

## **IMPACT OF BAMBOO IN SILVI - HORTICULTURE**

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### **Abstract:-**

Drastic reductions in forest area and forest productivity levels have led to serious economic, social and environmental degradation in India. The efforts of government to bring forests back to the sustainability have not yielded the desired results. Import bills of forest products have increased to nearly Rs10,000 crores per annum (Rs.27 crores per day) without any sign of abatement. The forestry programmes suffer from many limitations. For successful forestry management a new approach is needed. In this background scientific forest management should be supplemented with aggressive silvi-horticulture, watershed development and ecotourism programmes.

Silvi-horticulture / agro-forestry is being practiced in China and India since ancient times. Only intensity and species mix have been changing depending on utilization, demand and search for higher profits.

The author has introduced over 50 species of bamboos along with teak, sandal, rattan and other plants in his silvi-horticultural farm and has been observing their performance from the standpoints of conservation, economics, employment and environment. Efforts towards value addition in the form of bamboo handicrafts have also been started. The shelter-belt effect has improved the soil and moisture conservation in the farm. The preliminary results are encouraging.

In view of its beneficial effects on agricultural production and also considering the anticipated large-scale death of bamboos in the North-East threatening its very agricultural basis, it is desirable to start planting useful bamboo species in silvi-horticulture programmes in a big way. This will be a boon to the people of the North-East, who are at the threshold of Mellocanna baccifera flowering in an area of 18,00,000 hectares and the subsequent rodent menace, for which there is no solution other than this. Myanmar and Bangladesh also face the effects of flowering of this species; the intensity probably may be less in these countries.

Bamboo in silvi-horticulture practice will also help in arresting expansion of 90 million hectares of wasteland in India. For meaningful impact this concept and

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model require immediate attention and implementation on a large scale and with close observation. Silvi – horticulture is one of the simple, easy ways of helping the farming community globally. We cannot think any other programme which can easily be picked up by the farmers and **usher in a NEW ERA** .

### **Introduction:-**

Drastic reductions in forest area and forest productive levels have led to serious economic, social and environmental degradation in India. The environmental damage because of deforestation and land degradation is estimated to be Rs.9450 crores annually, as per world bank report. Import bills of forest products have increased to nearly Rs.10,000 crores per annum without sign of abatement. Concurrently farm production has started to fall. Over exploitation of groundwater for farming etc., is leading to a fall in the water table of half a metre to a metre per year in India and China. In this background there is need to develop and adopt a new approach. It should be developed and built around old philosophies, practices and principles.

Silvi-horticulture / agro-forestry is being practiced in China and India since ancient times. Other countries also would have similar practices in some form or the other. It is easier to build upon this age-old system, keeping in view the present-day utilization and demand. Compatible Species with short gestation, compatibility and higher returns should be given top priority. Soil and moisture conservation and environmental and ecological factors also should be given importance.

### **Trials of different species**

Keeping the above objects in mind the author started trials in a coconut garden. Originally it was a coconut grove with 55 coconut plants of about 35 years age with some vacant space. During 1995-96, the area was fenced and an independent bore-well was dug. Twenty, grafted mango were planted in the blanks. The northern boundary was planted with bamboos. The eastern side, which had some open areas, was also planted with grafted teak and bamboos. Coffee was planted underneath the coconut trees. Pepper plants were planted at the base of the coconut trees. Banana, papaya and rattan canes were introduced in the coffee rows later.

Wherever space was available many miscellaneous species like Khaya anthotheca (from the Ivory Coast), Santalum album, Gmelina arborea, Wrightia

tinctoria, Caesalpinia sappan, Melia dubia were planted. As introduction of plants is still continuing, the farm (Shyamala Nandana Vana) also has young seedlings of Phyllostachys pubescens, Phy. hetercalada, Phy. spectabilis, which are 3 to 12 months of age. Some plants are 6 to 8 years of age, while the majority of plants are 3 to 4 years of age. In this background of introduction at different times, plants of different ages exist in the area. Germ plasm conservation and exchange is one of the objectives. The observations made here are indicative and suffer from many limitations.

### **Germ plasm conservation and exchange of plant material**

Bambusa bamboo: Planting material and seeds from genetically superior mother plants producing up to 15 culms per year\_ from the Western Ghats are collected and multiplied in the farm and distributed.

Dendrocalamus strictus: Highly productive plants are being multiplied for distribution. Deogan (1937) had reported the occurrence of a large type of Dendrocalamus strictus in Uttar Pradesh, Bihar, Orissa, and to a limited extent elsewhere. This type attains big size with little side branches and seldom shows signs of congestion. A few rare clumps of this type are observed in the Western Ghats. They are raised in the garden for multiplication and distribution. Genetic characterization of this type must be carried out.

Oxytenanthera stocksii: Highly productive plants from the Western Ghats and also obtained from farmers of Maharashtra are collected and multiplied and are being distributed.

Calamus nagbettai: This is a species endemic to Subramanya region of Dakshina Kannada district in Karnataka and sporadically distributed along the borders of Kodagu and Hassan districts only in a 15 km belt. These plants in the author's farm have borne flowers and seeds. Natural regeneration is also taking place abundantly (not witnessed to this extent in the wild).

Calamus travancoricus: This slender, delicate and graceful plant is becoming scarce in the Western Ghats. Because of overexploitation there are not many seed-bearing plants left in the forest. Hence this is becoming a threatened species. This plant is cultivated and protected in the farm. Ten plants have increased to 50 culms. Some of these plants have started setting fruit this year. In the next few years seedling distribution work will be taken up.

Guadua angustifolia: ( South America) This non-clump-forming, highly productive plant has attracted the attention of everyone who has seen it. This plant also is

being multiplied and distributed to as many people as possible. This species is reported for its durability, nail holding capacity and less congestion habit.

From 2000 till date, planting material from Shyamala Nandana Vana has reached many states in India, from Kashmir to Kanyakumari and from Himachal Pradesh to Arunachal Pradesh. The only request to each plant recipient is that he should multiply and distribute to 10 people and they in turn to 10 more. If this concept of distribution to 10 people is continued, within the next three years the first 10 recipients would have helped in the distribution of one lakh plants. The success of this concept depends on the sincerity of the recipients.

As mentioned earlier agro - forestry / silvi-horticulture is being practised in India as well as in China since ancient times. Because of its beneficial effect it is still being continued. Only the intensity and species mix are changing depending upon the utilization, market demand and need for higher profits.

### **Economics**

Banana: About 45 banana plants (Musa sapientum) have been planted. Annually each plant produces about 10 kg of banana.

Black pepper: About 30 plants of black pepper (Piper nigrum) have started producing 0.5 to 1 kg of pepper from each plant. Because of the falling of coconut fronds on pepper plants replacement of failures has been carried out. The other damage to pepper climbers is at the time of picking coconuts, which is done by pickers who climb up the trees. At present the total production is about 10 kg . If proper attention is paid the yield can go up to 2 kg per plant.

Coconut: When the land was purchased the first harvest did not produce 1000 coconuts (Cocos nucifera). Gradually, with care and attention the annual yield went up to 3500 nuts. During 1999 and 2000 there was a large-scale attack of Nusi disease in the entire state. In this farm also quality, size and productivity were adversely affected because of this disease. Friends in the Horticulture Department staff provided treatment by way of root adsorbtion and injection into the stem. Today the plants have recovered by almost 85%, and quality, size and productivity are on the road to recovery. During 2003 the annual production improved to 3000 coconuts. The horticultural experts feel that the recovery of coconut plants is very fast in this garden and attribute it to the presence of

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bamboo plants, which may be acting as a sieve against the pathogen. The coconut trees recovered from Nusi(.....) attack quickly, the size of the coconuts improved, and the nuts are fetching higher price. Nusi pathogen is air borne. The shelter-belt effect and also the bristles on bamboo leaflets might have screened out the pathogen as the coconut garden is surrounded by bamboo on two sides completely and on the other two sides partially. Another reason may be the **organic farming** practised in the farm, which probably has given enough strength to the plants to develop resistance.

### **Environmental aspects**

Monitoring of plots in tropical forests of South America has revealed that the plots accumulated nearly 0.34 ton of carbon per hectare annually. In the silvi - horticultural garden different species are planted, including bamboo and cane. Bamboo and most canes add new culms every year. Thus carbon sequestration will be better.

If we can convert 10% of the irrigated lands in Karnataka into silvi - horticulture gardens the area under such cultivation reaches a figure of 1 lakh hectares, which has a potential to fix 50,000 tons of carbon every year in Karnataka state.

It has been shown in China that tree crops generally enhance the microclimate for agricultural crops. Wind speed was reduced by between 21 and 51%. Evaporation rate was reduced by 9.7% during day and 4.3% during night. Moisture content of the upper layer of soil increased by 19.4% and air temperature went up by 0.2 to 1°C in winter and down by 0.2 to 1.2°C in summer. There was a strong trend of increased yields; millet increased by about 20%, maize between 7-17% and wheat 6-23% The Chinese studies were carried out in plots mostly under Paulownia tree. There are no studies with bamboo as the tree crop, but the above observations may be taken as a general thumb rule till data are available for bamboo.

Bamboo is mostly a surface feeder whose root system spreads up to 3-4 m wide. Where the original mother plant is growing, the roots go down 25-40 cm deep. In contrast, roots of horticultural trees like mango, coconut, etc. penetrate deeper. This difference allows bamboo to grow in different soil zones without competition from other plants.

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Soil analysis: Soil analysis in the farm has given the following results.

	Control coconut plot	Organic farming coconut + bamboo etc.
pH	6.5	7.5
Organic matter	2.8%	3.89%
Phosphorus	7	7
Potash (kg)	280	380

The analysis indicates improvement in soil fertility after introducing silviculture species into the horticultural garden. The pH which was slightly acidic has moved towards alkalinity. Water yield has improved by 35%. Water analysis does not reveal any undesirable features.

The anthills in the area are growing in size and number; the tallest is 2 m tall. The population of butterflies has increased. One can see hundreds of them on bamboo clumps flying off when disturbed. There is an increase in insects, birds, worms, bees, reptiles visiting the area and the flora has also increased.

I am a strong proponent of the relation

$$F = k E1 E2 E3 / E4,$$

where F stands for productivity of forest of any type and any form, k is some constant (to be worked out), E1 stands for economics, E2 for employment, E3 for environment and ecology, and E4 for rural poverty. If forests are healthy and productive, they generate good employment, improve environment and ecology and bring economic gains. The value of environmental gains is beyond measure. When forests are ruined rural poverty increases. This is amply evident in India, Indonesia, Philippines, Cambodia, Myanmar and in several countries of Africa. My own small experiments in my garden have demonstrated the value of thinking in terms of this relation among forests, environment and rural poverty.

### **Productivity**

Original	Now (8th year)
1) 55 coconut ( <u>Cocos nucifera</u> ) plants - 1000 coconuts per annum	55 coconut plants - 3500 coconuts per annum
2)	45 banana ( <u>Musa sapientum</u> ) 500 kg fruit

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| 3)    | 30 pepper ( <u>Piper nigrum</u> )<br>15 kg  |
| 4)    | 100 bamboo (different species)<br>100 culms x 8 culms x 9 kg<br>= 7 tonnes dry                            |
| ===== |   |
|       | 5 years from now  |
| 5)    | 50 rattan (different species) -<br>anticipated yield<br>1 m x 4 culms/clump<br>= 200 metres of cane       |
| 6)    | 12 grafted teak<br>( <u>Tectona grandis</u> )<br>20 years anticipated yield<br>= 12.0 cu m (or 420 cu ft) |
| 7)    | Sandal ( <u>Santalum album</u> )<br>4 trees x 500 kg sandal wood<br>(28th year anticipated)<br>2000 kg    |

Bamboo productivity: In an area of 1.5 acres there are nearly 100 bamboo clumps. The productivity of bamboos varies from 6 to 10 culms per clump. The weight on an average varies between 15 and 20 kg per culm. The annual production of bamboo timber per acre will thus be 100 clumps x 8 culms x 9 kg = 7220 kg dry weight.

The major component of the wood is carbon. In addition to other benefits the area would have done a good job of carbon sequestration by fixing carbon from the atmosphere. As bamboo is a C4 plant it continues the job of releasing oxygen to the atmosphere till it dies.

If this quantity of bamboo is just sold to paper mills it fetches an income of about Rs.7000 annually. This quantity of bamboo can produce 3 tonnes of paper or 4 tonnes of newsprint when used as raw material for these industries (N. S. Adkoli).

When the same quantity of bamboo is used for making agarbathi sticks, the employment generated and the value added is really good. One person can produce 6 kg of agarbathi sticks per day. Thus this quantity of bamboo when

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used in agarbathi industry can generate employment of 700 man days (A. C. Lakshmana).

When this quantity of bamboo is used for handicrafts, which I am experimenting with at present, it can generate a high degree of employment. For a group of 10 persons, about 2.5 kg of dry bamboo is required per day. For one month about 80 kg is sufficient. Annually about one tonne is sufficient to generate employment for 10 persons. **About a 100 people can get employment from this area of one and a half acres.** This is a pollution-free cottage industry occupying little space. The annual potential is around Rs.75,000 net return. That gives a ten-fold return over that from supplying bamboo to paper mills because of value addition. The employment generation is also very high.

In addition the branches, top end and leaves totalling about 3 to 4 tonnes are left in the area to become organic manure.

Grafted teak: There are about 20 numbers of grafted teak (Tectona grandis) of Karnataka provenance, planted during 1996. They are coming up well along the stream margin and also in places where the teak plants get enough sunlight. A few plants which are overshadowed by bamboo or lantana weed along one boundary have not fared well and are excluded from measurements.

The girth measurement varies from 35 cm to 100 cm. The sum of the girths divided by the 12 number of trees Excluding the trees that have not fared well gives an average girth of 57 cm. This works out to a mean annual increment of 7 cm. The trees have a clean bole of about 7 metres height. This growth is observed to be better than that of the parent trees at Thithimathi reasearch centre in Kodagu, where the teak trees are grown in pure patches. Better performance of teak in this garden can be attributed to improved management practices of soil working, farmyard manure application, protection and irrigation. These trees can be extracted at any time after 20 years. When they wanted have reached a volum of 12 cu m ( 420 cubic feet)

Sandal: There are five sandal trees (Santalum album) planted in 2002 [ok?]. They are expected to reach 0.5 tonne per plant at the end of the 28th year. The anticipated production will be 1.5-2.5 tonnes of sandalwood, valued at Rs.13.5 lakh - 22.5 lakh. Including sandal is an exceptional practice applicable to only sandal-growing states.

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(a) About 20% of the agricultural land in the country is under assured irrigation. Every year 1% of the total irrigated lands should be brought under silvi - horticulture. In Karnataka 2.5 million hectares of land is under irrigation About. 5 to 8 million hectares can easily be brought under Silvi – horticulture practices in Karnataka alone. This practice should be continued till a balance is reached.

(b) North-East and other high-rainfall areas of India, Bangalore, Indonesia and Myanmar Any area that gets more than 1500 mm rainfall per year is ideal. The North-East is ideal because of the imminent Melocanna baccifera bamboo flowering and ensuing death. By introducing this method we can put an end to the practice of **jhum or shifting cultivation** which is a drugery to the people of the North-East. When the rest of the world is enjoying the fruits of tractors, bulldozers and permanent agriculture it is pathetic to observe entire families of all ages engaged in jhum cultivation which is difficult and offers dipping profits. This scientific and profitable jhum cultivation practice has lost its original advantages and has become a burden to the people of the North-East. It is high time all those who have concern for the people and their welfare should jointly take action to introduce silvi-horticulture and reduce the burden and bring smiles and profits to these people. This new multifunctional silvi-horticulture is bound to succeed because of the hardworking nature of the people, absence of grazing, good rainfall and rich soils. Only some changes are required in the species mix. If this method is introduced this year itself the rodent menace that is staring the people in the face can also be reduced.

(c) Garden lands: All the existing monoculture garden lands should be converted into silvi - horticulture. In states where there is demand for aromatic and medicinal plants suitable species can be introduced under silvi - horticulture. A huge area of nearly 90 million hectares is classified as wasteland in India. The lands may be restored to their original fertile condition. Controlled irrigation can be considered wherever possible. There is an urgent need to restore the degraded environment and ecology.

### **Suggestions**

Economically important bamboo species can be used as shade trees in coffee and tea plantations. Bamboo can also be introduced in rubber plantations and the

bamboo can be clear-felled in 7-8 years when the rubber tree is ready for tapping.

Watershed development programmes: These are site specific and give importance to the contours of the land. Higher regions are treated like protection working circle to be supplemented with forestry and horticultural tree crops. Middle and lower regions get agriculture, pasture, garden, horticultural crops, etc. Animal husbandry, pisciculture, etc. also get their due share depending upon the resources and market. Participatory management is an additional strength of this programme.

Ecotourism programmes: Most countries are bestowed with tourism prospects based on experience of Nature. These tourism areas, particularly around forests, wild life area, beaches, lakes, waterfalls, hills, valleys, rivers and historical places, should be developed in such a way that visitors have opportunities to study and learn about the flora and fauna. They should be considered as open classrooms about nature giving opportunity for visitors, particularly the younger people, to learn through literature, pamphlets, library books, etc. This will educate the people about nature and also bring in the essence of living together in the tradition of the noblest saying *sarvejanaah sukhino bhavantu* (let all creations of god live happily forever).

**Conclusion:-** Silvi – horticulture is one of the simple, easy ways of helping the farming community globally. This programme can cover vast stretches of lands and a larger population of farmers. The cumulative beneficial effects of this programme will be high we cannot think off any other programme which can easily be picked by farmers and **usher in a NEW ERA**

No time should be lost. Whatever incentives, training, policy decisions to help the growth, development, industrial application and marketing are necessary for this programme, the concerned people, organizations or government should act quickly. Forest management and research should also be given priority with a clear mandate and direction.

Silvihorticulture is the only tantra and mantra that can reduce the negative impact of environment destruction. It is the only tantra and mantra for tackling malnutrition, unemployment, ill health and poverty, which are the themes of discussions at national and international fora.

World peace is possible only with this method, failing which human hunger, poverty, illiteracy and ill health will eat away all the so-called industrial and technological development leading to restlessness, which is already making its presence felt globally. We have these two options before us: world peace and or restlessness.

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