

To-Day And Tomorrow of The Fibrous Material Requirement of The Indian Paper Industry

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For considering the present fibrous material requirements of, and availability to, the Indian paper and board industry, a reference to the materials, used in the past, will not be out of context. The machine-made paper industry started in the country in 1832. Grass was commercially used for pulping for the first time in 1870, when the "Grass Era" began. The grass era can be considered to have continued upto 1925.¹ With the expansion of industry, the consumption of grass for pulping also increased and grass had a virtual monopoly, as a paper and board making raw material in the early period of the machine-made paper-industry in India. However, grass could not hold this monopolistic position very long. With the establishment of more paper and board mills, the demand for grass was increased and the supply was found inadequate. Further, due to indiscriminate harvesting without efforts to regeneration, increased cattle grazing and for various other reasons, not only the acreage but also the yield of grass per acre gradually declined, resulting in inadequate supply and a sharp rise in price. At the top of these, bamboo was found to be a very suitable and economic material for pulping, and in many respects, also better than grass as a

The Indian paper industry has undergone tremendous expansion during the last two decades. With 17 mills in 1951-52 having a total rated capacity of about 1.37 lakh tons/year, the number of mills increased to 57 in 1971-72, with a total installed capacity of about 7.31 lakh tons/year.

Bamboo, the main fibrous material, on which the industry has depended since 1925 for subsistence and growth, has almost reached the limit of supply. To keep pace with the increasing demand of paper and board, the industry has started using mixed hardwoods. For a number of cogent reasons, the use of softwoods in India, at present, for pulping, is ruled out. Beside bamboo and hardwoods, the industry is also using small quantities of grass, bagasse and waste paper.

The production of paper and board in the country is falling short of the requirements and the gap between the supply and demand is increasing. The country's forest resources are scanty, and, even at present, when off-take of wood, for various wood-based industries, including pulp and paper, is low, there is just an even balance between the supply and the requirement of forest wood. With the expansion of all wood-based industries there is a serious apprehension of shortage in near future.

The paper industry is the largest single consumer of wood, but has the lowest capacity to pay for the wood, as compared to various wood-based industries.

To meet the present increased need of fibrous material and greater need of future, the industry will have to depend more and more on the so-called non-conventional raw materials like waste paper, agricultural by-products, reeds and the like, which may be available handy in the nearby area.

raw material.

Assured with a plentiful and almost perpetual supply on which the future growth and maintenance of the industry can be used, for years to come, the Bamboo Paper Industry Protection Act was passed in 1925, which dislodged grass from its pre-eminent position as a paper-making raw material. (*ibid.*) Bamboo was found to be a paper making raw material *par excellence*, from

which almost all types of chemical pulps have been produced in India. The bamboo era of the Indian paper industry, which began in 1925, is still continuing and presently about 60% of the total fibrous requirement of the industry is met by bamboo.

The current trend of the utilization of the fibrous material for pulping can be traced in the peculiar endowment of the natural resources of the

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country. The proportionate average annual consumption of various fibrous material during different plan periods in India², detailed in Table I, will illustrate the position.

tonnes. This increased to about 4.1 lakh tonnes a year during the second Plan period (1956-60) and to about 7.4 lakh tonnes year during the third Plan period. (1961-64) Du-

but surely increasing. The use of waste paper is more or less static. The use of pulpwood which made a small beginning (7.75% of the total fibrous material annually used) during the third Plan period made a phenomenal progress and its intake has almost doubled (15% of the total fibrous material consumed yearly) during the fourth Plan period.

A reference to the price structure of various raw materials, will show that except bagasse all other raw materials are costlier than bamboo. Pulpwood is about 33% more costly and grass about 40% costlier than bamboo. One reason for decline in the use of grass for pulping is the high cost of the commodity. The price of straw is more or less at par, or only slightly more than the price of bamboo. This may also be the case with many other agricultural byproducts. India is the only country where bamboo is the predominating material for paper. The world's raw material for paper is wood. Of the total quantity of bamboo yearly available in the country, only about 17% finds its use for pulp manufacture, and the rest (83%) is consumed to meet other requirements³ (e. g., in rural uses, in housing, and for various other purposes). The main long-fibre material on which the Indian paper industry has depended since the twenties for sustenance and development is bamboo. This is supplemented to a limited extent by short-fibre material like, straw, grasses and bagasse⁴ and incidentally all the three are non-wood fibres. With the expansion of the paper industry more and more bamboo was required for pulping. To meet the increasing demand of the indus-

Table I
Average Annual Consumption of Different Fibrous Material
During Various Plan Periods

Fibrous material	Price Rs/tonne (as in 1954)	Percentage of total fibrous material used during various plan periods (expressed on average annual consumption.			
		I Plan (1951-55)	II Plan (1956-60)	III Plan (1961-64)	IV Plan (1965-69)
Bamboo	90.1	72.65	70.30	67.21	60
Grass	126.2	15.32	13.11	7.82	6
Pulpwood	120.0	—	—	7.75	15
Waste Paper	Not available	7.56	9.52	7.74	7
Bagasse	58.1	2.98	5.14	6.91	8
Straw	98.7	1.22	1.91	2.86	4
Total		99.73	99.98	100.29	100

The figures in Table I will show that bamboo is still the mainstay of the Indian paper industry representing about 60% of the total fibrous material consumed annually during the fourth plan period. The gradual decline in the percentage of bamboo consumed (on average annual basis) from the first Plan to the fourth Plan is no indication that the annual tonnage for bamboo consumption by the paper industry has declined, which in fact has increased. Thus, during the first Plan (1951-55) period, the average annual consumption of bamboo was about 2.6 lakh

ring the year 1967-68, the industry consumed about 8 lakh tonnes of bamboo. As compared to bamboo, the average annual consumption of grass was very insignificant during various plans. In the first Plan the average annual consumption of grass was 0.055 lakh tonne. In the second Plan the figure was 0.077 lakh tonne a year and in the third Plan it was 0.086 lakh tonne per year. In the fourth Plan the average annual consumption of grass was about 0.060 lakh tonne.

The Table also indicates that the use of bagasse and straw is slowly

try, indiscriminate harvesting, without systematic regeneration of bamboo, has taken place all these years, resulting in a gradual decline in the yield of bamboo to a staggering low of only about a ton per acre. No other country is using bamboo to such a large extent for pulping as India—other two countries in Asia and the Pacific region, using bamboo for pulping are Pakistan (presumably, East Pakistan, now Bangla Dēsh) to the extent of 3% of available bamboo and Japan to the extent of 4% of the bamboo available³—and in no other country the yield of bamboo is as low as in India. It appears paradoxical that a country which depends most on the bamboo for pulping has done nothing to improve the yield per acre by suitable research and management, but has allowed the yield per acre to dwindle down, by neglect and careless harvesting. Bamboo is and will remain for a long time to come, an indispensable fibrous material for paper making in India and is the only long fibre material in use for papermaking. Other fibrous materials in use like bagasse, straw, hardwoods etc., are short fibred, the pulps of which should be blended with about 25% long-fibre pulp (bamboo pulp) to impart strength and other qualities.

Of late the paper industry is experiencing considerable difficulties in securing adequate supply of bamboo and has to procure the supply over long distances. This naturally increases the transport charges with a consequent rise in the cost of the finished products. The country's capacity of supplying bamboo to the paper industry has almost reached

the limit. With the present amount of bamboo yearly available, more supply to the paper industry is not possible, if the requirements of various other end-users of bamboo is to be satisfied. Further expansions of paper industry based on bamboo alone is not possible, except in a few pocket areas, and should not, therefore, be envisaged,

The Indian Paper Industry which included only 17 big mills in 1951-52, with a total installed capacity of about 1.37 lakh tons a year, has undergone tremendous expansion during the last two decades, and in 1971-72, has 57 big mills in the list with a total installed capacity of about 7.31 lakh tons a year. Thus during the last twenty years, forty new mills have come up and some of the old mills have expanded their daily production capacities (ranging from 100 to 150 tons)

Although, much increase in the production of paper and board has taken place in the country, the demand of these commodities have far exceeded the production. This has resulted in widening the gap between

demand and production year after year. It is estimated that given an uninterrupted supply of fibrous material, the paper and kindred products in the country will increase as shown in table II. The figures in the table are explicit and need no comments.

According to another estimate⁷ made in 1964, the anticipated total requirements of fibrous raw materials in million tons to realise the target production are 4.2 in 1970-71, 7.2 in 1975-76 and 10.2 in 1980-81. Out of these anticipated requirements of fibrous raw material, the bamboo is expected to be consumed, in all the three years referred to above to the extent of 2.0 million tons a year, (*loc. cit.*) which implied that the production of bamboo and the use of this raw material has virtually reached a saturation point.

With increase in the demand of paper and board in the country, and the limited supply of suitable fibrous material for pulping, the industry finds itself between the horns of a dilemma and is blamed for the current shortage of paper in the country.

Table II
Estimated Out-put of Paper and Kindred Products On Basis of
Uninterrupted Supply of fibrous Material.

Year Item	1970-71 *	1975-76 *	1980-81 *	Calculated percent increase on 1970-71, figure in	
				1975-76**	1980-81**
Paper & Board	1.20	2.00	3.00	166.6	250
Newsprint	0.30	0.45	0.60	150	200
Chemical Pulp	0.20	0.40	0.60	200	300
Total	1.70	2.85	4.20	167.67	247.5

* Figures in these columns are expressed in million tons.

** Figures in the columns are expressed in percentage.

However, the fact remains that the Indian paper industry is consistently utilizing more than 85 percent of the rated capacity for the last several years⁸. It was also felt that there was a need (even in 1964) for creating additional capacity by establishment of at least two new units of about 200 to 250 tons per day. (*loc. cit.*) One of the reasons for the present country-wide shortage of paper is due to inadequate supply of suitable pulping material to the industry at a reasonable price. That a raw material shortage may hamper the growth of the industry has been visualized and voiced by many.^{7,8,9}

As a way out of this impasse, the industry has to supplement a part of its fibrous material requirement by wood. Thus, the wood era of the Indian paper industry has begun only in 1963. Although the wood era has come to stay, the wood used for pulping is mixed hardwoods of the tropical forests. The industry has hardly any say in the selection of the species and has to use, whatever species are made available, more out of necessity than a choice, to keep the production going.

Of the total forest area in the country, the conifers occupy only 4 percent and are found in the high Himalayan terrains.¹⁰ Although the conifers are very suitable for chemical pulping and some like spruce and fir, can be used for the production of ground wood pulp, their use in the paper industry is ruled out on economic reasons. The extraction and transport costs are excessive. They generally grow in the inaccessible region and the rate of growth is slow due to low stocking and neg-

lect¹¹. Only a small amount of offcuts of conifer and a little twisted chir (pine) are used for pulping (*loc. cit.*) The maximum price which the newsprint (groundwood) industry can pay for the conifers on the basis of 80 to 90% yield of mechanical pulp is from Rs. 100 to Rs. 120 per tonne¹². As compared to this, the saw milling industry can pay for the same coniferous timber Rs. 208 in Assam and Rs. 233 in Punjab per cubic metre (1 ton=1.4 cubic metre) (*loc. cit.*). Therefore, the use of soft woods for pulping on the ground out cost is not possible. The major part of country's forest area (96% of the total forest land) is under mixed tropical hardwoods.

Of the various industries depending on wood, the pulp and paper industry is largest single consumer of wood. The growing stock in the Indian forest has been estimated to be around 2000 million cubic metres of which the broad leaved species is about 1900 million cubic metres (representing 86% of the total by volume)¹³. The hard woods are costlier than bamboo (vide, Table I) and produce short fibre chemical pulps, with no special merit to score over bamboo chemical pulps. Even then the use of hardwoods for pulping is increasing because bamboo is not available to the required amount to the industry.

In the tropical Indian forests different species of hard-woods are growing at random. Selective harvesting of a particular species (even if it be found suitable for pulping) is not considered a feasible proposition on the ground of high cost of selective harvesting and inadequate quantity available for a sustained supply ev-

en to moderate sized mill. Therefore, the mills are supplied with various species of hardwoods in whatever proportion they are available and harvested, irrespective of their similar or dissimilar pulping characteristics.

Chemical pulping of mixed hardwoods are not uncommon even in other countries and has been mentioned in the literature^{14,15}. However, pulping together of mixed hardwoods unless more or less of similar pulping characteristics, is sure to result in unsatisfactory overcooked pulp and lower in yield, if conditions are adjusted to suit the pulping need of the most resistant of the species in the mixture. It is desirable that some kind of sorting of the wood into different grades in accordance with the similarity of pulping character may be undertaken by the supplier. Heterogeneous mixtures of hardwoods of varied pulping characteristics and of varying composition, which may change from consignment to consignment, will lead to unnecessary and uncalled for technological problems in pulping and bleaching and may have serious repercussion on the pulp yield and quality. The economic utilization of tropical hardwoods is rather difficult due to heterogeneity of the species and limit its use in higher productions¹⁶. This has seriously limited the use of hardwoods in mixtures, and in general paper mills do not use more than 30% of the total fibrous material in the form of hardwoods⁵. If an uniform process could be developed for pulping of all hardwoods, with equal efficiency, that would have greatly increased the utilization of

mixed hardwoods for papermaking.¹⁷

Although the paper industry is the largest consumer of wood, its capacity of payment for the wood is the lowest, as compared to various other industries depending on wood. This can be seen in Table III.

Table III
Capacity of Payment by Various
End-Users of Wood
(Basis-Price of pulpwood in
1964, Rs. 120/tonne)

Industry	Capacity of Payment*
Paper	1.0
Plywood	1.7 times that of paper industry
Saw milling	1.8 " " " " "
Charcoal	2.2 " " " " "
Domestic	
wood fuel	2.8 " " " " "
Furniture	3.3 " " " " "

*Compiled from scattered informations.

Interestingly, the voracious consumer of wood, which the paper industry is, pays the least for the wood it consumes. The sorting of the wood on the basis of similarity of pulping must entail into expenditure and will make pulpwood more expensive. It is doubtful if the industry will bear the cost of sorting or grading of wood on the basis of pulping characteristics. This may be the reason of reluctance, on the part of the supplier, to undertake grading or sorting of the pulpwood. The only redeeming feature is that, of the various industries listed in table III, paper is the only industry which can do without using wood.

India is a poorly forested country, covering only 21 percent of the total land area. According to the international standard about 33% of the

land must be under forest. The yield of wood per acre in the naturally growing tropical Indian forests is very low. Apart from this low growing stock, the fact that the forest area is gradually shrinking, since midfifties, due to encroachment of forest land for agriculture and urbanization, for transport routes and industries sites, and for other needs of increasing population, like human rights to graze cattle and collect fire wood, grasses and other produce, is very disheartening. Further, of the total forest area of nearly 69 million hectare, only about 4/5th is exploitable, that is where wood can be profitably grown.

All industries, including paper, depending on wood are expanding and the demand on the limited resources of wood is accordingly increasing. A substantial quantity of total wood removed from the forest is used as fuel when the per capita fuel consumption in the country is very low (about 0.2 cubic meter per year per person). Fuel is in such a short supply that leaves, straw and other agricultural residues and even dried animal excreta is used as fuel. Even with this present low offtake of wood, there is just an even balance between the demand for and the supply of wood. It is visualised that with increase in population and per capita income, the fuel requirement will increase, and with the increase in the tempo of industrialization (some of them requiring wood) and urbanization the demand of wood will also increase. If the annual out-put of wood tend to remain static as at present and do not increase there is a serious apprehension of wood shortage. When there is a shortage of a commodity and

various interests are in the field to purchase, the highest bidder alone can buy. Obviously, the paper industry is not in a position to pay for the wood as many other wood-based industries can. (vide, Table III).

There is no distinction between fuel wood and pulpwood and by a slight-adjustment of the process fuel wood can be pulped. However, the price structure of the domestic fuel wood, about 2.8 times more (table III) than pulp wood may preclude such a venture, but there is nothing to exclude the sale of pulpwood as fuelwood. Discussing the future requirements of industrial wood Seth has suggested⁵ that the anticipated requirements for 1975 will be around 13.3 million cubic meter and is likely to be around 32 million cubic meter in 1985, whereas the annual yield in 1985 has been estimated at about 12 million cubic meters. There would thus be a short fall in the anticipated demand and the production of wood. It has also been suggested (*loc. cit.*) that the gap can be reduced to a great extent (but not covered) by intensive forest management, by tapping the hitherto unexploited forest areas and raising more industrial wood plantation. It cannot be assumed that if and when the production of wood is increased by better forest management and silvicultural practices, the entire excess (or the bulk of the excess) of the produce will be diverted to paper making. Not only paper and allied industries but many other forest-based industries are also on their way of expansion¹⁸ as will be evident from table IV.

Table IV
Percentage Rise in 1970-71 of Some
Packaging Materials Over 1963-64
Consumption.

	Percent rise in 1970-71 over 1963-64.
A. Pulp Based.	
(i) Industrial Paper*	126
(ii) Paper board**	156
(iii) Corrugating board**	248
(iv) Straw board**	80
B. Wood Based	
(i) Tea-chest ply wood	49
(ii) Commerical wood	144

*use of wood optional

**manufacture independent of wood.

A survey of the figures in table IV will show that the increase in the demand of commercial wood in 1970-71 over 1963-64 is 144% as compared to increase in the consumption of industrial paper by 126% in the same period. The increase in the case of corrugating board 248%, the highest in the table, do not usually depend on wood (but mainly on agricultural byproducts) for manufacture.

It is not intended to decry the use of hardwoods for pulping. But in the context of the expanding paper industry of the country, the place of hardwoods should be viewed in its proper perspectives. Neither all the required quantity of hardwoods will be available for pulping, nor all the available species of hardwoods are technically and economically suitable for the purpose. The country is going to embark on a programme of plantation in Man Made Forests. The interest of the pulp and paper

industry will be amply served if such quick growing pulp-wood plants are cultivated in the proposed Man Made Forests which have relatively little use for other wood based industries.¹⁹

The other cellulosic materials currently in use and worth mentioning are, beside grass, bagasse and waste paper. The use of bagasse, which is a raw material used in the sugar mill for generation of steam, for pulping and paper making is faced with many techno-economical problems. This author and many others have discussed these problems in a number of scientific and technical journals and literatures are replete with references. It will suffice to say, that for many reasons bagasse in adequate quantity is not available for pulping.

Waste paper is another fibrous raw material for the paper industry. In many industrially advanced countries about a third of the fibre for paper and board mills constitutes of waste papers. In India, the largest amount of waste paper are obtained from government establishments. Waste paper from street sweepings or dust bins are usually not collected to any large extent due to contaminations. However, many small concerns in all big towns use waste papers collected from streets and municipal dust bins for conversion into low grade paper boards.

According to Podder,²⁰ in 1963, the consumption of paper and board in the country was 7 lakh tons of which 1 lakh tons constituted of waste paper. This works out to a recovery of fibres for paper and board to about 14.3% (which is less than half of the total percentage of

waste papers used as a source of pulp fibre in many industrially advanced countries). Out of the total amount of waste paper consumed in 1963, about 65 thousand tons were reused for production of high-grade paper and board and about 35 thousand tons for production of low-grade boards (mill boards) in many small paper-board making works (*loc. Cit*). Beside this, the producers of "paper machine" articles and the hand-made paper industry also use some quantity of waste paper. The present high price of waste paper and want of a grading system of waste paper for various end uses are acting as a deterrent for large scale re-use of waste papers, which are presently used for wrapping and packing purposes. The importance of proper utilization of waste paper to conserve other raw materials has also been emphasized by Sen²¹. For increased recovery and reuse of waste paper, to preserve the natural papermaking fibrous resources of the country, organised efforts for collection and utilization of the commodity are necessary.

To sum up, bamboo, hardwoods, grasses, bagasse and waste papers are the present fibrous materials of country for pulping and papermaking. Of these the first two are consumed to a larger extent but their availability is limited. Grass is also scarce and is costliest of the five fibrous materials referred-to before. The use of bagasse is seriously handicapped for non availability and the use of waste paper is more or less static at about 7% of the total fibrous material used annually for pulping.

This then is the present position of

the fibrous material in use in the country for the paper and board industry. The supply of suitable fibrous material in adequate amount and a reasonable price is the key to augment the production of pulp and paper to meet the country's present need and the expanded future requirement. If this is not done, the paper industry may deprive other forest based industries of their due share of wood, or else, the production will have to be kept static thereby increasing the gap between the supply and the demand. The present supply position of the fibrous material to the industry, *vis-a-vis*, its requirement may appear to be bleak but there is no cause of despondency, and the future is hopeful, if the hitherto untapped fibrous resources are judiciously utilized.

In an agricultural country like India, it appears curious that the pulping of agricultural byproducts and residues has not been undertaken in a big way, except bagasse and jute sticks. According to Guha and Pant¹¹ straw and agricultural byproducts are suitable as sources of pulp but their use for pulping is not feasible as some of them like paddy and wheat straws are used as stock feed and agriculture being primarily a rural profession is scattered all over the country. The collection and transport of the seasonal bulky byproduct of agriculture and their storage poses many problems. These two works have, therefore, advocated the use of hardwoods for pulping (*loc. cit.*). An opposite view has been expressed by Sen²¹, who has classified cellulosic raw material for pulping into two broad heads.

(i) The forest based woods which are likely to decrease with population increase if a break-through is not achieved to increase wood production, and (ii) "agriculture residue is likely to increase with population." According to Sen, in a country like India, the agricultural residues would therefore be a safer bet." (*loc. cit.*) Even if the wheat and rice straws which constitute the bovine feed are excluded from the purview of pulping, a large quantity of other agricultural byproducts and residues are still available for pulping. To illustrate, the stock or stem of the oil seed crops and of the pulses can be used as a source of pulp. The use of bast fibre-free jute sticks for pulping should act as an eye opener for use of bast fibre-free sticks of sunn hemp (*Crotalaria juncea*) and mesta (*Hibiscus cannabinus*). In the same way, the stem of the cotton (*Gossypium sp.*) plant after removal of the seed balls can be used with advantage of pulping. Beside the non-conventional raw materials in the form of agricultural byproducts or other non conventional raw material in the form of reeds like *Narkanda* or *Narpat* (*Arundo donax*) and many similar other non-conventional pulping materials that may be available in the vicinity can be used to augment the source of pulp. It may be of interest to note that a paper mill in Kerala, with an installed capacity of about 40 tonnes a day is engaged in the production of about 21 tonnes a day of speciality paper like match paper, tea paper, sack kraft, cable insulation paper, emery and sand base paper, to name a few, by using non-conventional raw materials like

reeds, waste paper and rag.

It is not intended to advocate the whole sale replacement of the conventional fibrous raw materials now used for pulping. In view of the precarious present balance between the demand and supply of hardwoods for pulping, the inadequate quantity of bamboo, grasses and bagasse available for pulping and the serious apprehension of shortage of pulping raw materials in near future, the non-conventional pulping raw materials in the form of waste paper, agricultural residues and byproducts and reeds etc. that may be available handy must be pressed into service to supplement the increasing pulp need of the industry. Most of the agricultural byproducts and residues and other non-conventional fibrous material will require less power for cutting, chipping, etc., will consume less chemicals for cooking and bleaching. The time required for completing these operations is also less. However, the pulp yield will be comparatively less and by themselves may not be suitable for production of strong paper, unless some long fibre pulp is added to the furnish. In general, these pulps are slow drainage.

The agricultural byproducts and residues reeds, etc., are bulky and their transport will be costly. Their transport over long distances will not pay. They should, therefore, be utilized in a mill situated nearby. They are seasonal and will have to be collected and stored in the season. They are easily affected by weather and will have to be stored properly against the ravaging action of nature. Being associated with agriculture, the byproducts are subjected to the

vicissitude of crop failure due to occasional flood and draught and hence there is a likelihood of uncertainty of supply and fluctuation of price.

The paper and board industry can be greatly benefitted by judicious use of one or more agricultural by-products, reeds, etc. as may be locally available, provided use of such materials will not deprive the cattle of their staple food or other industries of their raw material. They should preferably be separately pulped, bleached and beaten and then added to the pulp produced from the conventional raw materials. Their use will not only go to meet the current shortage of pulp but also for diversification of products.

In this period of expansion, the paper industry must develop a reorientation of outlook, so as to include those fibrous materials in its purview which are generally termed as non-conventional and which were hitherto not much used for pulping. Indeed, with such a reoriented view point, the research and industry can thrive and prosper to solve problems facing them and to the mutual advantage of both.*

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*Adapted from a talk given at the Scientific Society Shree Gopal Paper Mills, Yamunanagar.