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BAGASSE BASED PAPER AND NEWSPRINT IN INDIA : ECONOMIC AND POLICY ISSUES

By

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Industrial uses of agricultural and agro-industrial residues have strong backward and forward linkages to accelerate the pace of a country's economic development. Such uses have, therefore, been emphasized upon, particularly in the recent past. This paper deals with one of the agro-industrial residues, bagasse, for newsprint and paper making in India. Such uses have been encouraged through policy interventions such as

- duty free imports of used integrated pulp and paper mills starting around the mid 1970s, and
- excise duty exemption on paper produced with at least 75 per cent bagasse starting 1979.

There has been a rapid growth of small paper mills. A few large scale bagasse based newsprint and paper mills have also been set-up. At the same time, many of these units faced problems due to bagasse shortages and rising prices, and have either shifted to other materials within 2-3 years, or ran substantially below the installed capacities, or closed down. Such developments indicated that the policies were not based on adequate assessments of financial and managemental feasibilities of pulping bagasse on a substantial scale.

This main objetives of the study were

- to estimate the quantities of residual bagasse without planned action by sugar and/or paper mills, and to assess financial and managerial feasibilities of using that material for pulping,

to estimate the potential for residual bagasse due to improved thermal efficiency at the sugar mills, and to assess their financial and managerial feasibilities,

to assess the financial and managerial feasibilities of surplus bagasse due to replacing bagasse fired boilers with coal fired boilers at the sugar mills, and

to review the policies to encourage bagasse use for paper/ newsprint making and suggest necessary and feasible modificatons.

Methodology for the study comprised seven case histories of bagasse based newsprint and paper making units; a review of the available literature; and discussions with knowledgeable people : foresters, industrialists, economists, paper and sugar technologists, and policy advisors.

To start with, however, an assessment of demand for paper and newsprint in the foreseeable future, say AD 2000, was necessary to assess the demand-supply management of cellulosic materials as a whole, and the potential role of bagasse.

2. Demand for Paper/Paperboards and Newsprint by AD 2000

A review of the literature showed that the the demand for paper and paperboards in India has been substantially overestimated since 1951 (1/). Such demand forecasts by AD 2000 have varied from 3.25 million tonnes to 4.40 million tonnes against the 1987 output at 1.57 million tonnes, adequate supplies in the market, and little imports. Qualitative observations on the markets for paper and paperboards, thus, indicated that the demand in the foreseeable future could rise by 3.5 per cent a year. This means

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1. Gupta and Shah, 1987 : for a detailed treatment of this subject.

that without imports and without any attempts at demand management, the markets for paper and paperboards should be in equillibrium with a gradual rise in production to 2.5 million tonnes by the turn of the century. But, in view of the current installed capacity of 2.8 million tonnes a year, production capacity in the pipeline, the recent policy interventions to encourage the consumption of paper and paperboards, and possibility of some exports; we have chosen to work with annual growth rate in demand at 4.0 per cent. That would entail a prodution of 2.7 million tonnes by AD 2000.

Contrary to paper and paperboards, the demand forecasts for newsprint have been lower than the observed consumption, particularly during 1985-86 and 1986-87 (Table 1). That situation can be attributed to the recent spurt in home production. In the

Table 1 : Demand forecasts and observed consumption of newsprint in India : 1960-61 to AD 2000

('000 tonnes)

Years	Studies				Observed consumption*
	ESRF	DCPPI		Seventh Plan Working Group	
		Low	High		
1960-61	100	-	-	-	119
1964-65	133	-	-	-	NA
1965-66	115	-	-	-	136
1975-76	313	-	-	-	182
1985-86	-	301	305	390	464
1986-87	-	313	317	413	460
1989-90	-	353	357	494	-
1994-95	-	429	435	662	-
AD 2000	-	535	550	891	-

* Taken equivalent to production and imports.

Sources: ESRF, 1969, p.57; DCPPI, 1983; GOI, 1984, pp.15-16; CMIE, 1987, pp.91-92.

same context, however, the forecasted demand of nearly 900,000 tonnes, 2000, i.e., a compound annual growth rate of 5.2 per cent over the current observations appeared logical.

Thus, the country must be self-sufficient with 3.6 million tonnes of paper, paperboards and newsprint by the turn of the century.

2. Current and Potential Output of Bagasse

Annual sugarcane output in India during 1980-81 to 1986-87 averaged at 178 million tonnes. Around 40 per cent of that was crushed in the organized sector (Table 2) where bagasse output varied between 30 to 35 per cent. Thus, the bagasse produced in the organized sector could be 23 million tonnes a year.

Table 2 : Production and utilization of sugarcane in India : 1970-71 to 1986-87

('000 tonnes)

Year	Production	used for		
		centrifugal sugar	gur and khandsari	Seed, feed, chewing, etc.
1970-71	126	38(30)*	72(58)	15(12)
1975-76	141	42(30)	82(68)	17(12)
1980-81	154	52(33)	84(55)	18(12)
1981-82	186	87(47)	80(41)	19(12)
1982-83	190	83(44)	84(45)	22(12)
1983-84	177	59(34)	92(54)	21(12)
1984-85	174	60(35)	92(53)	21(12)
1985-86	172	69(40)	83(48)	20(12)
1986-87	182	85(47)	75(41)	22(12)

* Figures in parentheses are percentages to total production.

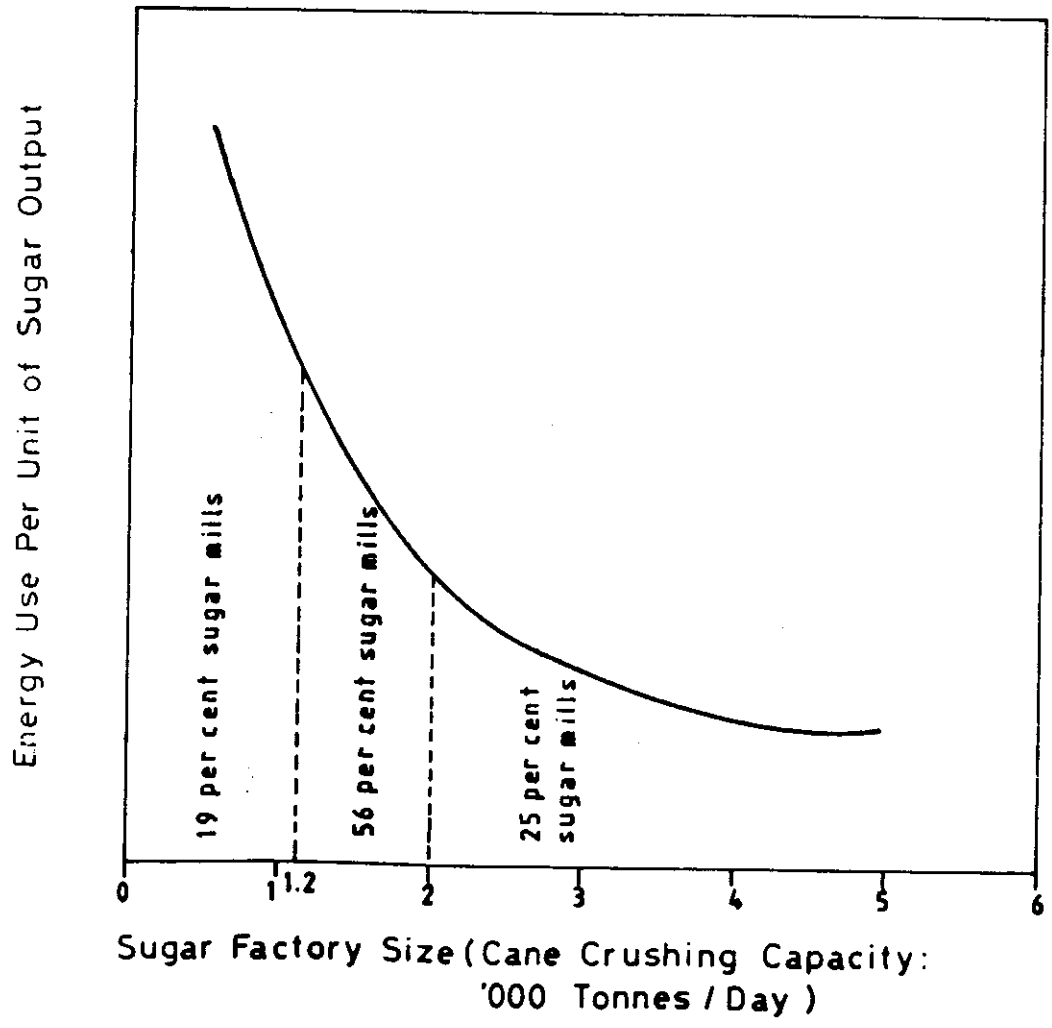
Source: Indian Sugar, Various years.

Assuming the ratio of bagasse and other celluosic materials at 80:20, this could suffice to produce 4.3 million tonnes of

chemical pulp based paper/paperboards and newsprint, i.e., more than the estimated demand for these goods in the foreseeable future.

The situation could, however, not be that optimistic since i) a major portion of bagasse has been and continues to be used as fuel in the sugar production process, and ii) quantity of bagasse used as fuel per unit of sugar output has varied inversely with the size of the sugar mills (Figure 1), such that nearly 20 per cent of the sugar factories with cane crushing capacity below 1,200 TPD have generally had no residual bagasse

Figure 1 : A hypothetical example of economies of scale in energy use per unit of sugar output



Thus, the quantity of residual bagasse must be systematically assessed.

2.1 Current Availability of Residual Bagasse

Estimates of the residual bagasse with the sugar mills have varied widely (Table 3).

Table 3 : Bases for estimating residual bagasse without using other sources of energy for sugar production in India

Factory size (TPD)	Estimated saving in baagsse		Source
	Percentage	Annual total (Tonnes)	
Aggregate	1.5 - 3	-	Poddar, 1983, p.68
Aggregate	2	-	ISMA, 1974, p.17
Not specified	7 - 16	-	Patil, 1979
200	8.5 - 11	8000-10000	Pathak, 1977
Not specified	13.0	-	Gurumutrhy, 1988, p.251
2,400	30	-	Gaikwad, 1982, pp. 12-13

In addition, discussions with a few sugar technologists and other knowledgeable people indicated that sugar factories with cane crushing capacity at 1,200 TPD should save nearly 10 per cent of the bagasse output. But, that also did not appear to be realistic due to the prevalent inefficiencies in steam generation and consumption at a majority of the sugar mills.

Moreover, one of our basic approaches for this study has been to err on the lower side of availability of residual bagasse to ensure against avoidable tensions in the planning and policy making processes. It was, thus, thought that, on an average, sugar factories at and above 1,200 TPD capacity could have residual bagasse to the extent of five to six per cent of the total.

The sugar mills in this category handled nearly 90 per cent of the cane crushed in the organized sector. . . Assuming that there were no significant variations in capacity utilization amongst sugar factories, the total residual at the current sugar production level could be estimated at 1.08 to 1.30 million tonnes a year.

It may, however, not be managerially feasible to utilize small quantities of the residual at sugar factories in relatively remote areas. Allowing an estimated 20 per cent for that, 860,000 to 1,030,000 tonnes a year could be available for pulping(2/).

Once again, with 80:20 ratio of bagasse and other cellulosic materials, these quantities could support 10 to 12, and 16 to 19 per cent of the observed outputs of paper/paperboards and nesprint with chemical pulp processes, and with 80 per cent mechanical bagasse pulp and 20 per cent chemical wood/bamboo pulp, respectively.

Planned use of this material should also be advantageous for the sugar industry which, till the recent past, had to pay to discard it. Thus, the sugar producers may even have an incentive to enhance the quantity of residual bagasse by improving the thermal efficiency of the mills.

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2. Opportunity cost of residual bagasse in other uses has not been assessed, but the value added in paper making appeared to be highest.

2.2 Potential Availability of Residual Bagasse Through Improved Thermal Efficiency of Sugar Mills : Current and Future

Thermal efficiency and steam/power economy measures at sugar mills would include installation of waste heat recovery units, economisers, air pre-heaters, bagasse drying to enhance its calorific value, etc. [Manohar Rao, 1983, p.656]. Likely enhancement in residual bagasse due to enhanced thermal efficiency has not been assessed, but, assessment of change in the residual due to bagasse drying appeared feasible.

Since sugar factories at and above 1,200 TPD capacity burnt around 20 million tonnes mill wet bagasse a year, their total energy consumption was nearly 36,500,000 million K. calories. This energy can be had from about 8.6 million tonnes bone dry bagasse (36,500,000 ÷ 4,250). Thus, a maximum 17.2 million tonnes (8.6 x 2) mill wet bagasse could meet the total energy requirements of the sugar mills under reference if bagasse was bone dried prior to feeding the boilers. The residual can thus, be enhanced to 3.8 million tonnes a year (3/). Around 80 per cent of that or 3.2 million tonnes may reach paper/newsprint mills.

That quantity would suffice for 662,000 tonnes of chemical pulp based paper/paperboards and newsprint. If the mix of cellulosic materials in the furnish was to be as in Table 4, nearly 732,000 tonnes of paper and paperboards or 930,000 tonnes of newsprint or any intermediate combination can be based on this material.

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3. The residual would be further enhanced if the material was depithed at the sugar mills and pelletised pith was used as fuel. But, we could not account for such situations.

Table 4 : Feasible combinations of different types of pulp for paper/paperboards and newsprint production

Description	Paper and paperboards	Newsprint
Bagasse chemical pulp	60	20
Bagasse mechanical pulp	20	60
Hardwood chemical pulp	20	20

Definite data to assess the cost of residual bagasse due to drying were not available. Discussions with some technologists, however, indicated that maximum investment on bagasse drying stations for sugar factories up to 2,000 TPD could be Rs.15 million. Interest, depreciation, and operation and maintenance costs were estimated at 15, 6.7 and 5 per cent, respectively, or Rs.4,000,000 a year. Thus, the cost of residual bagasse could vary between Rs.210 to Rs.330 a tonne.

It should be financially and managerially feasible for the paper/newsprint producers to use this material, particularly if perceptions pertaining to acute scarcities of conventional materials hold good. The sugar mills must also be generally willing to accept the bagasse drying processes.

Pricing the material saved through steam/power economy, and bagasse drying measures may be difficult. Cost of a marginal unit of residual bagasse including some margin for the sugar mills should be a logical approach. Though it would not result in a uniform price due to substantial variations in operational efficiency amongst the sugar mills, yet that should not be a problem as the concerned parties can be expected to appreciate the value of basic economic concepts and of mutual benefits to be

able to make case by case arrangements. The task may be facilitated where paper/newsprint mills choose to install bagasse drying stations at the selected sugar mills.

To estimate the residual bagasse by AD 2000, four additional assumptions and observations were that :

i) sugarcane production technology may enjoy no distinct advantage over its competitors such that sugarcane output may be around 230 million tonnes;

ii) Gur and Khandsari would continue to be produced by dispersed small scale units, and industrial uses of bagasse thus produced would not be managerially and financially feasible;

iii) proportion of cane crushed in the organised sector would rise to 50 per cent of the total output or 115 million tonnes; and

iv) cane crushing capacity of the new sugar mills would be above 1,200 TPD.

On that basis, cane crushed in sugar mills above 1,200 TPD would be at least 107 million tonnes, and the corresponding bagasse output would be 35 million tonnes a year. Out of that, around 6.5 million tonnes would be residual if all the 35 million tonnes was bone dried prior to feeding the boilers. But, once again, only 80 per cent or 5.2 million tonnes of that may be available for pulping.

That would suffice to support 1,080,000 tonnes chemical pulp or 30 per cent of the estimated demand for paper/paperboards and newsprint by the turn of the century. If the furnish could be as presented in Table 4, bagasse based output of 1,198,000 tonnes of paper and paperboards or 1,520,000 tonnes of newsprint, or any intermediate combination should be feasible.

2.3 Surpuls Bagasse by Using Other Fuels for Sugar Production

It has long since been suggested that coal may substitute for bagasse as a fuel [GOI, 1965 and 1974]. Surplus bagasse in the event of its complete replacement as fuel for the mills above 1,200 TPD would more than suffice to meet the total demand of cellulosic materials for paper and newsprint production. But, the extent of coal usage to fire the sugar factory boilers must be a function of the relative financial and economic costs of i) different cellulosic materials ii) residual bagasse due to its drying, and iii) surplus bagasse due to its replacement as a fuel.

3. Practices for Obtaining Bagasse by the Paper/Newsprint Mills

Bagasse based paper and newsprint has been produced in India for a reasonably long time. To be able to draw experience based observations, seven existing and proposed bagasse based paper and newsprint units were studied. The sample units were purposively selected to represent variations with respect to size, age, location, etc. These could be grouped in three categories:

i) Small paper mills without long term contracts with sugar producers such that the quantity of bagasse received and prices paid were negotiated during each season,

ii) Small paper mills based on surplus bagasse generated by sugar mills under common management but not necessarily at the same sites, and

iii) Paper/newsprint mills which installed or proposed to install coal fired boilers at selected sugar mills to get bagasse.

3.1 Small Paper Mills Without Regular Contracts for Bagasse

This category included three units. Average landed cost during 1982-83 to 1986-87 varied from Rs.320 to Rs.380 per tonne of mill

wet bagasse, and rose continually during that period. Other cellulosic materials were also used. Some relevant data have been summarised in Table 5.

Table 5 : Cost of cellulosic materials per tonne of chemical pulp at three selected paper mills : 1982-83 to 1986-87 averages

(Rupees per tonne rounded to nearest five)

Description	Average landed cost			Cost of cellulosic materials per tonne of chemical pulp		
	Paper mills					
	01	02	03	01	02	03
Bagasse	380	370	320	2,260	2,215	1,930
Wheat straw	305	-	545	1,265	-	1,790
Paddy straw	-	355	-	-	1,170	-
Coarse forest grasses	-	-	810	-	-	2,230
Bamboo	-	500	-	-	1,250	-
Paper cuttings	-	3,750	-	-	4,870	-
Indigenous waste paper	2,350	-	2,590	3,055	-	3,370
Imported waste paper	3,290	-	4,925	3,290	-	5,910
Bamboo pulp	-	5,565	-	-	5,565	-
Imported pulp	4,490	-	5,450	4,490	-	5,450

It can be observed from the Table that the bagasse cost per tonne of pulp has been considerably higher than that of other cellullosic materials. Moreover, because of the absence of regular arrangements with sugar mills for bagasse supplies, these units also faced an environment of uncertainity. There have even been instances when they could not get the desired quantities of bagasse and had to utilize higher proportions of other cellulosic materials including imported ready pulp, or had to lower the capacity utilization. The cases, thus, indicated inadequate planning whereby each one thought that the limited supply of bagasse would be available for its use.

More importantly, at least some of the producers in this category could not have stayed in the business if duty free imported pulp was not treated as an unconventional material for purposes of excise concessions. That, however, is neither logical nor commensurate with the policy of conserving scarce foreign exchange resources.

3.2 Integrated Management for Paper Mills and Sugar Mills

The category included two small paper making units. None of them could, however, meet the bagasse requirements from the sister sugar mills. Prices paid to the sister sugar mills varied between Rs.100 and Rs.200 per tonne whereas the prices paid to the other sugar mills varied between Rs.370 and Rs.460.

This meant that bagasse price paid to the sister organizations were in the nature of book adjustments. More importantly, the sister sugar mill in one of these cases has been continually improving upon its thermal efficiency to release larger quantities of bagasse, and also planned to have a bagasse drying and densification station to further reduce its consumption as fuel.

In spite of such efforts, landed cost per tonne of mill wet bagasse in these two cases averaged at Rs.395 and Rs.250 during 1983-84 to 1986-87 (Table 6). Once again, the average cost of bagasse per tonne of pulp was higher than the other cellulosic materials.

On the whole, however, these units were better placed than their competitors.

Table 6 : Cost of cellulosic materials per tonne of pulp at two selected paper mills : 1983-84 to 1986-87 averages

(Rupees rounded to nearest five)

Description	Average landed cost		Cost per tonne of chemical pulp	
	Paper Mill			
	04	05	04	05
Wheat straw	-	-	-	1,120
Paddy straw	-	205	-	675
Bagasse	395	245	2,375	1,475
Elephant grass	-	240	-	660
Bhabhar grass	-	450	-	1,230
Waste paper	5,180	2,210	6,730	2,870
Imported pulp	8,790	-	8,790	-

3.3 Paper Mills Installing Coal Fired Boilers at Sugar Mills

This category in the sample included two large newsprint and paper making units. The bagasse price was based on its comparable calorific value with coal, and cost of coal at the sugar mills.

Data on landed cost of bagasse and other cellulosic materials at these units have been summarized in Table 7. It can, once again, be observed that bagasse cost per tonne of pulp has been substantially higher than that of eucalyptus wood.

The enterprises in this category also were faced with uncertainity of obtaining bagasse. An interesting observation for one of these cases was that, in spite of adequate quantities of bagasse available from the contracted sugar mills, and willingness on the part of some other mills in the area to supply bagasse; the management entered into a contract with an additional sugar mill and installed coal fired boilers for them.

Table 7 : Cost of cellulosic materials per tonne of pulp at two selected paper/newsprint mills

(Rupees rounded to nearest five)

Description	Average landed cost		Cost per tonne of chemical pulp	
	Paper Mills			
	07	08	07	08
Bagasse	475	545	2,850	3,270
Eucalyptus	490	405	1,320	1,095
Imported pulp	-	5,215	-	5,215

It may also be noted that the project report in this case estimated the coal:bagasse substitution ratio at 1:2.52 but the observed ratio was 1:1.4. The difference appeared mainly due to poor quality of coal. The mill also faced problems in obtaining the required quantities of coal from the designated sources, and substantial portion had to be obtained from distances exceeding 2,000 kms. That further pushed up the bagasse price as the landed cost of coal was considerably higher than the initial estimates.

4. Future policy and practices

There has been a relationship between bagasse cost to the paper mills and the mode of obtaining it. The costs were highest where the material was obtained due to installation of coal fired boilers at the sugar mills, and lowest where a major portion of the material was residual at the sister sugar mills.

It has also been observed that financial and managemental feasibilities of enhancing availability of residual bagasse through steam/power economy and bagasse drying measures at sugar

mills would be substantially better than of surplus bagasse by using alternative sources of energy (4/).

It can, thus, be suggested that the policy to encourage coal usage to save bagasse for paper/newsprint making may be reversed. That should also be desirable due to i) a delicate balance between the demand and supply of coal, and ii) widely shared concerns for quality of the bio-physical environment which necessitate minimal use of the stock resources.

More importantly, the most viable and sustainable approach could be to have integrated sugar and paper/newsprint producing units. It has been estimated that a 2,500 TPD sugar mill at the observed efficiency levels can support a 100 TPD paper mill with 75 per cent bagasse in the furnish. The two enterprises can also have an efficient common power generating system [GOI, 1988a, pp.9-10].

This may limit the capacity of bagasse based paper/newsprint plants to 30,000-35,000 TPA as the size of sugar mills would be limited by sugarcane availability from a command area. But, that need not be a problem as paper/newsprint mills with capacity at 30,000 TPA can harness the economies of scale.

That would also be close to the GOI's stipulations whereby cane crushing capacity of new sugar mills should be 3,000 TPD or higher, and minimum economic size of agricultural and agro-

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4. We could not examine the issue in detail for want of data/observations. A large scale newsprint unit to be based on bagasse released by a cluster of sugar mills due to adoption of steam/power economy and bagasse drying measures has been proposed. The project document was, however, not available for our use.

industrial residues based paper mills should be 33,000 TPA [Anon, 1987 and GOI, 1988b].

This may be the most opportune time to move towards these objectives for at least three reasons.

1. The nation should be in no haste to create additional production capacity for paper/paperboards and newsprint. To repeat, the markets for paper and paperboards are in a state of equilibrium with the current output at less than 1.6 million tonnes against 2.8 million tonnes installed capacity. For newsprint also, the share of imports to total consumption declined from over 80 per cent during early 1970s to around 40 per cent in 1987. Moreover, at least three newsprint mills with capacity at 220,000 TPA have already been planned, and indigenously produced writing and printing paper can substitute for imported newsprint to a considerable extent.

2. Cellulosic materials have not been as scarce as they were perceived to be, and the prospects for the foreseeable future may even be better. By the turn of the century, at least 30 per cent of the estimated demand for paper/paperboards, and newsprint can be based on residual bagasse due to its drying at sugar mills with capacity at 1,200 TPD or higher. Another 20 per cent can be supported by recycling waste paper [Gupta, 1988]. The existing and proposed paper and newsprint mills based on surplus bagasse due to installation of coal fired boilers, and those based on other unconventional sources of cellulose : grasses, wheat and rice straw, etc. can be expected to meet at least another 10 per cent of the estimated demand for these goods.

Thus, a maximum of 1.5 million tonnes of paper and newsprint poduction by the turn of the century may have to be based on conventional cellulosic materials : mainly bamboo and hardwods. With 40:60 mix of these, the industry's demand should be around 1.5 and 2.4 million tonnes, respectively. Even that much should not be necessary with enhanced use of mechanical or chemo-mechanical pulping processes. Supplying these materials for industries with economic, cultural, social and political significance should not only be feasible but also convenient by harnessing only a part of the estimated potential output from only a part of the forest and non-forest wasted lands, and/or at least partial success of social and farm forestry programmes.

3. The GOI has been thinking of integrating the planning process for sugarcane, sugar, molasses and alcohol, and bagasse production/processing which have been under the charge of ministries/departments of agriculture, food and civil supplies, chemicals and petro-chemicals, and industrial development.

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