Agricultural Residues As Paper-Making Raw Material And Mini Paper Plants

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India is basically an agricultural country. In spite of limited irrigation facilities, she is the second largest producer of rice, jute and sugarcane in the world, and amongst the first five in cereals, millets and cotton producing nations. On the other hand, our forest resources are much less in comparison to other countries. Our forests cover hardly 23% of the total geographical area, and the yield of woods per hectare per annum is low.

The communication facilities continue to be poor. The total road kilometerage is as low as 180 Km. for every lakh of population, which is hardly 1/20th of the road kilometerage of developed nations. These conditions, obviously, make one think of planning the future paper industry in India, on raw materials available from farms rather than from forests. If we look to the projected demand of paper and paper products for present and future (Appendix I), we find that nearly 75% of total paper requirement of the country can be produced mostly out of short-fibred pulps with restricted proportion of long fibred pulp in

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India is second largest producer of rice, jute and sugarcane in the world, and amongst the first five countries producing cereals, millets and cotton. But the forests cover hardly 23% of its total geographical area.

By end of 1979, i. e. V plan, nearly 1.68 million tonnes of paper and board will be needed. This demand is likely to rise to 2.36 million tonnes by end of 1984 and 3.3 million tonnes by end of 1989. To meet this demand, the existing conventional raw material, like Bamboo ,Soft Woods, etc, are far too short. Agricultural residues are the only pontential source to meet future demand of the country. Therefore, our planning for the Paper Industry is to be based on such raw material. It is necessary to extensively investigate pulping properties of different surplus agricultural residues available, and segregate them according to their pulping properties to make different varieties of paper and board. Besides surplus agricultural residues, forest and farm weeds Like Lantana camara, Prosopis juliflora, forest wastes like pine needles and various fibrous wastes from industry also form a potential source of fibre to Paper Industry.

It is imperative that extensive studies should be made to develop suitable pulping procesess, and also the right type of pulp and paper making machinery with 100% indigenous expertise and know-how to process such raw material.

Further, the concept of having large-sized paper & pulp units or big mother pulp-mills in India, also needs a radical thinking on grounds of paucity of facilities to make such machinery and equipment here and lack of foreign exchange for their import. The salvation of future of the Indian Paper Industry is only in setting up small paper and pulp units of 10-20 TPD, scattered all over the country, designed to utilise locally available raw-material from forests and farms. Then only, many a problem of transport cost, employment opportunities, environmental pollution, etc. can be successfully solved.

Sirpur Paper Mills, have carried out extensive research work in establishing new processes to pulp various types of agricultural residues, forest and farm weeds, municipal and industrial wastes, etc. to make different types of paper and board, with lesser chemical consumption, losses, pollution problems and reasonably low capital investment.

According to these findings, waste material like cotton stalk, Tur/Arhar Stalk, Oil-seed Stalks, Rice/Wheat straw, millet straws bomboo lops and tops, pine needles, copper caddies, etc. prove to be very good source of fibre for paper and board making.

furnish. Only about 25% of the production, consisting of special quality paper and board, would require long fibred pulp. It is also a fact that in the foreseeable future, the availability of the agricultural residues is much more assured than the forest produce for paper making. As such, if we do not take into consideration these facts for future planning, a situation may arise when we shall face a similar glut what we are facing today for material and machinery shortage in paper industry.

Planning for Raw Material

While planning for a raw material for paper industry, a number of points have to be taken into account. Some of those are enumerated below ?

1. How far the communication facilities make a raw material source easily accessible and economically feasible ?

2. What is potentiality of supply of such raw material to the industry on sustained basis ?

3. How far the ecology is influenced, and how far the pollution hazards from the process can be tamed to maintain ecology balance of the locality ?

4. How far the indigenously developed technology and equipment can process the available raw material for desired results ? and last but not the least:

5. Can the present and future planning of the industry be faithfully based on such raw material, both for home and export markets ?

Accordingly, the planning of raw material, both for the present and future paper industry in India, has to be based on the following:

1. Production of Common Variety of printing and writing papers, including Newsprint and Board; and

2. Manufacture of high quality special grades of paper and industrial paper.

For the former, agricultural residues, mixed hardwoods, forest and farm weeds and wastes can be usefully utilised; whereas long fibred source like conifers, hemp, rags, etc. can be reserved for the latter varieties of paper. For our type of Socio-economic pattern and ecology, small units spread out all over the country and based on locally available raw-material, would prove to be more advantageous than the large-sized units. Large-sized Mother Pulp Mills or Integrated pulp and paper mills, can be built only at a few selected places having facilities of bulk transport of raw material, effluent disposal and sustained supply of water, fuel and power.

For our country, which is producing millions of tonnes of agricultural residues (Appendix II) as by-product, technology to make common variety of paper, board and Newsprint from such residues has got to be developed. It is only then that we can successfully meet the demand of paper for the masses and the industry. Establishment of small units, based on locally available raw material and man-power, is the only answer to solve the problem of paper shortage and unemployment.

Unfortunately in our country, and particularly so far paper industry is concerned, our planning had failed to give due cognizance to the above facts. Even today, we depend mostly on imported technology. We hardly realise that it is difficult, if not impossible, to fit this technology within the frame-work of our socio-economic structure. For this purpose we have to tackle the problem on three-pronged basis, viz.

1. To investigate paper-making properties of all cellulosic raw materials available as waste and surplus from farms and forests, and also from industry. Woods like *Prosopis juliflora, Lantana camara* and wild grasses, growing extensively, have huge potential to give paper-making fibre. Necessary technical know-how is to be developed for processing such raw material.

2. To develop and design suitable machinery and equipment to process the above mentio-

ned raw materials separately or in mixture to produce required quality of paper or board; and

3. To augment the developed technology and know-how to minimise, if not altogether eliminate, the problem of environmental pollution, and stop indiscriminate deforestation.

As can be seen from the Appendices, there is a wide gap between the availability of conventional raw material and future plan-projections of paper and board. This gap cannot be bridged by man-made plantations, nor by increasing the exploitation of existing hard-wood forests. For forest-based raw materials, huge sums are required for extensive layout of road complexes and forest management, whereas to exploit the farm-residues, no extra money or management is needed.

Plantation of fast growing species like *Kenaf* and *Sesbania* are also not profitable and favourable in our social set-up. We need every part of our irrigated fertile landfor growing grain and cereals. *Kenaf* and *Sesbania* grow only on such land, and at the same time, have no other utility except as pulping raw material. For agricultural residues and weeds, we need no extra land, water or fertilizer, which are otherwise required for pulp-wood plantations. Such a situation does not give us any choice, but to find out ways and means to get the best use of unconventional raw material for papermaking.

Unconventional Raw Material and its Pulping Properties

From Appendix II, we observe that huge quantity of agricultural residues are available without any extra investment on irrigation, fertilizer and management. It has been the observation of these authors that fairly good quality of Paper, board and Newsprint can be economically made out of of above raw materials.

Appindix III gives pulp properties of some such materials tested so far and their approximate cost of pulping. These datas prove beyond doubt that quality of pulp can be produced with fair economy and ease in processing. For most of these tests, low pressure cooking with low alkali was adopted to produce semi-chemical pulps. It may be further observed that according to pulping nature two or more of such materials can be grouped together for the purpose of their mixed cooking or for producing a particular quality of paper and board.

Rice-straw, Wheat-straw, Grasses and Linseed-straw are easily pulpable. Both semi-chemical and chemical grade of pulps can be made out of them with alkali 5 to 10% on b.d. weight of material and cooking under mild pressure conditions. Yield of S.C. and chemical pulps comes to around 65-70% and 30-32% respectively. Semi-chemical pulp can be suitably processed to produce Newsprint also.

Cereal stalks from Arhar (Tur), (*Cajanus cajan*). Maize (*Zearnays*), Jowar (*Sorghum Sp.*), and Oil-seed-stalks from Til (*Sesamum Sp.*), *Castor* (*Ricinus communis* and Tobacco, etc. can be processed to make suitable for fluting media, packaging board, wrapper and low-grade Kraft papers.

Prosopis juliflora is a hardwood and its young wood gives fairly good pulp and Unbleached and Bleached varieties of paper.

(*Lantana camara* gives S.C. pulp suitable for board and low-grade Kraft paper. Bamboo Buntings and Branches can be processed like normal bamboo to give conventional type of Unbleached and Bleached pulps

Unconventional Raw Material & Mini Plants

Raw materials mentioned above have scarcely been commercially exploited by Paper Industry in India and abroad. To use such materials, we have to develop our own technology and equipment. It is not necessary that only the existing known processes and machinery should be employed for the purpose. Low-pressure continuous digestors, cooking pulpers incorporating both impregnating and hot defibration action, high density deflakers, defibrator and high density chlorination equipment should be developed to handle such raw material. Work Shop facilities are

now available in India, where pulping and stock preparation equipment can be made without any difficulty. Majority of the components required for 10/15 TPD paper board machines can also be manufactured in the country. Import substitution has attracted the attention of many young entrepreneurs, and there is no reason to doubt that all the necessary components for such machines will be available from indigenous sources shortly.

The present investment for a 10/15 TPD Pulp and Paper mill comes to around Rs. 5,000/-per annual tonne for unbleached varieties of paper, and around Rs 7,000/-per annual tonne for bleached varieties of paper. With proper engineering know-how given to small scale industries, this investment can be further brought down.

Effluent disposal, which poses a serious problem with large sized pulp and paper mill, will be easier to handle in mini plants, since the volume of effluents to be handled in the latter case is much less. By suitable treatment and recycling processes, it may be possible to convert such effluents for useful irrigation of fields and farm-lands.

Conclusions

With the spread of education and industries, large quantity of paper and paper-products will be needed for the country. But there is serious shortage of raw material to meet the demand of such expansion. Conifers are scanty and grow only in the Northern most boundary of the country, from where its extraction is difficult & costly. Bamboo is not much and already paper industry is facing its shortage. Hardwoods are at present available in plenty, but their selective extraction and exploitation poses a major economical problem due to lack of approach roads and transport. To extract woods and bamboo from interior of forests, approach roads are to be built first; which means huge investment of money on road complex. By the time such roads are built; most of the bamboo and woods will decay and die. Raising man made forests is a long term proposition and for this also huge sums will be required for management and fertilizers. Thls gives a dismal picture of expansion of Paper Industry in India.

Setting up large-sized units will create problems of effluent disposal. Day-to-day difficulty in smooth flow of raw material and finished product due to inadequate transport facilities by rail and road and energy crisis, will be the added disadvantages.

To face such a situation and to meet the future demand of raw material for increased paper production, the use of agricultural residues and forest and farm waste is the only answer. Such material is available quickly and at no extra cost for fertilizer, irrigation or management. In different regions, different types of agricultural residues are available as surplus or waste, which can be utilised for making paper, board and Newsprint. It is now time for us not to depend too much on conventional raw materials.

In India, facilities are available to make small paper machine of 10-15 TPD production. Foreign exchange requirements for such units will be negligible. They will solve many a problem of reduced transport cost of raw material, better employment opportunities to local people and lesser investment. It will be easier and cheaper to handle the conservation of ecology and maintaining balance of nature, which is a very important factor for safe-living and people's health. Indiscriminate deforestation, pollution hazards of effluents and disappearing villages are some burning problems of the day created by heavy industries and large scale units. In case of small units based on agricultural residues and wastes, such problems will automatically be solved. Small units can help better in maintaining the balance of nature and preserve environmental conditions, which we should realise before it is too late.

Appendix I

Planned Requirement of Paper, Board & Newsprint in India

Description	IV Plan (1973-74)	V Plan (1974-79)	VI Plan (1979-84)	VII Plan (1984-89)
	All figures are in '000 M.T.			
I. Cultural Papers :				
i) Printing	340	495	680	900
ii) Writing	120	250	340	450
	460	745	1020	1350
II. Newsprint :	200	350	500	700
III. Industrial Papers :				
i) Kraft & Brown wrappings	160	250	350	530
ii) Others	75	100	150	220
iii) Paper Boards	155	235	340	520
	390	585	840	1270
Grand Total	1050	1680	2360	3320

(Source: Planning Commision Reports).

Appendix II

Availability of Agricultural Residues (Present)

(all figures in '000 M.T.)

Material	Approx. availability per year	Regions
I. Agricultural Waste :		
1. Jute Sticks	3,000	Bengal, Bihar & Orissa.
2. Hemp Sticks	100	East U.P.
3. Oil-seeds stalks/straws :		
a) Castor	500	U. P., M. P., Maharashtra, Andhra Pradesh, Bihar.
b) Til	1,000	U.P., M. P., Telangana. Maharashtra.
c) Linseed	200	U.P., M.P , Telangana.
d) Mustard	1,000	U.P., M. P., Rajasthan, Haryana.
4. Miscellaneous :		
a) Cotton	6,000	Maharashtra, Tamilnadu, Karnataka, U.P.
b) Tobacco	500	U.P., M.P., Bihar, A.P.
c) Chillies	200	U.P., Haryana, M.P.,A.P.
5. Cereal Stalks :		
a) Arhar (Tur)	1,000	U.P., Rajasthan, Bihar, M.P., Maharashtra, Andhra Pradesh, Haryana, Rajasthan.

II. Agricultural Residues :		
1. Rice-straw	64,500	Bengal, Bihar, Orissa, U.P., Haryana, Kerala, A.P., Maharashtra, Tamil Nadu, Karnataka, M.P., Punjab.
2. Wheat-straw	40,500	Haryana, Punjab, U.P., M.P., Maharashtra, Rajasthan.
3. Jowar/Maize Stalk	6,000	U.P., M.P., Rajasthan, A.P.
4. Pine apple leaves	300	Kerala, Assam.
5. Banana leaves	862	Bengal, Kerala, Maharashtra, Karnataka.
III. Forest waste :		
1. Bamboo Bunting & Branches	750	All India.

Appendix III–A

Pulping of some Unconventional Raw Material

Raw Material	Cost Data	Quality of Paper: Corrugating Media	Kraft (Unbld.)	Kraft Bleached
Group 'A' : Bagasse, Cereal Straws, Millet-straws, Grasses	Pulp Yield	55–60%	50–55%	30–33%
	Raw Material M.T. (per M.T. of Pulp)	1.8–1.6	2.0–1.8	3.3–3.0
	T.A.A. required as Kg. Na_2O/M.T. of pulp	58–116	58–116	255–350
	Cost of Pulping (Por M.T. of Pulp)	Rs. 1200–1450/-	Rs. 1800–2500/-	Rs. 2600–3000/-
Group B : Mixed rags, waste hessian bags, Old hemp ropes Kenaf, Cotton-stalk, Til & Linseed-stalk, Arhar (Tur) stalk.	Pulp yield	70–75%	45–70%	40–55%
	Raw Material M.T. (Per M.T. of pulp)	1.4–1.3	2.2–1.4	2.5–1.8
	T.A.A. required as Kg Na_2O/M.T. of pulp	58–86	78–195	78–430
	Cost of Pulping (Per M.T. of Pulp)	Rs. 1200–1500/-	Rs. 1700–2600/-	Rs.2500–3000/-
Group C : Bamboo Buntings & Branches, mixed woods, saw-dust, Veneer waste.	Pulp Yield	65–75	40–50	30–36
	Raw Material M.T. (per M.T. of pulp)	1.5–1.3	2.5–2.0	3.3–2.8
	T.A.A. required as Kg Na_2O/M.T. of pulp	58–116	230–335	350–600
	Cost of Pulping (Per M.T. of pulp)	Rs. 950–1200	Rs. 1500–2000	Rs. 2500–3000
Group 'D' Mixed Waste Paper	Pulp Yield	55–65	55–60	50–55
	Raw Material M.T. (Per M.T. of pulp)	1.8–1.5	1.8–1.6	2.0–1.8
	T.A.A. required as Kg Na_2O/M.T. of Pulp	15–30	15–30	20–40
	Cost of Pulping (Per M.T. of pulp	Rs. 1000–1200/-	Rs. 1200–1500/-	Rs. 2000–2200/-

Note:—Above cost figures do not include overheads.

Appendix III–B

Pulp Properties of Unconventional Raw Material

Raw Material	Data	Corrugating Media	Kraft (Unbld.)	Kraft Bleached
Group 'A'	Burst Factor	10–15	25–35	8–15
	Tear Factor	30–50	60–70	30–50
	Breaking Length (Km)	2.5–4.0	4–5	2–3
	No.of Double Folds	10–12	30–40	3–10
Group 'B'	Burst Factor	10–15	25–45	10–30
	Tear Factor	30–50	80–100	30–70
	Breaking Length (Km)	3.6–6	5–7	3–6
	No.of Double Folds	10–100	30–200	8–20
Group 'C'	Burst Factor	6–8	20–30	10–20
	Tear Factor	25–30	70–100	50–70
	Breaking Length(Km)	2–3	4–5	3–4
	No.of Double Folds	2–4	30–60	5–20
Group 'D'	Burst Factor	6–8	20–25	8–12
	Tear Factor	25–30	60–70	30–50
	Breaking Length (Km)	1.5–2	3.5–4.5	2–3
	No.of Double Folds	2–4	20–30	3–5