# A Computerized Approach for Pulp and Paper Industries Development

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#### SUMMARY

A computerized approach by providing a systematic data collection and processing system, to identify suitable locations for the establishment of pulp and paper industries, developed by the World Bank/FAO is discussed. The results from this model by an analysis of test data collected by Preinvestment Survey of Forest Resources and processed at FAO Headquarters at Rome are presented. The analysis indicates a phased investment to a tune of Rs. 41.280 million by the year 1995 to generate a capacity of 3.353 million TPA of different varieties of paper by the year 2000 A.D. The location-wise and product-wise break up of paper products in different phases of development are presented. If the new capacity envisaged does not come on stream the cost of imports estimated are to the tune of Rs. 21,280 million by the year 2000 A.D.

#### INTRODUCTION

The World Bank has developed a computerized model to provide a systematic basis for data collection and identify possible locations for establishing wood based industries at least cost, on a scientific basis with special reference to pulp and paper industry sector.

The model which is basically a linear programming application, provides the basic frame work to identify suitable plant sites, taking into consideration, the demand, consumption pattern, availability of raw materials, their costs including transport of wood raw material and intermediates from their sources to the mill sites and that of the final products from the mill sites to the market centres. The complete infra-structural costs including power, fuel, labour and other allied costs also form part of the input matrices and are taken into consideration to determine the optimum locations for establishment of the mills, comparing and weighing the relative advantages and disadvantages of each of the proposed set of locations

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provided by the user with reference to one another. The model builds up capacity in accordance with market demand and resource availability first at those locations, which have the best comparative advantage. Capacity in less favoured but still viable locations (those where the financial internal rate of return is more than 10 percent) is established only when growth at the prime locations has reached a serious capacity constraint.

### THE DATA BASE OF THE SYSTEM

The main input to the system which forms the data base to the system consists of a variety of information of which some important items are listed below—

- -the projected demand and consumption point prices of various grades of Paper and other forest products;
- -the locations to be evaluated and the cost of inputs such as power, oil, coal, chemicals at these locations;
- -the cost of labour, administrative overheads and supplies;
- -the forest regions with alternative cutting options by type of wood;

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- -the centres of waste paper availability and the probable available quantities of grade waste paper;
- -the prices of wood, other fibrous raw materials and waste paper;
- -transport cost matrices specifying unit costs of transport of :
  - -wood from every forest region to every mill location,
  - -other fibrous raw materials from every collection centre to every mill location,
  - -waste paper from every collection centre to mill location,

  - -finished products from every mill location to market area;
- -the installed capacities of existing mills;
- -the time periods to be analysed;
- -discount factors for the thresh-hold level of internal rate of return expected;
- -export bounds and export prices for different products;
- -Linear capacity dependent equations for calculation of investment costs and investment cost factors to account for differences between locations:
- -cost of infrastructure and site development at every location.

For the purposes of test data, information from more than 30 survey reports of the Organisation' Preinvestment Survey of Forest Resources' and other published information from various other agencies was collected, gaps filled up by educational guesses and used as the data base.

#### **OPERATION OF THE MODEL**

The identification of least cost industrial locations, from a specified list, after an evaluation of the comparative advantages of each one of its members in relation to the others, and the formulation of a frame work for phased development of the industry using this model is achieved through the following three action phases.

(i) Input preparation and master file updating; The input required for this model as described in the 'Data base of the system' is collected, coded in a form suitable for pro-

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cessing and a region specific data file is created with this data base.

- (ii) Use of OMNI/PDS Software System: OMNI/ PDS is a matrix generator system, which is a compiler type system that processes the user specified statements into machine level computer instructions ready for execution by the Computer IBM 360 or IBM 370. In this phase the problem is specified to the computer to be solved in the next phase.
- (iii) Use of MPSX or MPS software system for solution of the linear programming problem: The real solution to the problem as specified to the computer in the steps (i) and (ii) above is derived with the help of this package. This phase finally processess the data and outputs the solution.

A general flow chart of the model is presented in Figure-1.

Fig.1



# APPLICATION FOR THE MODEL

Higher literacy is an important objective of our national goals and the inter-relation between literacy and the per capita consumption of paper

needs no emphasis. As it is, the per capita consumption of paper in India is so low, compared to that of developed countries that the question of reaching that limit in near future is almost an impossible task. To maintain at least the present level of consumption, keeping in view the rate of growth of population and therefore the demand of paper in future, it is obvious that paper industry must grow at least in proportion to the population, if not by multiple dimensions to keep pace with the developed nations.

Having estimated the demand of paper at a given time there are three options to the decision maker.

- (i) To import,
- (ii) To produce indigenously; or
- (iii) Partly import and partly produce indigenously.

Of these options the production indigenously of paper would require raw material and the other infrastructure to establish a paper mill. The main raw material which is a natural resource namely 'wood' though produced in the forests has certain local demands-for fuelwood, furniture, agricultural implements etc. After making a reasonable estimate of the local demand and the growing stock, with various management practices which gave rise to cutting options. one can estimate the surplus wood available for industrial use from any forest region. Thus from each of the forest catchments estimate of the surplus raw materials are to be arrived at. This would necessarily involve a forest inventory of the catchment. PIS with its experience in the field of forest inventory provides the necessary data base for this purpose. The next step would be to identify the possible locations for establishing the paper mills. Naturally nearness to the forest, nearness to the market centres and the existence of other facilities like transport, power, fuel and labour would form part of this decision. Having thus determined the probable mill sites, the next point of decision will be which one of these sites would allow an establishment to come up with least cost to produce paper and transport it to the market centres to the maximum limit of their demand. It is humanly impossible for any body to keep in mind various constraints and restrictions to be satisfied, and relatively weigh the costs and benefits that would result in building the paper industry at a particular site A, in relation to doing the same at a given number of alternative mill sites B,C,D This model will be of immense use in ranking a pre specified list of probable mill sites according to the magni udes of their total costs of construction production and transport of final products to

market so that the decision maker can see at the same time the advantages or otherwise of the alternative sites. The model also takes into consideration the existing industries and decides to the advantage of the planner whether to build a new mill at the site or expand any existing mil to produce more so that the construction/fixed costs of the industry need not be duplicated.

As a by-product of the benefit of the model the interpretation of the mathematical output from the model, done in an objective way, can indicate to the forester as to what cutting option to adopt for better management of the forest resources, how much area to be planted and where (provided one codes the necessary details and constraints in the model). Depending on the availability of raw material and other infrastructure if one expects a mill to be profitably built at a site A, and if the model does not support the same idea, one can see to which particular costs the model is sensitive by varying the structure of the input data and can understand from this analysis what are things to be taken care of in order to establish the industry at the same site. If lot of raw material is observed to be transported from different forest regions to this site, thereby making this site less profitable due to high transportation costs, may be the possibilites of raising plantations nearer to the site could be studied or if the raw material is being transported to the site in a circuitous way due to non availability of roads /rails the possibilities of constructing new roads/ rails transport can be studied. Thus an overall developmental plan can be evolved to serve the best interests of the nation by a proper understanding and interpretation of the results of this model.

Incidentally the scope of the model is not only restricted for pulp and paper industry. Basically being an optimization model using the linear programming techniques, by varying the data base and the dictionary and specifying the constraints that form part of the problem the same model can be applied to any other situation wherever an optimization problem exists-for example saw milling, fibre/particle board, fertilizers, nutrition, or any other situation that needs a similar mathematical model. In this paper only paper industry is discussed.

## ANALYSIS OF THE TEST DATA AND THE RESULTS

Data collected by the Organisation Preinvestment Survey of Forest Resources was analysed at FAO (Rome) and the results arrived at are presented below. The analysis was attempted for 4 periods of 5 years each starting from year 1981 and ending in year 2000. Thus the four periods in discussion below refer to 1981-85, 1886-90, 1991-95

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and 1996-2000. These results are only indicative as is evident from the fact that these are derived from the test data and also that only 24 probable mill sites are considered, but they can definitely form a basis for further discussion between the specialists of related fields.

The analysis identifies nine locations out of 24 which were evaluated as forming the most financially favourable combination for a phased programme for the development of a viable pulp and paper sector in India upto the year 2000. India should aim at building new capacity with an investment of Rs. 41.280 million in the next 20 years to domestically manufacture and supply some 3.35 million tons of paper. Even after this huge investment, given the assumed projected consumption of paper (some 5 Kg/per capita in 2000 A D), India will not be self-sufficient with regard to its paper requirements. The country will still need to import some 650,000 tons of paper of various grades by the year 2000.

The analysis thus identifies seven locations where investment should take place during 1980-85 to enable new capacity of some 1.9 million tons to be produced from 1986. Capacities, by paper grade, for each of these locations are : expansion is suggested at all the above locations; new capacity should be created in Himachal Pradesh (News print and printing/writing paper) and a 100,000 TPA capacity market pulp mill to manufacture unbleached bamboo pulp to be built in Tripura. The capital requirement during investment period 1986-90 would be Rs. 12,290 million.

During period 3 (investment during 1991-95), only Uttar Pradesh and Bihar have the potential to support new capacity the order of investment would be Rs. 7,720 million.

Tables 1 and 2 summarise the details of capacity built and investment requirements. Even after capacity build up, as suggested above, the solution indicates an import of 126,000 TPA of papers during 1986-91, rising to 177,00 TPA during 1991-95, and 650,000 TPA during 1996-2000. The annual cost of imports from the international market would be Rs 590 million, Rs. 840 million and Rs. 3,060 million in the respective periods. If the new capacity envisaged in this study does not come on stream, the cost of import of paper is estimated to reach Rs 9,790 million per year in period 2 rising to Rs. 15,220 million in period 3 and Rs. 21,280 million in period 4.

		Loeality	Paper Grade	Capacity Tons per Annum
1.		Jammu & Kashmir	News	66 000
2.	a)	Uttar Pradesh	Printing/writing	100 000
	b)	Uttar Pradesh	Corrugating Medium	300 000
3.	a)	Bihar	Kraft	47 000
	b)	Bihar	Printing/writing	61 000
	c)	Bihar	Corrugating Medium	100 000
4.		Assam	Kraft	216 000
5.	<b>a</b> )	Orissa	Kraft	77 000
	b)	Orissa	News	100 000
	c)	Orissa	Corrugating Mediun	165 000
	d)	Orissa	Paper Boards	125 000
6.	a)	Madhya Pradesh	Kraft	154 000
	b)	Madhya Pradesh	Printing/writing	161 000
7.	a)	Maharashtra	Kraft	186 000
• -	b)	Maharashtra	Printin/writing	39 000

In addition to the above a market pulp mill of 22 000 TPA bleached bamboo kraft pulp is suggested in Assam.

The investment requirement during 1880-85 would be Rs. 21 280 million. During period 2 further

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It is assumed that the new capacity will be distributed in the states (locations) at more than one site and the size of individual mills may range from 50 tons per day to 200 tons per day capacity It would be necessary to undertake feasibility studies of individual mills to translate the planning

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		Уеаг		
Location	Product	1986	1991	1996
Jammu & Kashmir	News	66	66	66
Himachal Pradesh	News	· · ·	100	100
	Printing/writing	· ·	61	61
Uttar Pradesh	Printing/writing	100	100	283
	Corrugating medium	300	300	430
	Kraft		47	47
Bihar	Printing/writing	61	122	1996 66 100 61 283 430 47 122 141 230 100 75 90 263 100 263 100 263 100 263 100 263 100 263 100 263 100 263 100 124 165 150 200 154 156 186 3353
	Kraft	47	141	
	Corrugating medium	100	165	
	News		—	
	Paper Boards	<u> </u>	50	75
Assam	Market pulp	22	50	75 90 263 100
	Kraft	216	263	
Tripura	Market pulp		10 <b>0</b>	100
Orissa	News	100	200	1996   66   100   61   283   430   47   122   141   230   100   75   90   263   100   200   124   165   150   200   154   100   156   186   3353
	Kraft	77	124	
	Corrugating medium	165	165	165
	Paper Boards	News1002Kraft771Corrugating medium1651Paper Boards1251	125	150
Madhya Pradesh	Printing/writing	161	200	200
<b>u</b>	K raft	154	154	100 200 124 165 150 200 154
	Corrugating medium		100	100
Maharashtra	Printing/writing	39	177	156
117 M 19 19 19 19 19 19 19 19 19 19 19 19 19	Kraft	186	186	186
INDIA	Total Papers	1897	2786	3353
TT 4++ T4 P				

# TABLE-1 CUMULATIVE NEW CAPACITY DEVELOPMENT, 1986-1996 Unit : 1000 TPA

## TABLE-2 SUMMARY OF ESTIMATED CAPITAL REQUIREMENT FOR THE IDENTIFIED INVESTMENT OPPORTUNITIES Unit Rs. million

1	0	1110 TCD1 1111011			
	Capital requ	 Tet=1'te1			
Locality	1980-85 1986 90		1991-95	Iotal capital	
Jammu & Kashmir	830			830	
Himachal Pradesh	·	1790	<del>-</del> .	1790	
Uttar Pradesh	3570	590	3690	7850	
Bihar	2150	3550	2320	8020	
Tripura	<del></del>	850	<del></del>	850	
Orissa	5190	1680	400	7270	
Madhva Pradesh	3860	1380	·	5240	
Maharashtra	2680	1240	620	4540	
INDIA	21280	12280	7720	41280	

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perspective of this study into bankable projects.

The analysis suggests that during period 3 the annual requirement of hardwood pulpwood varies from 177,000 m<sup>3</sup> in Himchal Pradesh to more than 1 million m<sup>3</sup> Madhya Pradesh and Uttar Pradesh; the requirement of bamboo ranges from 120,000 tons in Orissa to some 480,000 tons in Assam. Substantial capacities are bised on use of Bagasse and straw as well. The requirement of different fibrous raw materials in the three periods is :

ing wood based industries to meet national goals.

The test data presented here is based on inumerable assumptions and may only be regarded as indicative and not conclusive. There is an immense need for developing careful data collection systems so that the underlying assumptions of the model be realistic and based on factual situations and at the same time based on more scientific methods of estimation. The assumptions of the model with reference to the raw material availability, the transportation costs, the power,

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5-2000 407 244.2 853 911.8
156 34.8%)
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9 nfrastructural cost lisation before a . The main air

⊶need epting them for further action. The main aim of the for sustaining raw materials supply through largepaper is to provide a basis for thought in this scale industry oriented plantations of quick growing direction and bring to the notice of the people pulpable species. However it may be noticed that concerned, the methodology and the facilities the wood requirement for the respective periods available so that constructive projects for national constitutes 46, 40 and 35% of the total tonnage of raw material requirement for the creation of the planning can be undertaken.

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Direct employment opportunities generated

by the proposed development are estimated to be in

the order of 86,000 year round jobs in period

2 rising to 127,000 in period 3 and to 152,000 in

CONCLUSIONS AND RECOMMENDATIONS

provides a systematic basis for data collection for

the planner to study the possibilities of establish-

The world Bank/FAO model discussed above

said capacities.

period 4.

49

8%)