

PAPER MILLS AND BIODIVERSITY

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PROLOGUE: The Pulp and Paper mills play important role in economic and industrial structure of India. About 215 paper mills were established in India till late eighties, comprising 179 small Paper mills with total installing capacity of 7,12,340 tons per anum (TPA) and 36 large Paper mills with installing capacity of 13,29,160 TPA, to cater the domestic requirement of paper in the country. The total installed capacity was about 2.4 million tons per anum. The small Paper mills contribute about 35% and large Paper mills contribute about 65% of the total production of paper in the country. Most of the Paper mills particularly the large Paper mills are dependent on forest based raw materials like bamboo and forest wood for manufacture of paper (CPCB 1988).

Paper mills have direct influence on ecology and biodiversity due to their consumption of large amount of forest products and simultaneous release of huge amount of toxic liquid, solid and gaseous waste in to the environment. To produce a ton of writing paper the Paper mills require the following materials-

1. Bamboo	- 2.2 Metric ton (Moisture free)
2. Caustic soda/salt cake	- 150 kg.
3. Chlorine	- 120 kg.
4. Talcum powder	- 200 kg
5. Alum	- 60 kg.
6. Rosin	- 10 kg
7. Dyes	- 50 gm
8. Power	- 1800 KW
9. Coal	- 2 tons
10. Furnace oil	- 40 litres
11. Water	- 250 M ³

RAW MATERIALS: The raw materials of large Paper mills are primarily bamboo (in some mills mixed with forest wood) which are found in abundance in hills as well as plains in most parts of India. Bamboo growth is facilitated by alluvial sandy and clayey soil with acidic P^H, balanced NPK, silica etc. with high amount of rainfall pattern. Reportedly there are about 500 species of bamboo mostly found in South America and Asia. In India, there are about 165 species of bamboo of which about 65 species are found in North Eastern region alone and this region covers about 2.7 million hectares of bamboo growing areas in both hills and plains, and in total accounts for 66% bamboo production in the country (Dutta 2001).

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It has been estimated that in well grown areas such as hills of Assam 1 hectare of bamboo plantation produces about 16-20 metric tons of bamboo. The yield is variable depending upon the bamboo species. The common variety of bamboo species used in paper production in the two large paper mills of Assam are – *Bambusa tulda*, *B. balcooa*, *B. vulgaris*, *B. dullooa*, *B. pallida*, *B. arundinacea*, *Dendrocalamus hemiltoni*, *D. giganteus*, *Meloconia baccifera*, *Oxylenchus servifolia* (Boorah 2000)

Traditionally every part of bamboo plant is valuable and required for daily use. The leaves are fodder for domestic animals, the rhizome is a good food item, the stem is used in house building and making of wall, fishing gears, materials for agricultural purposes, preparation of food items, carrying water, ornamental and decorative materials and variety of household items.

BAMBOO CULM NICHE: The bamboo culm in forest provide several niche or microhabitat such as burrows in roots and rhizome, tender shoots, stem cavities, leaves etc. These ‘niche’ are sheltering areas for small mammals, reptiles, amphibians, birds and number of invertebrates and insects (Sengupta, unpublished paper) The contribution of bamboo plants towards the conservation of ecology and biodiversity, pollution free environment, prevention of soil erosion and other socioeconomic values are well established.

QUANTUM OF BAMBOO NEED BY PAPER MILLS: As mentioned above, Paper mills consume about 2.2 metric tons of moisture free bamboo for production of 1 ton of good quality writing paper. A large Paper mill with 300 TPD production capacity requires about 660 tons of bamboo per day and proportionately other materials for production of paper. Reports indicate that one hectare of bamboo plantation yields 15-20 metric tons of bamboo, by this calculation daily requirement of bamboo will affect 60 hectare area resulting huge loss of bamboo cover in the forest of hills and plains. This not only reduces the forest cover but also destroys the habitat of hundreds of animal species. This is a common scenario of bamboo grown areas of hills and plains in the country including North Eastern States of Assam, Tripura, Nagaland, Arunachal Pradesh, Mizoram, Manipur and Meghalaya.

POLICY ON PRICING OF BAMBOO: Being State subject, the forest covers are exclusively under State Government jurisdiction and cared by State Forest Departments. The policy on bamboo extraction from the forest generally fixed by State Government and concerned Paper mills. For example- In Assam, the State Government has fixed a royalty of Rs. 123/- per ton of bamboo extracted and it goes to State Treasury. In addition, the mills have to pay about Rs. 800-900/- per ton of bamboo extracted from the forest and private farmers. This amount is paid to private parties or contractors and covers expenses for cutting, transportation and staking in mill premises. The contractors usually employ the local villagers for cutting and extraction of bamboo by paying Rs.50-70/- per person per day on daily wage basis with stipulated target for extraction. The locals are very much interested in the job because there are no other avenues to earn money in these remote areas. Reportedly, in Assam, single Paper mill pay about Rs. 1 crore as royalty to State Government and pay about Rs. 2- 2.5 crores for extraction and transportation of raw materials annually.

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PRECAUTIONS IN EXTRACTION OF BAMBOO AND MANAGEMENT: Bamboo felling is selective cutting and under joint monitoring of State Forest Department and Mill authority. The cutting is done in an area on 4 years rotation basis. The cutting of bamboo plant is carried out 1-2 feet above the base for proper growth of the culm in future. The resources of forest are exclusively managed by State Forest Department. Since forest is a renewable resource, recently the Paper mills in Assam have undertaken a plan termed Farm Forestry Scheme to involve the local villagers to cultivate bamboo with a promise to collect the grown bamboo by the mills in future at prevailing market price. A successful implementation of the scheme will perhaps contribute to manage the resources on sustained basis.

PAPER MILL POLLUTION: Water pollution by Paper mills is a major concern in recent days. Paper mill uses about 7000 gallons of water to manufacture 1 ton of paper and in turn generates huge amount of effluent, which pollutes the receiving wetlands and soil. It has been estimated that a paper mill with a capacity of 300 TPD releases about 2100 M³ of effluent per hour. The released effluent contains numerous organic and inorganic chemicals and is extremely harmful (Baruah *et al* 1996 a). The enormous amount of effluent severely degrades the water quality of receiving wetland (Baruah *et al* 1996 b) thereby jeopardizing the diversity and abundance of aquatic biota. In the receiving wetland the alteration of water quality immediately affects the diversity of plankton population, the very basis of food chain (Baruah and Das 1997 a) and fish population (Baruah and Das 1997 b) including some threatened species, viz. *Notopterus chitala*, *Catla catla*, *Mystus vittatus*, *Clarius batrachus*, *Heteropneustes fossilis* and *Anabus testudineus*. The effluent has the potential to pollute the soil by altering its physicochemical characteristics as well as nutrient status (Baruah and Das 1998 a) affecting the agricultural yield (Baruah and Das 1998 b).

Paper mills cause air pollution releasing gaseous pollutants from its digesters and boilers. The gaseous emission includes dust, sulphides, disulphides, mercaptan, fly ash etc. (Choudhury 1993), and these have adverse effects on both man and wildlife. Paper mills produce sizable amount of solid waste comprising wood dust and sand, lime mud, coal ash and sludge (Choudhury 1993) which are being dumped into nearby open fields and low lying areas, instead of utilizing these byproducts to establish ancillary industries.

ISSUES RELATING TO PAPER MILLS AND BIODIVERSITY CONSERVATION : Some major issues regarding Paper mills and biodiversity conservation include-

1) **Management of forest and resource sustenance:** It is necessary to have enough forest resources for continuation of Paper mill operation. Hence, there is a requirement to form a body comprising officials of State Forest Department and Paper mills, environmental activists or NGOs, to suitably design and vigorously comply the appropriate management of forest resources including regeneration, prevention of over exploitation, training of extracting personnel etc. There is a need for Research and Development establishment for the mill itself or the Forest Department, to look after resource development both qualitatively and quantitatively for resource sustenance. The unused forest land and waste land are required to be made available on lease basis for bamboo plantation or mixed plantation in planned manner by the mills or private parties along with necessary support. This would help employment generation, discourage encroachment of forest land and encourage growth of flora and fauna associated with bamboo plants and help in biodiversity conservation.

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2) **Monitoring at resource extraction and mill operation:** Resource extraction is a fundamental and delicate process in Paper mill operation. A bamboo plant requires 4 years to attain maturity and usable for paper manufacture. It is imperative to strictly follow the extraction guidelines that is, to cut the matured one only under joint supervision of Forest Department and Paper mill personnel. The workers employed should be able to select the matured one for sustenance of resource in forest. Periodic monitoring of the forest by environmental activists or NGOs or local bodies would certainly help in proper extraction of resource. Local communities should be made aware of the bamboo resource and the danger of its overexploitation and encouraged to participate in regular monitoring of extraction.

Regarding the operational status, the Mills need to take precaution in the functioning of effluent treatment mechanism to optimize the reduction of toxicity of released effluent as well as waste water from mill premises. Periodic removal of sludge from effluent treatment plant is a primary job in this regard. The aeration system in the treatment plant should be kept fully functional. It is necessary to add desired quantity of nutrients if the effluent is used for irrigation purposes for crop generation. The possible utilization of solid waste of Paper mills as raw materials to establish ancillary industries for manufacturing building materials as well as materials for land treatment should be encouraged by Paper mills or Government agencies with a motive of entrepreneurship development. This would not only help in reducing pollution pressure of environment but also help in overall development of the region.

3) **Promotion of Agro based resource/ waste utilization as alternative:** The agro based resources/waste such as - Rice straw, wheat straw, gunny or jute cuttings, bagasse, different types of grasses etc. and waste paper are some raw materials for the manufacture of some normal grade of paper and paper boards. Reports revealed that India produces about 150 million tons of rice straw, 17 million tons of bagasse and 1.4 million tons of raw jute and partially these are used as resources by the small Paper mills with production range of 3-30 TPD spread all over the country. The small Paper mills using agro based resources have been able to save valuable natural resources and encourage regional development. There is a requirement on the part of Government to encourage the growth of such Paper mills by providing adequate infra structural facilities and concessions for more growth of similar raw material based industries across the length and breadth of the country. Besides providing facilities Government needs to ensure protection of their interest keeping in mind their role in saving natural wealth. To develop such industry, a comprehensive study is required to assess the quantum of raw materials produced throughout the country and to evaluate the feasibility of establishment such agro based mills in different parts of the country. The paper produced by small Paper mills are dependent on the raw materials used and qualitatively inferior then the bamboo but their growth is necessary for vast agriculture dependent countries like India. The small Paper mills create more environmental problems because treatment of the waste become uneconomical. This is another area needs immediate attention for development of better low cost technology to combat environmental pollution in their operating areas.

4) **Monitoring of waste receiving ecosystem and environmental impact:** The quality of released effluent and waste water from the Paper mills need periodic examination to assess the quantity of organic and inorganic constituents responsible for pollution load in the effluent. The sampling for analysis should be done at the point of release or at the inlet and outlet of effluent treatment plant of concerned mills. This will provide information on operational efficiency of the mills and help to take corrective measures at appropriate time. Similarly, air quality of mill area, soil quality of solid waste and effluent disposal areas need periodic examination to assess the load of the pollutants. Elaborative ecological studies in mill area, particularly in the soil and wetlands receiving the mill effluent and solid waste, are extremely necessary to understand

the ecological implications and impact on microbial, floral and faunal diversity status. In this regard the Paper mills, State Pollution Control Boards and Central Pollution Control Board have greater role to play, in respect of periodic assessment of air, effluent and waste water quality, quality of water of receiving wetlands and soil of nearby areas. Besides, the local communities and NGO's required to remain aware of any ecological damage inflicted by the waste of the mills and to initiate actions for conservation of ecology and biodiversity of the area. Drinking water contamination, soil fertility reduction, cattle and human diseases are some common problems associated with the polluted environment in the vicinity of Paper mills that need immediate attention for the mitigation of sufferings of the affected people to maintain healthy environmental scenario in and around Paper mill area.

5) Community participation: There is a need to organize and educate the local villagers regarding the growth and conservation of bamboo species. It has been estimated that 1 ton of bamboo production will yield gainful employment for 40 man-days. It is imperative to supply good quality of bamboo rhizome, by the Mills, to the local communities of hills and plains at subsidized rate with a promise to buy later at usual market price. The people involved in extraction required to be trained in respect of different bamboo species and procedure for cutting which would ensure sustained supply of resources and species conservation and growth.

In hills the Jhum cultivation or shifting cultivation is regularly carried out by hill communities which involves large scale felling of all types of plants including bamboo in large areas in the hill slopes to prepare ground to facilitate crop farming. This is very common practice traditionally adopted by hill people of North Eastern States for cultivation of paddy, maize, millets, vegetables, ginger etc. In fact, the Jhum cultivation cause total degradation of forest ecosystem including biodiversity at an annual rate of about 3,87,000 hectares of land in North Eastern States of which about 70,000 hectares of land in Assam alone, (Chouhan 2000). In this context, an action plan is required to initiate with active participation of respective Governments, NGOs and local communities to protect the forest resources including bamboo and biodiversity from the menace of Jhum cultivation and contribute forest resource generation and optimize biodiversity conservation. The plan should include providing alternative sources for livelihood or subsidy to pursue other avocation so that people do not opt for Jhum cultivation. An aggressive awareness campaign against Jhum will also be helpful in discouraging more and more people for Jhum cultivation. In areas where it is impossible to prevent Jhum cultivation due to factors like tradition, culture etc. campaigning for bamboo plantation as an integral part along with Jhum cultivation will help in achieving both socio-economic benefit and biodiversity conservation.

6) Recommendations:

- A) To follow strictly the extraction guidelines for the extraction of bamboo.
- B) Involving the local people and NGO's to create awareness about extraction and bamboo species conservation as well as bamboo and biodiversity conservation.
- C) Allow the inaccessible areas to grow bamboo naturally, in accessible areas steps are required for promotion of bamboo generation by providing support and encouragement for growth of bamboo plantation or mixed bamboo plantation and also ensure regulated natural regeneration. Trial cultivations are necessary to carry on suitable species cultivation in a particular area.
- D) Establishing bamboo species germplasm bank and preserving both seed and seedlings of different species.

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- E) The mills should strictly adhere the norms for minimizing the pollution emission by adopting appropriate technologies for prevention of destruction of biodiversity of neighbouring soil and wetlands receiving the mill pollutants.
- F) Regularity in monitoring the pollution scenarios by the mill itself, by local people and Government agencies, and take necessary steps to address the problems of the affected people, viz. drinking water supply, enhancement of crop production, human and animal health care etc. This will ensure mutual trust between industry and people and help the nation to march forward for self-reliance.

EPILOGUE: Developing countries like India need more production of paper to cater the various demands of her huge population. The forest based resources are being exploited without proper planning which occasionally results in overexploitation and destruction. Because of this, the present scenario on sustained resource supply is extremely grim. The present situation demands a serious work plan to maintain a balance between demand and forest based resource exhaustion as well as biodiversity conservation. More emphasis is necessary in utilization of alternate resources instead of forest-based resources for production of paper. Simultaneously, there is a great need for upgrading the existing technologies employed in different industries including Paper mills to combat pollution of environmental components. Each and everybody involved in the work of forest resource development and conservation starting from ordinary workers to top bureaucrats should dedicate for natural resource sustenance as well as biodiversity conservation to ensure our own survival on this beautiful planet.

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