OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

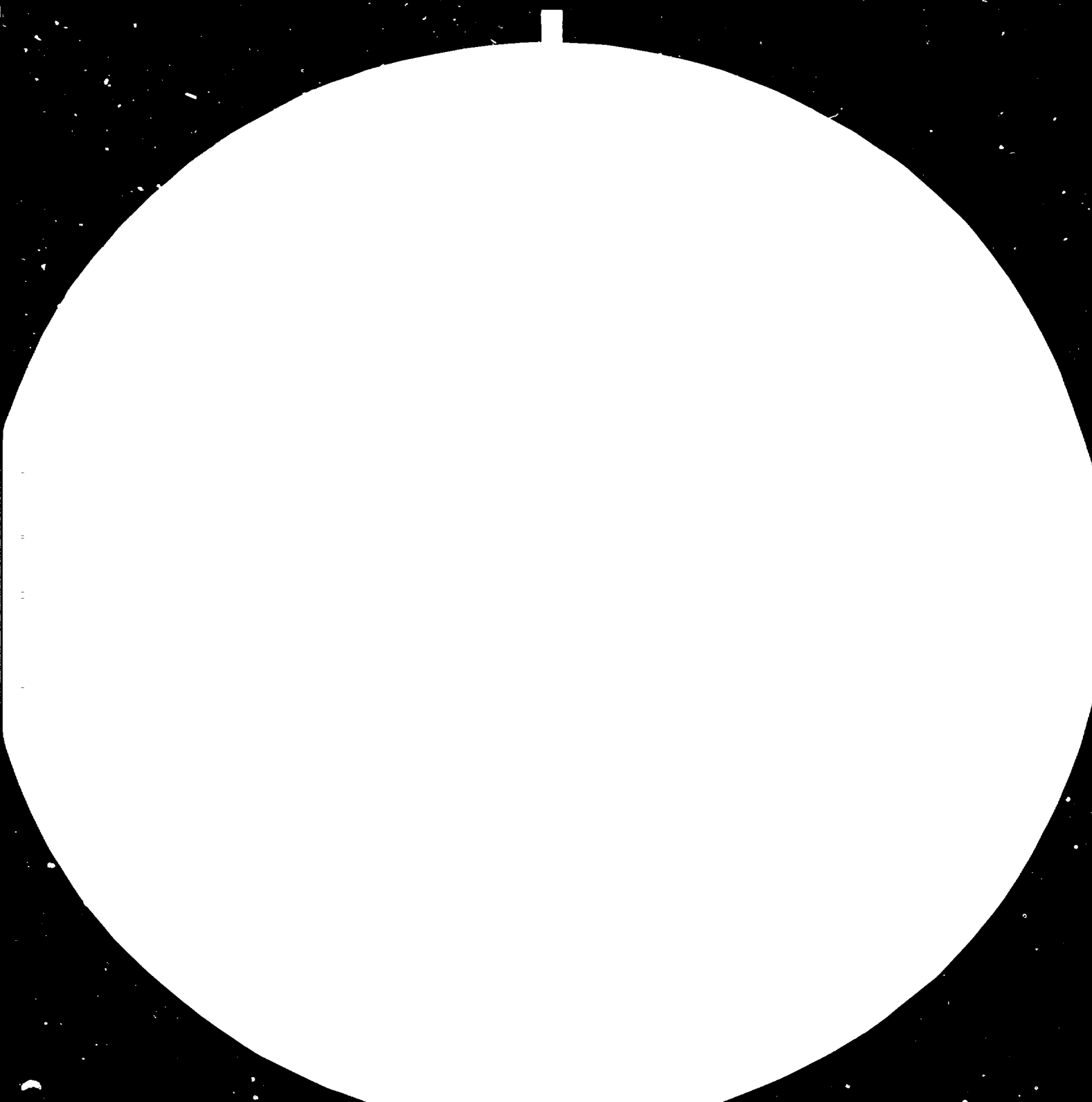
FAIR USE POLICY

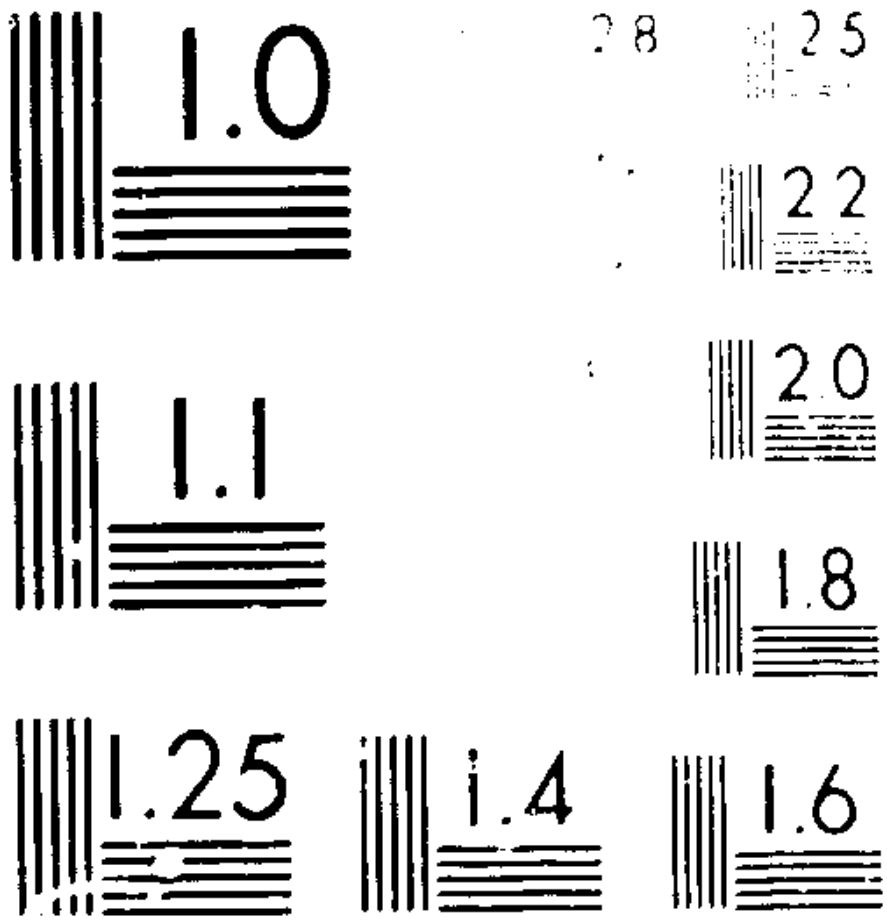
CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org




1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

10918

Distr.
LIMITED

ID/WG.352/24
30 October 1981

ENGLISH

United Nations Industrial Development Organization

International Experts Group Meeting
on Pulp and Paper Technology

Manila, Philippines, 3 - 8 November 1980

INDIA'S EXPERIENCE IN BUILDING SMALL PAPER MILLS BASED ON RECONDITIONED PAPER MACHINERY *

by

S. L. Keswani **

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Managing Director, Chemprojects Design and Engineering Pvt. Ltd., Consulting Engineers, New Delhi, India

V.81-31430

C O N T E N T S

NEED FOR SUCH A CONCEPT

There has been a prolonged gap between demand and supply in Indian Paper Industry. Consumption of paper by an Indian per annum is only 2 Kg. compared to 252 Kg. by an American. Total installed capacity in India is to the tune of 1.5 million tonnes and licensed capacity is 3.5 million tonnes. Letters of intent for another 2.5 million tonnes have been placed.

There are certain inhibiting factors which have come in the way of more investments from private sector. They are basically in the form of heavy capital investments coupled with low return, long gestation period, non-availability of raw materials and rising fuel costs.

The concept of setting up small paper mills based on agricultural residues using reconditioned machinery, has been developed keeping in view the above factors. How this concept overcomes the above-mentioned inhibitions, can be made clear by following arguments.

The capital investments for such mills are low compared to large ones due to two main reasons. Apart from the paper machines, other pulping and utility equipments can be procured indigenously. Since these mills are using agricultural residues as raw materials, their processing involves equipments which are simpler in design, indigenously procurable and lower in cost.

Usage of agricultural residues is also a major factor in favour of setting up such mills. As these agricultural residues are difficult to be transported over long distances, localised use of it is best suited for small paper mills.

Big mills requiring a huge quantity of such materials can not be conceived due to same reason. Moreover, the conventional raw materials like bamboo and wood are so limited in supply that substantial usage of them in near future appears doubtful.

Long gestation period of big mills is mainly due to long delivery schedule of vital equipments like paper machines, finishing equipments and utilities like steam boilers, etc. For small paper mills the gestation period is considerably shortened due to quick availability of used paper machines from developed countries where they are lying idle due to economic reasons. The dismantling, shipping, renovation and re-erection takes about one third of the total cost and delivery time of an equivalent new machine. The delivery period of other auxiliary items being of smaller capacity also considerably reduces.

In this paper these points shall be elaborated to clarify the need of small paper mills to utilize readily available agricultural residues with reconditioned second hand machinery available at much lower cost.

LIMITATION OF FOREST RESOURCES AND USAGE OF AGRICULTURAL RESIDUES

Since beginning of paper making in India, bamboo has been the basic source for fibrous raw materials. Hardwoods have also been used extensively mainly to provide the short fibred stock. The paper making processes demand an adequate mixture of long fibred stock to impart necessary strength properties into paper and short fibred stock to fill up the interstitial spaces between long fibres to impart uniformity. For too long this purpose has been met by use of bamboo, hardwoods and sometimes by coniferous varieties from temperate regions.

Paper Industry in India today faces a severe shortage of bamboo. Efforts have been made to augment the requirement by using more of hardwoods. The optimum ratio of bamboo to hardwoods is taken as 3:1 keeping in view the quality considerations. On average about 2.7 tonnes of bamboo and hardwoods with 10% moisture content is required to produce one tonne of paper.

There are 121 pulp and paper mills in India out of which 21 produce 73% of the total production. Over and above this, newsprint mill at Nepanagar and Rayon Grade pulp mills are also using bamboo. The existing installed capacity is 1.5 million tonnes per annum. Assuming about 90% utilization of the installed capacity actual production comes to about 1.35 million tonnes. Based on above figures estimated consumption of bamboo and hardwoods comes to 2.25 million tonnes and 0.75 million tonnes respectively.

Systematic data regarding availability of bamboo and hardwoods is not available. An estimated figure puts it as 5000 million cubic meter. There is no correct estimate of total area of growth for bamboo but as a reasonable estimate it is believed to be more than 10 million hectares. Based on this figure annual potential availability may be stated to be about 5 million tonnes. This figure however, is quite misleading if actual availability is to be gauged for

fulfilling future demand. This is due to the fact that bamboo plantations are concentrated mainly in Orissa, Madhya PradeshAndhra Pradesh, Karnataka and the north eastern States like Assam, Arunachal, Tripura, Mizoram, etc. Whereas some infrastructure is available in States like Orissa, M.P., A.P., and Karnataka, there is hardly any in northeastern States, where the major concentration of bamboo plantations lies.

Projecting the demand of paper in 2000 A.D. with per capita consumption of 3.0 Kg and a total population of about 700 million, we arrive at a figure of about 2.0 million tonnes per annum. This effectively means doubling up the present capacity utilization.

If this augmentation is to be met by conventional raw materials alone the requirements of bamboo and hardwoods will rise to the tune of 4.0 million tonnes even after allowing for reasonable circulation of such paper.

Regarding timber the task of demand estimation was taken up by National Commission on agriculture which predicted the timber demand at 2.8 million tonnes by 1982. In the context of this alone, the shortage of bamboo is inevitable.

Solution to this problem therefore lies essentially in utilization of non-conventional raw materials like wheat and rice straw, bagasse, waste paper, rags, etc. Cereal straws are abundantly available in this country with vast amount of agricultural land available. The present availability of wheat and rice straws comes to 86 million tonnes. Other cereal straws may be placed roughly at 24 million tonnes. Allowing for 10-15% of the total available straws to be consumed as cattle fodder and 10-15% as fuel, still an enormous amount to the tune of 60.0 million tonnes is available for paper making. Taking 30% yield over the raw material for paper making, the total potential of paper making from such cereal straws works out to 18.0 million tonnes.

There are certain inherent problems too in utilization of cereal straws for paper making. They are broadly classified below :-

(a) Cereal straws cannot be transported over long distance due to their bulk and heavy constraint on the transportation system of this country. Long distance transportation therefore becomes quite uneconomical.

(b) Cereal straws being seasonal items, a large amount of storage at the mill site also has its own problems. Storage area required per tonne of cereal straw is much higher compared to that of bamboo or timber due to its high bulk. It has also been experienced that a larger spacing between stacks is required in case of cereal straws due to fire hazards especially during summer.

Considering the above factors we come to the logical solution that paper mills based on non-conventional raw-materials cereal straws have to be limited to a capacity of 30-50 TPD. This in other words means that small paper mills up to a capacity of 30-50 TPD should be made to utilize the agricultural residues as basic fibrous raw-materials for paper making. In next few sections it will be shown how small paper mills are further justified due to their low capital investment, apart from being potential utilizers of agricultural residues which otherwise cannot be utilized in a large size paper mill.

However, one important point may be clarified here that even small paper mills cannot be solely based on agricultural residues as fibrous raw materials due to the fact that length of fibre obtained from these sources is much smaller compared to that of wood-stock or bamboo and does not withstand sufficient beating or refining before paper making. These raw materials are therefore normally supplemented with long fibred stock from rags or purchased pulp to make a reasonably good paper stock. However, it has been practically possible to use agricultural residues to form 70% of the total pulp stock for paper making.

LOW CAPITAL INVESTMENT

The capital investments required for a small paper mill are of vital importance for its economic viability. Utilization of agricultural residues coupled with use of reconditioned second hand machinery has contributed towards lower capital investment in the following manner:-

(1) The use of agricultural residues call for simpler equipments like straw or grass cutters, dusters, batch digesters, etc. These items are much cheaper and indigenously available on a short delivery schedule compared to those of chippers blowers, centrifugal screens (for wood based mills) which are much costlier. Chippers etc. are still imported with a long delivery schedule and its high price tag.

(2) Power consumption for refining agricultural residues is quite low compared to that of wood or bamboo pulp. This means fewer refining equipments too.

(3) The use of imported reconditioned machinery considerably reduces the project cost. A typical 30 tpd writing and printing machine imported for reconditioning costs about Rs. 4.0 million, whereas the same machine procured new from indigenous sources with some imported items like suction couch may cost about Rs. 12 to 15 million. The fact that a reconditioned paper machine has a substantial effect on the total project cost is beyond controversy.

(4) The lower gestation period for such mills (This is elaborated further in next section) also reduces the project cost considerably. The pre-operative expenses like establishment cost and interest paid during construction are considerably reduced.

It is therefore an established fact that both the aspects i.e., utilization of agricultural residues and use of imported

reconditioned machinery are complementary to each other for reducing the investments for mills of capacity ranging from 20 to 50 T.P.D.

As given in case histories, Case-I includes minimum of reconditioned machinery i.e., only paper machine and finishing equipments. As a result of which the capital investment per annual tonne of installed capacity is the highest.

Case-II has a larger share of imported reconditioned machinery i.e., stock preparation equipments in addition to paper machine and finishing equipments, although cost figures in this case date back to 1974. The apparent effect of this case can be seen in capital investment per annual tonne of installed capacity.

Case-III refers to a mill with more than 80% equipments which are imported and reconditioned. The cost figures are current, in fact, mill is being commissioned in October 1980, and shows a substantially low investment figure per annual tonne of installed capacity.

Case-IV refers to a 30 tonnes per day saleable writing and printing paper mill. This will is expected to be commissioned by January 1981. The mill has a fourdrinier paper machine having a size press. The other imported reconditioned equipment are several stock preparations for almost 2 years. It has about 30% imported equipment while raw materials preparation, pulp mill equipment and utilities are of Indian origin and new.

These case histories also prove beyond doubt that larger share of reconditioned machinery considerably reduces the capital investment.

SHORT GESTATION PERIOD

One of the most important aspects of a paper mill using second hand imported, reconditioned machinery is its short gestation period. From our experience of setting up such units, an imported paper machine takes about 10-12 months for dismantling, shipping, reconditioning and re-erection. Whereas for a new paper machine of similar capacity total time taken between placement of order and commissioning may be as high as 20-24 months.

Total project implementation schedule of a 20-30 TPD paper mill using imported reconditioned machinery has been found to be about 20-24 months. For a similar mill using new machinery shall be anywhere between 36-40 months.

A short gestation period considerably reduces the pre-operative expenses incurred in the form of establishment cost and interest payment. This further contributes to lowering of project cost apart from the fact that reconditioned machinery, re-erected, costs about one third of its new indigenous counterpart.

CASE HISTORIES

We have taken up four cases of small paper mills to study different aspects especially project cost, extent of utilization of agricultural residues, gestation period, etc.

Case-I refers to a mill of 20 T.P.D. capacity producing M.F. Kraft and writing/printing on a second hand reconditioned machine utilizing straw and hessian as primary raw materials. Total project cost is reported to be Rs. 35.5 million. (Projection No. 6)

The profitability statement in the Case-I shows negative cash accrual. However, if cash accrual from depreciation is also taken into consideration, the net cash accrual shows a healthy return. It will also be noted that the mill is paying the interest on debt which is bound to be dissipated gradually with repayments. This means better cash accrual in progressive years.

Case-II refers to a mill of 30 tpd capacity producing posters, Kraft and writing/printing varieties on a combined machine. All stock preparation equipments, paper machine, finishing equipments and boiler are imported and reconditioned. The total project cost has been reported to be Rs. 20.00 million. The estimation of profitability shows a healthy return of 48.3% on investment. This is due to the fact that capital investment is quite low and short term loans have been repaid.

Case-III refers to mill of 50 T.P.D capacity to be commissioned by end of October 1980. The mill will produce kraft and writing/printing grades on a fourdrinier combined machine. Complete pulp mill with separate streets for straw and wood handling, stock preparation, paper machine, finishing equipments, etc. are imported and reconditioned. The total project cost is expected to be within Rs. 42.50 million.

In this case the estimation of profitability has been done on the basis of realistic computations based on experience in similar mills as the mill is yet to be commissioned.

Case-IV refers to a mill of 30 T.P.D capacity to be commissioned by end of December 1980. The mill will produce writing and printing grades on a fourdrinier multicylinder machine. The paper machine is imported and reconditioned. The total project cost is expected within Rs. 60.00 million. (Projection No. 7)

As the mill is yet to become operational, profitability has been estimated on the same lines as in Case-III.

PROBLEMS AND PROSPECTS

Prospects

In the foregoing sections we have tried to impress upon the main problems and advantages of setting up small paper mills in India based on reconditioned machinery. The main advantages like low capital investment and short gestation period are incentives in themselves for small entrepreneurs to invest in the paper industry. Another important fact is these small mills are potential consumers of agricultural residues abundantly available in India. As we have pointed out earlier, due to transportation and storage problems agricultural residues cannot be economically utilized on a large scale by big paper mills. Small paper mills up to the capacity of 50 T.P.D. are the only ones which can utilize this cheap and abundant resource. This, therefore, can be considered to be one of the immediate benefits of this concept. India being one of those countries where the supply of paper has always been lagging behind the demand, it becomes all the more necessary to explore all the available sources of raw materials. Conventional raw materials like bamboo and wood available in India cannot be immediately utilized for paper making due to many constraints like higher economy of scale, poor transportational infrastructure in remote areas where such raw materials are available, etc.

The gap between demand and supply is already quite apparent where some immediate short term solution is urgently required. The concept of small mills of the nature described above is probably the only viable solution.

It is also noteworthy that India's immediate need lies in the writing/printing and packaging varieties of paper. These

small mills using short fibred raw materials like agricultural residues are more suitable for such varieties for mass consumption. Immediate benefits of this concept can therefore be listed down as given below :

(a) Scope of utilization of agricultural residues which otherwise is not possible on a large scale.

(b) Lower capital investment to attract private sector to invest in paper industry.

(c) Short gestation period which means quicker period which means quicker realization of objective to meet the market demand.

(d) More employment opportunities in the form of direct and indirect employment.

Constraints:

So far we have discussed the benefits of the concept of small paper mills based on reconditioned machinery. There are quite a few problems too which for too long have been nagging the entrepreneurs in this field. We shall take them up for discussion here in the order of priority.

The second-hand machines in the capacity range of 15 TPD to 50 TPD for writing/printing or packaging varieties are available with difficulty, thus increase in the scale of operation may have to be considered by adopting continuous pulping etc. as described in Case-III. In order to encourage quick growth of capacity this limit will have to be increased for import of paper machines of reasonable capacity.

The small paper mills do not incorporate chemical recovery systems for economic reasons. This results in much higher

chemical input, like caustic soda, per tonne of paper compared to that of a big mill. This substantially increases the production cost in comparison to big mills with chemical recovery. Non-recovery of chemicals results in higher load of pollutants in effluent and thereby increases the cost of treatments. In course of time, discharge of effluents from mills without chemical recovery can be a major source of pollution. It is, therefore, necessary to plan for effective recovery systems for small paper mills and ensure that the small paper mills install such recovery systems to prevent wastage of chemicals and pollution.

The third problem lies in the area of quality. In view of the small scale of production and the inherent nature of the agricultural residues being poor in quality compared to bamboo or wood as raw materials, there is a risk of small paper mills not being competetive with the existing or new paper mills based on forest raw materials.

This lacuna can however be overcome to some extent if these small mills are prepared to take up the manufacture of speciality and superior varieties of papers. However, in view of shortages of normal grades of writing or printing papers which can be satisfactorily made from these raw materials, this problem may not be of prime importance. However, if suitable technology is made available, superior quality of writing and printing varieties can also be manufactured by these mills.

STATUS OF THE INDUSTRY

The Table No. 1 gives the distribution by percentage contribution of production in various sizes of plant capacities. It shows that 20% of the products is contributed by smaller paper mills at par.

The Table No. 2 shows anticipated demand-supply gap by 1983-84. The table shows that if the entire capacity gap was to be met from small paper mills and even if the optimum capacity for a small paper mill is taken as 10,000 tonnes per annum, the country would require an establishment of 40 small paper units during the next 4 years i.e., almost 10 units would have to be commissioned every year which itself is a stupendous task and unlikely to materialise. But after taking into account pipeline capacity, the scope for new small mills for next 4 years may be estimated at 200,000 tonnes needing at least 5 units each year over the next 4 years.

Table No. 3 shows the changes in pattern of production of paper in India from 1970-1979.

It is quite apparent from Table 1, Table 2, Table 3, and Table 4 that small paper manufacturing units have contributed to about 20% of the total production. This itself is a major achievement of the last decade and has proved to be quite a relief to meet the shortages. It can therefore be confidently predicted that higher percentage share of such mills in gross national production of paper will play a crucial role in years to come.

TABLE NO. 1 *

PRODUCTION OF PAPER AND PAPER BOARDS IN 1979

BY CATEGORY OF MILLS

(PROJECTION NO. 1)

(in tonnes)

Mills (Per annum)	No. of Mills	Production	Percentage Share
1000 to 2000 Tonnes	36	37513	3.59
2000 to 5000 Tonnes	31	74543	7.13
5000 to 10000 Tonnes	24	92505	8.85
10000 to 20000 Tonnes	8	75417	7.22
20000 and above	21	764894	73.21
Total:	120	1044872	100.00

* Courtesy - The Institute of Economic And Market Research Pvt. Ltd., New Delhi.

TABLE NO. 2 *

(PROJECTION No.2)

DEMAND - SUPPLY GAP

(in '000 tonnes)

Year	Writing/Printing	All
1979-80	110	152
1981-82	170	290
1983-84	220	400

Note: Supply assumed at 1 million tonnes per annum

*Courtesy - The Institute of Economic And Market Research Pvt Ltd., New Delhi

TABLE NO. 3 *

(PROJECTION NO.3)

VARIETY - WISE PRODUCTION OF PAPER ('000 TONNES)

Year	Printing & Writing Papers	Industrial and Other Papers	Total
1970	444.71	313.66	758.37
1971	463.95	316.88	780.83
1972	444.26	359.28	803.54
1973	440.77	355.52	796.09
1974	482.00	355.00	837.00
1975	503.89	325.21	829.10
1976	526.48	353.76	880.24
977	535.00	401.99	936.99
1978	598.74	431.26	1030.00
1979	609.70 (E)*	435.21 (E)	1044.91

E* = Estimated

Note: Variety-wise production of paper slightly differs from mill-wise production of paper

* Courtesy - Institute of Economic and Market Research Pvt Ltd., New Delhi

TABLE NO. 4 **

(PROJECTION NO. 4)

SUMMARY OF INSTALLED CAPACITY OF PAPER AND PAPER BOARD INDUSTRY CATEGORY - WISE AS ON 1.1.1980

S.NO.	CATEGORY	NO. OF UNITS	ANNUAL INSTALLED CAPACITY (TONNES)
1.	Above 20,000 Tonnes	21	1,075,460,
2.	10,000 to 20,000 Tonnes	8	112,500
3.	5,000 to 10,000 Tonnes	24	185,900
4.	2,000 to 5,000 Tonnes	31	111,160
5.	Less than 2,000 Tonnes	37	53,145
	Total :	121	1,538,165

** Source : D.G.T.D., New Delhi

TABLE NO. 5

(PROJECTION NO. 5)

Unit Size (Tonnes per day)	Total Investments (Rs. in million)	Investments per Annual tonne (Rs.)
30	60	6000
100	450	13600
200	750	11300

Note: Rs. 100/- equivalent to U.S. $ 12.8

ANNEXURE -I

CASE HISTORIES OF FOUR SMALL PAPER MILLS

PARTICULARS	CASE-I	CASE-II	CASE-III	CASE-IV
1. Production Commenced	1978	1974	Oct. 1980(expected)	Dec. 1980 (expected)
2. Capacity Installed (TPY)	6600	10,000	16,500	10,000
3. Production Range	M.F. Kraft or writing/printing of 50-100 GSM	Creamwove, posters, Kraft of 32-400 GSM	Kraft & Writing/ Printing	Writing/printing (50-250 GSM)
4. Details of reconditioned machinery (Imported)	a) Paper Machine b) Slitter rewinder & sheet cutter	a) Stock Preparation equipments b) Paper machine c) Finishing equipments d) Boiler	a) Complete pulp Mill with continuous digestors, washing & Bleaching equipments b) Stock preparation Equipments c) Paper Machine & finishing equipments d) Boiler & Turbo-generators	
5. Cost of Project (Rs. in million)				
5.1 Land & Site Development	0.46	0.70	0.70	1.50
5.2 Buildings	4.32	6.20	6.50	9.50
5.3 Plant & Machinery (including foundation, erection)	14.59	7.80	15.00	22.86

CASE HISTORIES (CONTD.)

PARTICULARS	CASE-I	CASE-II	CASE-III	CASE-IV
5.4 Miscellaneous fixed assets (Utilities, office equipments, vehicles, etc.)	8.30	2.00	7.00	10.88
5.5 Pre-operative expenses	6.07	2.30	.30	8.24
5.6 Contingency (if any)	-	-	-	2.80
5.7 Margin money for working capital	1.70	-	Included in pre-operative expenses	3.30
Total Project: (Cost Rs. in Million)	35.44	19.00	42.50(expected)	59.08
6. Investment/annual Ton (Rs./Tonne)	5370	1900	2575	5900
7. Remarks	Investment per tonne of annual production is high as the extent of imported reconditioned machinery is limited to paper machine and finishing equipments	The cost figures are pertaining to 1974. Due to higher proportion of reconditioned machine the investment per annual tonne is low	Considering the fact that figures relate to 1979-80 prices, investment per annual tonne is quite low as proportion of reconditioned machinery is very high.	Investment per annual tonne is the highest as the extent of reconditioned machinery used is only the paper machine.
8. Courtesy	NATH PULP & PAPER	LAXMI BOARD AND PAPER MILLS	UNITED PULP & PAPER	SHIVA PAPER MILLS

ESTIMATION OF PRODUCTION COST AND PROFITABILITY IN FOUR CASES (CONTD.)

(Figures in Rs. per ton of product)

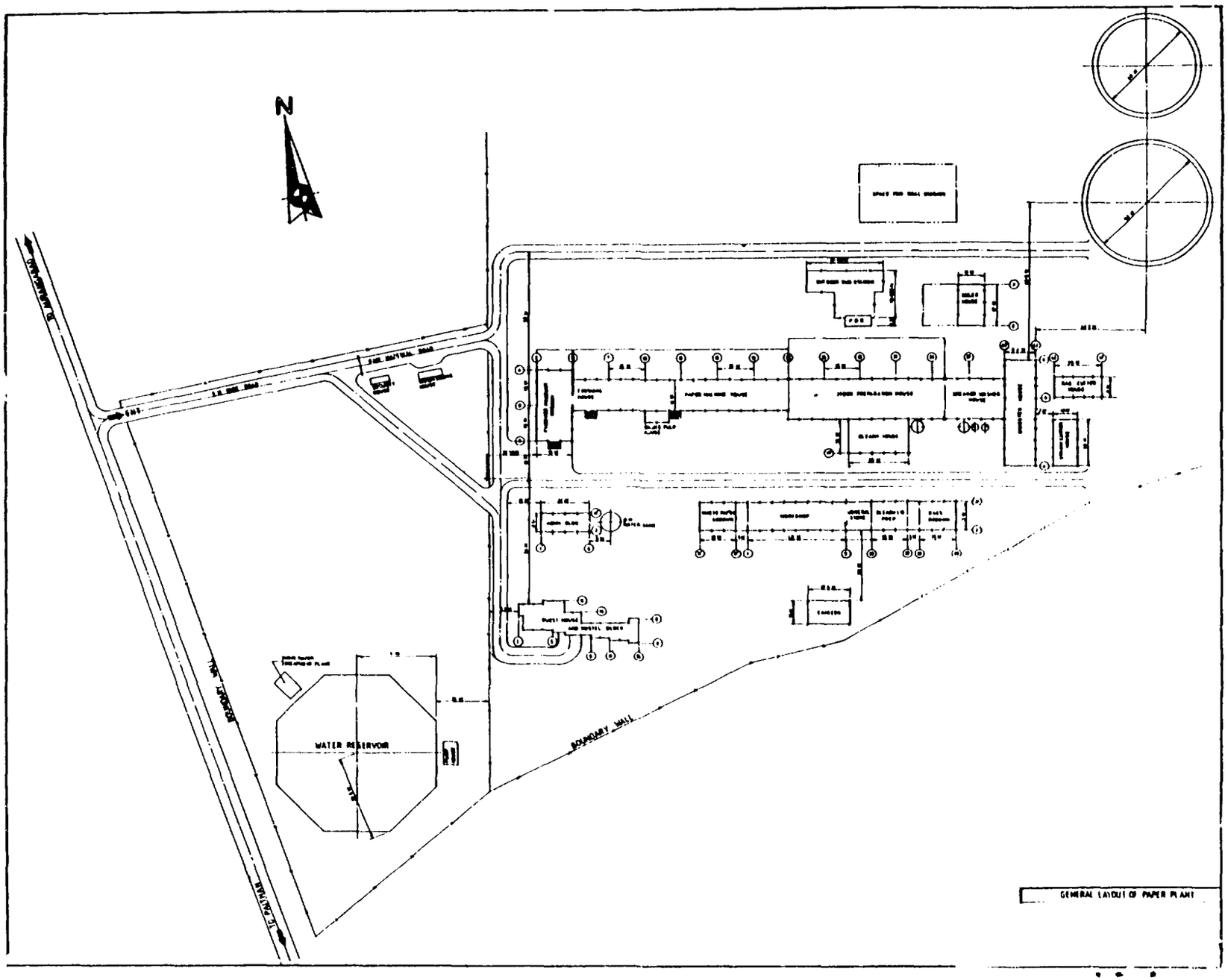
S.No.	PARTICULARS	CASE-I	CASE-II	CASE-III	CASE-IV
3.	ADMINISTRATIVE & SELLING EXPENSES				
	3.1 Salaries & Wages	388	210	250	400
	3.2 Administrative overheads	225	50	50	150
	3.3 Selling Expenses	100	60	50	420
	3.4 Interest	882	180	215	480
4.	TOTAL PRODUCTION COST	7317	3034	4098	5275
5.	SELLING PRICE				
	5.1 Price (Ex-Factory)	6950	-	-	-
	5.2 Dealers Commission (less)	521	-	-	-
	5.3 Excise Benefit	810	-	-	-
	5.4 Net Return	7239	4000	5000	5500
6.	PROFIT PER TON	(-)78	(+)966	(+)902	(+)225
7.	REMARKS	Although net profit is negative, cash accrual from depreciation, when taken into account, gives net positive cash accrual. Investment per annual tons is high in this case which results in higher interest rate.	Satisfactory (Estimated at 100% capacity utilization)	Satisfactory (Estimated at 100% capacity utilization)	Satisfactory (Estimated at 100% capacity utilization)

ANNEXURE II

ESTIMATION OF PRODUCTION COST AND PROFITABILITY IN FOUR CASES

(Figures in Rs. per tonne of product)

S.NO.	PARTICULARS	CASE-I	CASE-II	CASE-III	CASE-IV
1.	COST OF RAW MATERIALS AND CHEMICALS:				
	1.1 Straw	660	143	352	400
	1.2 Linters/Jute/Sabai grass	693	72	250	160
	1.3 Purchased pulp	472	59	591	-
	1.4 Waste Paper	-	1503	-	480
	1.5 Caustic Soda	1160	97	810	1115
	1.6 Other chemicals	720	50	50	250
	1.7 Coal		240	700	400
	1.8 Power	1190	180	550	600
2.	MANUFACTURING EXPENSES:				
	2.1 Repairs & Maintenance	262	50	50	120
	2.2 Depreciation	565	140	180	300


N
WATER RESERVOIR
BOUNDARY WALL
GENERAL LAYOUT OF PAPER PLANT