much essential for germination of seeds and establishment of young seedlings.

Minus the bamboo wealth, most of the mixed deciduous forests, where bamboos are mainly located in all over India, will find it difficult to maintain themselves as forest at the cost of low valued mixed species having no market except as fuel therein.

In Sal forests of Assam, the bamboos such as *Malocane bambusoidese*, nurse the sal seedlings when young (Champion, 1956). In Balaghat forests of M.P., some sal seedlings manage to survive and

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get through many a time when bamboos (Dendrocalamus strictus) are prevalent, This regeneration appears thin and weak but grows alright subsequently. (Champion, 1933). Similar beneficial effect of bamboos on regeneration of sal has also been observed in forests of Bilaspur Division of M.P. by the writer. Bamboos have been seen to form an amicable understorey with sal when the density of latter is under (6) or sal maintains a deciduous nature (part of Rayagada and Kalahandi Divisions of Orissa) or when the crown of sal is too high i.e. Sal crop is approaching quality II-I (as seen near Koli river on Betala-Banari road in Daltanganj Division of Bihar). Under all these conditions, minimum requisite amount of lateral or direct light necessary for clump development of bamboo is ensured.

5. Facts for Examination : In day to day life, efforts should be made to look for an orderly system of empirical predictions, after corelating past with the present, based upon observations. It will be a scientific way of describing reality, restricted to the limits of observations. Having known fully a factual and truthful present, it will not be difficult to determine the future course accurately and completely. The old belief treating bamboos as weeds, which keep the regeneration of timber species excluded due to their low and dense shade, needs to be watched closely in the fast changing environmental conditions in the forests :-such as, over-exploitation through excessive fellings. frequent devastating fires and heavv grazing etc. and above all, the intensive systematic working and management of bamboos, dawned hardly a decade or two back. A time is fast approaching when we shall all feel that there will not be much scope to consider the adverse role of bamboos in the present day forestry. When weighed in the context of subsidiary source of economic potential of high order which bamboos haughtily now stand for, they deserve to be preserved, propagated and managed with utmost care and vigour. Complete absence of bamboo regeneration in several good bamboo areas affected by large scale flowering (over 50%) since 1962-63 (Raibiji, Tarlandi and Anderlima blocks-areas over 20,000 acres of Ravagada Division—Orissa—to quote as one example), is a matter of grave concern indeed even from the point of view of natural regeneration of timber species

too. Fortunately, grazing is not a problem in this part of the forests. Fire appears to be mostly responsible for destroying seed fallen on accumulated leaf litter ere to germination. It may also so happen that bad culms under flowering fail to produce fertile seeds. at least in adequate quantity ultimately or the viability of the seed developed under such tense conditions, recedes to its lowest ebb. In some cases, the denuded and hard soil surface may prove to be an inhospitable seed bed and the seeds may be washed away to distant lands. Evidently, future of such old good bamboo and timber areas, is very obscure. Such destructive factors need to be safeguarded immediately everywhere, lest it should be too late. But the forest departments in several states are sure to fall short of funds for undertaking strict fire protection and regenerating measures, a task of colossal financial and physical magnitude. Even in the plantation areas of valuable species, like teak, where the socalled menace of bamboos has to be kept under control with frequent cutting back, it is quite true that the same bamboos will prove an excellent and paying understorey, if encouraged through artificial planting, and otherwise, immediately after the first thinning in such plantations or when the plants have surpassed the damaging height of bamboos, whichever is earlier. Bamboo can at most be a weed, when they over-top or over-hang the planted stock, but for that act definitely as a feed. For safeguarding interests of planted species, it may not be necessary to fell all the bamboo culmps again and again for a series of years as a part of tending and cultural operation. Part felling of a clump in several cases, might serve the contemplated purpose. In fact, in view of the shortage of long fibre pulpable raw material in India, sacrificing rich bamboo forests as suitable site for the so-called valuable plantations like teak, needs to be done after thinking twice. Dividends from bamboo forests, for the rotation period for teak, will not fall short of the latter if closely examined. Suitably handled and well-managed bamboo clumps (as seen by the author in a greater portion of Bihar forests in January 1966) will be more often an asset than liability to the forest. Maintenance of well-managed 80-110 clumps per acre under the timber trees will not prove any hindrance either to the growth of existing trees or their natural regeneration. Per contra, it will exert its multipurpose benefical effects forementioned.

ROLE OF BAMBOOS IN INDUSTRY.

6. Since good old times, bamboos have played an important part to feed a number of cottage industries, such as, furniture and basket-making, mats, fans, tool handles, walking sticks, etc. They have further been pressed into use for manufacture of light umbrella handles, musical instruments, artificial silk, toys bows and arrows for sport and pastime. Some species of bamboos have earned a medicinal value too for their rare secretion :—"Banslochan". Use of tender shoots of bamboos for pickles and vegetables is well-known. They have always been considered a poor man's feed and shelter in the forest areas. With the advancement of knowledge and stepping in of chemical preservative treatments for wood, utility of bamboos for constructional purpose has increased many-fold and is particularly suited to localities of volcanic regions invaded by frequent earth tremor. Evidently, use of bamboos has been increasing progressively in various industries and with its latest subjection into production on extensive scale as cellulosic raw material for high grade pulp for paper, and rayon time is fast approaching when this hitherto considered weed of the forest, will run short of market demand as is anticipated from field observations.

Mr. V. Poddar, Chairman of the Development Council for Pulp, Paper and allied industries, Government of India, places the future requirement of cellulosic raw material for the country as under :—

Year	Million tons	Against per capita con- sumption of.	Total expected annual produc- tion of bamboos from existing resources.	
1970-71 IV Plan	4.2	3.5 Kg.	2.4 Million tonnes	
1975-76 V Plan	7.2	5.0 Kg.		
1980-81 VI Plan	10.0	7.0 Kg.		

With all the stand-by hardwoods to meet the shortage of pulping raw material, the bamboos have their own singularly indispensable part to play in that they have long fibre qualities.

Parallel to that, if we just lend a peep through the national revenue which bamboos fetch to the Central

and State governments annually as raw material for paper only in the form of various taxes, such as, excise duty on paper, income tax, sales tax, corporation tax, duty on electricity, vehicle and road tax, sales tax, water tax, royalty, dividend tax, octroi and other levies, it runs in the neighbourhood of Rs. 200/- to Rs. 250/- per tonne of bambcos. Details of taxes paid on per tonne of paper produced are given in Table 2. Over and above that just ponder over the vast employment platform which the bamboos afford to lacs of our unskilled masses from the felling stage of bamboos in the forest to the finishing product as paper in the fatcory.

### TABLE NO. 2.

Estimated Revenue to Central and State Governments from a 20,000 tonnes annual production paper plant.

**Revenue** to Central Government :

1.	Excise Duty on paper	Rs.	66,00,000
2.	Income Tax.		
	(i) Corporation tax (ii) Sur Tax (iii) Dividend Tax	Rs.	34,00,000
	Tota	al Rs.	100,00,000
3.	Revenue to State Governments :		
	(i) Royalty (increasing day by day	y) Rs.	2,50,000
	(ii) <i>Electricity</i> : Duty on Electric generated	Rs.	4,00,000
	(iii) Vehicle and Road tax	Rs.	78,000
	(iv) Water charges	Rs.	6,000
	(v) Lease Rent	Rs.	18,000
(	(vi) Sales Tax : Central and State	Rs.	9,63,000
(1	vii) Octroi and other levies	Rs.	1,33,000
	<b>T</b> otal	Rs.	18,48,000
	or	say Rs.	18,50,000

Therefore total tax on 20,000 tonnes paper<br/>production ...1,18,50,000Hence tax on one tonne of paper will be aboutRs. 600'00

State governments also share partly from the central taxes, both excise and income tax. They gain by direct contribution in the development programme too. Therefore, in the light of all this the feeling of some forest officers about meagre return from bamboos by way of royalty, cannot be a sound criterion for their stand, when viewed over the national spectrum and needs a second time balanced calculation. It is a considered opinion that, even the good productive teak plantations per acre will not contribute to the national exchequer to that tune as the insignificantly placed bamboos do, after reckoning the compound interest at ordinary bank rate on quick returns of the latter. It is worth recording here that for such an indispensable source of Indian Pulp and Paper Industry due care is not being taken for preservation and augmentation of bamboo resources in several states. The phenomenon of bamboo flowering (after which bamboo clumps die and the area is rendered unproductive for more than a decade even under wellcared-for conditions), capable of dislodging the economy of huge and monumental industries, does not appear to perturb much the state Forest Officers. Most of them are content with the idea that bamboos, like Dendrocalamus strictus, do not flower gregariously, and as such, there cannot be much of danger to the industry from their sporadic flowering. The situation prevalent on the field does not, however, leave room for such fond complacency. In case, the regeneration conditions are left to nature, rest assured type of flowering, whether gregarious or sporadic, will affect the availability of bamboo yield from the flowered areas. In case of gregarious flowering, there will be sudden and whole-sale dislodging of available raw material resources, and such an incidence will be no less than a bolt from the blue to the industry. In case of sporadic flowering, the loss, though it is gradual, yet the pace of natural regeneration, (under the ever-increasing and devastating effects of aggressive biotic influences like fire, grazing, shifting cultivation and excessive removal of the wood cover in dry zones), is so low that it scarcely bears any satisfactory relation to the extent of loss sustained. Then, under the prevailing conditions, the type of bamboo clumps produced are poorer both in quality and density, and the annual rate of production of bamboos tends to recede to its lowest ebb permanently. Every cloud has a silver lining. So also the gregarious flowering has an advantage too in the practical sense that it will attract serious attention of the Forest Officers and the affected areas, being large and concentrated, are easy to look af er for regenerating purposes. On the contrary, sporadic flowering will go un-noticed up to the last and holds its own management difficulties for aiding restocking of the scattered areas. Instances are not wanting, when areas under influence

of sporadic flowering for 10-12 years continuously, ultimately degenerated to the extent of "No availability" for a period of 7-8 years thereafter, and above all, extent of future supply from those areas has been rendered highly uncertain. To quote a specific example, while preparing Working Plan of North Kanara Division-Mysore in 1946-48 vide para 389 of the Working Plan, the working plan officer, F.A.B. Koeli, predicted that Bambusa arundinacea (locally called "Douga" and elsewhere "Daba"), was expected to flower within the next 10 years and would upset any long term programme. He also mentioned about the beginning of sporadic flowing in patches of *Dendrocalamus stricius* (locally called 'Medar' and elsewhere 'Salia') as back as 1946 in those areas. Subsequently, after about a decade, the entire area of about 241.0 sq. miles under discussion with a total bamboo potentiality of about 1,00,000 tonnes (30,000 tonnes Dendrocalamus strictus and 70.000 tonnes Bambusa arundinacea), was leased out to West Coast Paper Mills. Sporadic flowering of Salia (Dendrocalamus strictus) bamboos is said to have completed in 1958, the year which strangely enough coincided with the sudden large scale flowering of Bambusa arundinacea. The latter covered the entire remaining leased area within 3 years upto 1960. It is remarkable that sporadic flowering of salia, though commenced in 1946 and completed in 1958, thus distributed over about 12-13 vears period; no mature green salia bamboos were available for felling from any part of the leased area from 1958-63. Delayed formation of clumps from the early flowered areas is attributed to very high intensity of grazing and ruinous fires all along ordinarily from an area of 30,000 tonnes salia bamboos potentiality, spread over 12-13 years for flowering, absolutely no yield of green bamboos for 6 vears (1958-63) even from high rainfall areas of North Kanara Division, is a matter of no mean surprise. But it lends an ample picture of the tremendous need for protecting the bamboo regeneration areas against fires, grazing etc. if exploitable sized clumps are to be aimed at within 10-12 years after flowering from the same area. By chance, the entire misfortune fell upon the West Coast Paper Mills just in the first year of their going into production. Probably no one took note of the warning registered by the talented Working Plan Officer more than a decade back. But appreciation needs to be recorded to the Mysore State Government, and thereafter. the State Forest Department for liberally meeting

the shortage of raw material to the Paper industry from some of the distant unleased areas and also extending all facilities to West Coast Paper Mills for undertaking all regenerating measures, which include fencing with barbed wire, cutting and maintenance of extensive fire lines both external and internal, transplanting at suitable spacing after removing the 3-4 year old bamboo seedlings from the natural thick stands in the forest and other tending and cultural operations for quick formation of clumps. The management of West Coast Paper Mills also deserve commendation for upkeeping the faith reposed in the private investors, who within a couple of years have successfully restocked thousands and thousands acres of forest which looked terribly open and deserted after flowering only a few years back. They made use of the natural bamboo seedlings in the forest for planting at regular intervals of 20-25 feet.

It is quite amazing that the end of salia flowering in 1958 synchronised with the beginning of large scale flowering of Daba. Despite that, total yield obtained from the clear fellings thereafter amounted to about 60,000 tonnes only with about 10,000 tonnes salia. This speaks itself for the heavy losses of dead inflammable clumps through fires and also the considerable fall in yield caused through the so-called sporadic, patchy or irregular flowering of salia (Dendrocalamus strictus).

This from the far-sighted policy, constant and indefinite leakage of raw material supply, after completion of flowering event in sporadic stages is distinctly equally, if not more, perilous. In any case, there is every reason to safeguard the interests of long term pulp and paper industries, faced with an uncertain future owing to inevitable flowering phenomenon of bamboos, beyond the control of human reach.

From the foregoing narration, it is evident that it is highly imperative that accurate records of flowering cycles for different species in different areas are collected and maintained with utmost caution with the forest department. It will be of immense value in ensuring and arranging constant supplies to the industries. Unfortunately, information on this topic at present is very scanty and untrustworthy. By introducing bamboos of varying flowering cycles from different origins in a particular zone, it will be possible to stagger large-scale flowering to separate periods in well-distributed blocks to tide over rather set aside the possibility of sudden break in supplies of raw material to the industries. That will be a sure and short-cut way for the bamboos to immortalise their name, in their intricate but sacred dual role in "Forestry" and "Industry".

- 7. SUGGESTIONS :
  - (i) More often than not, bamboos act more like 'feed' rather than a 'weed' inside the present day forests, and their propagation should be encouraged judiciously.
  - (ii) Long term leases with due safeguard to local public interests under the agreement, should be preferred over annual auctions of bamboo coupes, obviously in the larger interests of the forests, in general, and bamboos, in particular.
  - (iii) There cannot be any other golden opportunity for regenerating bamboo forests most economically at their flowering period. It should be properly made use of everywhere.
- (iv) As in other fields of production, policy of 'Mixed Economy' needs to be extended towards the restocking, if not management of depleting bamboo forests, and for that matter, plantations of any other fast-growing pulpable hardwoods too, in the broader welfare of the country. It needs to be imbibed rather engrossed in our National Forest Policy both in letters and spirit. Private investors and/ or big corporations and/or Industrial Plantation Co-operative Societies, under presettled terms of agreement will certainly come forward for raising plantations in Government forests for ensuring stability of raw material to their long term industries and there should not be any difficulty for formulation and execution of such agreements. Government will get manyfold multiplied revenue without any efforts or investments from the same areas. Several progressive countries of the world, like the U.S.A., Sweden, Norway, Italy, Canada, Australia etc., have preserved and aggravated the forest wealth in a similar way. Combined national efforts pooled in by the public and private sectors jointly will also induce competitive spirit and positively bear better dividends.

Lastly, in view of the dawn of rapid industrialisation of the country under the five year national development plans, time is now ripe for reconsideration and absolute reorientation of our national forest policy, founded as back as 1894, the era when 'Imperial Interests' were supreme. The circumstances have totally changed during the intervening wide span of period. The new forest policy re-enunciated in 1952 to suit the changed conditions, is not free from serious drawbacks. In any case, the gradual experience is telling that forests which are considered to be a national asset, do not deserve to be exclusively the state's subject only. Partial, if not complete, jurisdiction, of the centre would act better for planning, execution and distribution of raw material on national level in consistence with the local demands and suitability of different tracts for various wood based industries.

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