L. C. SHARMA

INTRODUCTION

Paper meets one of the basic needs of modern life. Its importance lies in the fact that no other manufactured product has so diverse a use. Paper helps in preserving the legacy of knowledge for posterity. It also helps in diffusing literature and science and in marketing most of the products by providing packaging materials. For developing countries like India, paper is recognised as a touchstone for growth. The growth in education and other social activities and development of Industrial complexes in the country during the last few years have led to a steady increase in the demand for paper. However, the country needs more and more paper for implementing the educational programmes envisaged for the future. Some market research studies suggest that the rate of growth of demand for paper might be of the order of 7 to 8 per cent. It would, however, appear that if complete programmes of educational activities are to be carried out in India, a much higher rate of growth of demand for paper for cultural and industrial uses may be expected. On a conservative estimate the growth of demand for paper in India during the next five years might rise by 12 per cent per annum.

The Indian Paper Industry has made considerable progress since 1951 — the beginning of a planned development programme in the country. There were 17 paper mills in 1951 with a total annual capacity of about 13,000 tonnes. Presently their number stands at 57 with a capacity of 767,900 tonnes. Besides, there are two market pulp mills and one newsprint mill with an annual

Dr. L. C. Sharma, Research Officer, Resources & Scientific Research Division, Planning Commission, New Delhi.

Role of forests in India for Supply of Raw materials for Paper economy during the decade ending 1980-81

capacity of 90,000 and 75,000 tonnes respectively. There are also about 50 mills producing straw and mill-boards with a capacity of about 10,000 tonnes per annum.

Paper Industry is not concentrated in one part of the country but it is fairly well-spread. Paper mills are situated in every State/Union Territory except Assam, Jammu & Kashmir, Punjab, Himachal Pradesh, Nagaland, Manipur, Tripura and N.E.F.A. Out of the 57 mills, the first 18 account for about 80 per cent of the total production in the country. Newsprint is at present manufactured in only one mill, with a capacity of 30,000 tonnes per annum. Now the capacity has been enhanced to 75,000 tonnes with the installation of a new machine. This production is likely to be achieved by 1971.

Rayon-grade pulp is produced from bamboo and eucalyptus in a mill situated in Kerala with a rated capacity of 60,000 tonnes per year. At present it is producing 57,000 tonnes of pulp which is sufficient for meeting the entire current demand for manufacturing viscose staple fibre.

The first mill for manufacturing paper-grade pulp for market supply was commissioned in 1968 near Fort Songarh in Gujarat State, with its present capacity rated to produce 30,000 tonnes, likely to be achieved by 1970-71. In the beginning, this mill had to face some difficulties in marketing its produce within the country as a result of which it has been trying to establish export markets in the neighbouring countries. With the experience in marketing research and establishment of export market, the difficulty was removed.

Almost every variety of paper and paper product, except some special papers like stencil-base papers and ivory board, are manufactured in the country. As a result of this production at home, imports of only a few special grade papers required for the domestic consumption is permitted.

CONSUMPTION OF PAPER

India consumed 1.4 kgs. of paper per capita in 1966 which is one of the low est among the paper consuming countries of the world. In comparison to it, U.S.A. consumed 205 kgs., Canada 134 kgs., U.K. 106 kgs., Japan 57 kgs., USSR 16 kgs., Ceylon 2.5 kgs., Pakistan 1.5 kgs. and Burma 1.4 kgs. Thus India ranks 96th in per capita consumption of paper. This trend is not likely to prevail for a long time as she is expected to use more paper in future.

In 1935-36, India consumed about 123,000 tonnes of paper and paper boards which rose to about 144,000 tonnes in 1950-51. Since then there has been a steady rise in the consumption of paper and paper board. It touched 656,000 tonnes in 1968-69 and to 722,000 tonnes in 1969-70. The rate of growth of consumption was nearly 1.1 per cent per annum during the period from 1935-36 to 1950-51. During the first and second plan periods. it recorded an annual rate of growth of 8 per cent and 10.9 per cent respectively. In the third five year plan, it was envisaged that the demand, as distinct from consumption, would show a progressive annual rise of 12.5 per cent. Until the early part of the third plan period, on account of restricted availability of paper, the demand could not be fully satisfied owing to shortage of paper in the country. However, during the last four or five years, the demand for and supply of paper are in equilibrium. This balanced position is struck about by a slower growth in consumption, on account of the increase in the general cost of living, which has restricted the purchasing power of the consumer.

Ippta, January, February & March, 1971. Vol. VIII, No. 1

19

DEMAND FOR PAPER:

Several estimates of demand for paper have already been made by individuals and institutions. The F.A.O. has, for example, estimated the demand for paper at 1.5 million tonnes per annum by the year 1975. Most of these, however are based on assumptions not clearly set out. For purposes of this paper, two approaches have been adopted. First, the time trend of consumption and second the use of income elasticity of demand for paper.

(i) Time Trend Demand for Paper:

The growth of demand for paper and paper boards is influenced by a number of factors, viz., increase in population, role of industrialisation of a country, spread of education and consequent improvement in the standard of living of the people coupled with the increased purchasing power of the people. A simple method of projecting demand is by determining its secular growth over time in the past. A pure time trend approach suggests that the rate of growth of demand for cultural paper and industrial paper during the fourth plan period would be in the vicinity of 6 per cent. It appears that the demand in later period has risen at relatively slower pace. On the total consumption of paper in India, printing and writing paper (cultural paper) and packing and wrapping paper (industrial paper) constitute 60 per cent and 40 per cent respectively. From a time trend, fitted to past consumption of cultural paper, industrial paper and also newsprint, we get the results as shown in Table I.

(ii) Demand for Paper based on Income Elasticity :

Another approach is to establish a relationship between paper consumption and National Income using recent data on these. The perspective of India's development envisages National Income to rise by about 5.5 to 6 per cent per annum upto 1980-81. Using the relationship, the estimated demand for paper and paper board emerges as shown in Table II.

It will be observed that the income elasticity of demand approach gives a much higher estimate than the time trend approach. Since one of the principal factors affecting consumption of goods and services is income, it is the

TABLE — I

Consumption	Pattern	('000	tonnes)	Actuals	upto	1967-68	
and projectio	ons therea	after					

Year	Cultural paper	Industrial paper	Newsprint	Total	
1957-58	160.6	100.4	77.9	338.9	
1958-59	164.1	112.4	79.4	355.9	
1959-60	195.2	134.4	96.9	426.7	
1960-61	238.2	151.6	98.4	488.2	
1961-62	223.0	143.3	120.1	486.4	
1962-63	244.1	163.3	125.7	533.1	
1963-64	311.0	174.7	124.9	610.6	
1964-65	325.8	184.5	131.4	641.6	
1965-66	343.0	220.0	115.3	678.3	
1966-67	387.9	213.0	136.7	738.2	
1967-68	384.7	235.2	185.0	804.9	
1968-69	419.2	244.8	166.0	830.0	
1973-74	542.9	309.9	206.5	1059.3	
1978-79	626.7	375.0	247.0	1288.7	
1980-81	716.2	401.0	263.2	1380.4	

Note: For preparation of projection of demand for paper according to time trend centred at 1962-63, the following equations have been used :---

(a) Cultural Paper	Y = 270.7 + 24.75 t
(b) Industrial Paper	Y = 166.7 + 13.02 t
(c) Newsprint	Y = 117.4 + 6.10 t

TA	BLE	_	н

Consumption	Pattern	(*000	tonnes)	 Actuals upto 1967-68
and Projectio	ns there	after.		

Year	(Income Rs. Crores)	Cultural paper	Industrial paper	Newsprint	Total	
1960-61	13,308	238.2	151.6	98.4	488.2	
1961-62	13,795	223.0	143.3	120.1	486.4	
1962-63	14,067	244.1	163.3	125.7	533.1	
1963-64	14,889	311.0	174.7	124.9	610.6	
1964-65	15,945	325.8	184.5	131.4	641.7	
1965-66	15,045	343,0	220.0	115.3	67 8.2	
1966-67	15,173	387.9	213.6	136.7	738.2	
1967-68	16,525	384.7	235.2	185.0	804.9	
1968-69	16,822	420.1	238.2	164.8	823.1	
1973-74	21,986	847.2	413.7	282.0	1542.9	
1978-79	28,736	1709.0	719.0	482.6	2910.6	
1980-81	31,983	2262.0	896.0	598.1	3756.7	

Note: For Projections the following equations have been used :

(a)	Cultural paper	Log	Y	_	()	8.4470	+	2.6197	Log	X
(b)	Industrial paper	Log	Y	=	()	6.3428	+	2.0634	Log	Х
(c)	Newsprint	Log	Y	=	()	6.2582	+	2.0056	Log	Х

Ippla, January, February & March, 1971. Vol. VIII, No. 1

estimate based on income elasticity ap proach which should be regarded as relevant for future demand in contrast to one based on time trend.

Obviously, the above estimates depend crucially on the realisation of income targets. If income does not follow the expected patch and instead deviates here and there as has been the case in 1968-69, these estimates will either over-state or under-state the domestic demand for paper in future. Should the income growth rate be in the vicinity of 3.5 or 4 per cent per annum, the expected rate of growth of demand might be of the order of what it has been during the period 1960-61 to 1967-68. In that case the demand estimates will be as follows :

SUPPLY OF RAW MATERIALS

An examination of the pattern of utilisation of raw material for paper manufacturing in the world reveals that wood forms the principal source of fibrous raw material in all the leading couniries manufacturing, paper but the mainstay of the paper industry in India is the non-wood fibres. The reason for this seems to be the heterogenous character of the hardwood species and the lack of suitable technology for pulping the hardwoods, not fully developed so far in India. The most important raw material for manufacture of paper is bamboo which meets more than 65 per cent of the total requirement of raw materials. India is, perhaps, the only country using bamboo on such a large

scale in paper industry. The following

table shows a comparative picture of

raw materials used for paper manufac-

turing in the country.

TABLE	 ш

		Ргој	ected Estimates	('000 tonnes)	
Year	(Income Rs. Crores)	Cultural paper	Industrial paper	Newsprint	Total
1968-69	16,822	420.1	238.2	164.8	823.1
1973-74	20,467	701.1	356.9	244.3	1302.3
1978-79	24,902	1172.0	525.0	362.1	2069.9
1980-81	26,934	1442.0	629.1	423.8	2494.9

The above demand is likely to be effective if there are no curbs and restrictions on supply. Since these figures are exclusive of exports, further adjustments need to take account of these. Export of paper and paper board is expected to reach 60,000 tonnes in 1973-74 and 1,00,000 tonnes in 1978-79 and 1,20,000 tonnes in 1980-81. Inclusive of domestic demand, the required total supply of paper will, therefore, aggregate to 1362.3 thousand tonnes in 1973-74, 2169.0 thousand tonnes in 1978-73 and 2614.9 thousand tonnes in 1980-81. The raw materials required for manufacturing these quantities of paper based on present norms will be as follows :

TABLE --- IV

Raw Materials Requirement ('000 tonnes)

Year	Internal Consumption	n Exports	Total
1973-74	3906.9	180	4086.9
1978-79	6207.0	300	6507.0
1980-81	7484.7	360	7844.7

Note: 3 tonnes of wood is to give one tonne of paper

Ippta, January, February & March, 1971. Vol. VIII, No. 1

areas under different species, growing stock and potential yield. Exploitation of resources on commercial basis is very slow. The pre-investment surveys of forest resources currently being done in co-operation with the F.A.O. are likely to furnish an up-to-date inventory of the existing forest resources. However, based on information available, even though scanty, the likely raw material supply position is assessed below

Bamboo:

Bamboo, a long-fibred raw material, is at present mainly used for paper manufacture. It is found growing profusely throughout tropical and sub-tropical regions. The state-wise data on availability of bamboo is scanty and the estimates differ greatly. According to a survey carried out in 1958, the availability of bamboo is estimated at 2 million tonnes, distributed throughout the country.

The estimated potential of bamboo can be enhanced by following the silvicultural rules strictly and managing them scientifically. But as of today, the States are not paying much attention to improve upon the yield of bamboo, mostly because bamboo plays a secondary role in forestry production. Besides, this crop has low productivity coupled with the problem of gregarious flowering, which can always upset the

TABLE V

Average Annual Consumption of Cellulosic Raw Material during Three Five Year Plan Periods in India ('000 metric tons)

Raw Material	First Plan 1951-56	Percentage	Second Plan 1956-61	Percentage	Third Plan 1961-66	Percentage
Bamboo	260.4	72.6	412.7	70.3	741.4	67.2
Grass	55.8	15.6	77.0	13.1	86.3	7.8
Wastepaper	27.1	7.6	55.9	9.5	85.4	7.8
Pulpwood			_	_	82.0	7.4
Bagasse	10.7	3.0	30.2	5.2	76.3	6.9
Straw	4.4	1.2	11.2	1.9	31.6	2.9
Total		100.0		100.0		100.0

AVAILABILITY OF RESOURCES:

An assessment of the availability of cellulosic raw materials in the country cannot be done adequately largely for lack of information regarding forest working of the mills depending completely on bamboos. Secondly mechanised harvesting of bamboos is not possible in hilly terrain. A continued reliance on manual working implies that the cost of exploitation will keep or increasing.

21

Keeping all these factors in view, it is felt that bamboo cannot be relied upon for the supply of raw material for paper production in future.

Grasses :

Sabai or baib grass (Eulaliopsis binata) grows profusely in northern India and is very suitable for paper manufacture. Collection of this grass is done from the Sub-Himalayan tracts, mostly Nepal Terai and Sahibganj (Bihar). Recently the cultivation of the grass has been taken in hand in Uttar Pradesh and Bihar States. There are other grasses also which are suitable for manufacture of paper, viz., Ulla, Panni, Spear grass and Elephanta grass. According to a report of Council of Scientific and Industrial Research, New Delhi, the total availability of grass in the country might be of the order of 300 to 400 thousand tonnes annually.²

Bagasse:

The production of sugar-cane in India is about 100 million tonnes-the highest in the world. Out of this quantity, only 30 per cent is used for production of white sugar. The rest goes to manufacture of 'gur' and 'khandsari' and miscellaneous uses. Therefore, no pulpable material is supplied out of it. The seasonal character of supply of bagasse leads to the problem of drying and storing it before processing. This leads to deterioration of quality of the pulp and enhances the cost of the raw material. Bagasse is the principal fuel for sugar factories and practically all the bagasse is used as fuel. If bagasse is released for the manufacture of paper, sugar factories will have to be provided with a substitute fuel. Since no cheaper substitutes are available, it is likely to increase the cost of manufacture of sugar. Even so additional costs will have to be incurred in replacing old boilers by new ones. The paper industry is incapable to bear this burden. Large and modern sugar mills are at present supplying the surplus bagasse to the paper industry. Even in face of all the difficulties, bagasse pulping has received some impetus in the country. It can be safely assumed that about 25 per cent of the total bagasse produced in the country can be harnessed for paper manufacturing.

At present bagasse pulp is used for the production of printing and writing paper by Rohtas Industries Ltd., Shree Gopal Paper Mills, Mandya National Paper Mills, Bengal Paper Mills and Seshasayee Paper and Board Mills.

Wood :

Most countries of the world use wood as conventional raw material for paper manufacture. The coniferous soft woods are used from 85 to 90 per cent³ in the world's pulp production. They are used for making newsprint, kraft wrapping paper and kraft paper board. In spite of great expansion in pulp and paper manufacturing capacity which has taken place in the North America and Europe since World War II, use of coniferous wood is great. It has, however, assumed no importance in India so far. It is because soft woods are available in limited quantity in the country and that too in inaccessible areas. The inaccessibility increases the cost of exploitation of coniferous woods in the Himalayas. Owing to lack of developed communications and of modern logging techniques, these areas have not been tapped properly as yet. On account of this fact, the opportunity cost in respect of coniferous woods in the above inaccessible forests, is nil. The timber becomes a fire hazard there as long as these tracts are not opened up by creating a network of good transport system.

Hardwoods which cover about 80 per cent of the total forest area in India are not useful to the paper industry in the absence of a comprehensive survey of the tropical forests determining the suitability and availability of various species of wood suitable for pulping purposes are widely scattered over a large area. Pure stands of one or even a few species are not found in any forest in India. The net increment has been estimated at 20.7 million cubic metres of hardwoods and 2.6 million cubic metres of coniferous woods⁴. Most of the hardwoods at present serve no better purpose than fuel wood.

Waste Paper:

Waste paper is the principal source for fibrous materials in the world but this source is not being tapped fully in India. Presently India collects nearly 15 per cent of this material as against 30 per cent in advanced countries. The main sources of waste paper are (i) Printing, converting and packing establishments, (ii) Government offices and private business houses, and (iii) Street sweepings. Out of these, the first source is tapped fully and re-used. The office waste is usually found in mixed condition. It is disposed off through auction, tender or negotiation through middlemen. Therefore, it is not readily available to the industry in uniform quantity. The collection of waste paper from the third source is consumed by the mill-board industry. This type of paper is available only in big cities.

FOREST WEALTH OF INDIA:

The forests cover about 72.8 million hectares — 2.6 million hect. or 3.3 per cent of coniferous species and 70.2 million hect. or 96.7 per cent of broad leaved species. Protection forests where no felling can be permitted cover about 10.04 million hect. The remaining 62.84 million hect. comprise the principal commercial forests. Out of this, 53.9 million hect. are in use as commercial forests. The remaining area is either inaccessible or has uneconomic habitats with low density of wood.

The Table VI⁵ compares India with Sweden, a highly developed country in respect of forestry.

The above table reveals some interesting facts. India uses a greater part of its wood production as firewood while Sweden uses it as industrial wood. India's hardwood forests are poorly stocked whereas Sweden's conifers have a much higher volume per hectare. The annual cut in Sweden is 75 million cubic metres viz., 3.7 per cent of the total growing stock of 2,150 million cubic metres — while the annual cut in India is 56.5 million cubic metres, viz., 1.9 per cent of the growing stock of 2,900 million cubic metres. This is the result of low intensity of management caused by low investment in forestry sector. The exploitation can take place on the basis of replacement which is not possible as long as investment remains poor in forestry sector, and hence the forest cannot be exploited as desired.

Low annual cut per growing stock can neither be attributed to any forest potential nor climatic or soil conditions. Under tropical climate prevailing iu India, the vegetative growth is definitely faster than under temperate climate. Therefore, the annual growth in India is likely to be higher than in those countries having temperate clima-

Ippla, January, February & March, 1971. Vol. VIII, No. 1

S1.	No. Item		India 🦯			e.		Swed	en			
1.	Forest area (work	able)										
	(a) Hardwood fore	ests	41.0	million	hect.							
	(b) Softwood fores	sts	1.4	,,	**							
			42.4	,,	, ,,			24.0	million	hect.	<u></u>	
2.	Total growing stor (standing volume)	c.k		•			<u></u>					
	(a) Hardwood fore	ests	2,500.0 r	nillion	cubic	metres	•					
	(b) Softwood fores	sts	400.0	"	,,	**						
			2,900.0	,,	,,	,,		2,150	million	cubic	metres	
3.	Annual cut (estima	ated)					· · · ·	····				
	(a) Hardwoods		50.0	,,	,,	**						
	(b) Softwoods		6.5	,,	,,	"						
			56.5	,,	,,	,,		75.0	,,	,,		
4.	Current Exploitatio	n										
	(a) Hardwoods		18.0	,,	••					•		
	(b) Softwoods		4.7	"	,,	"						
			22.7	,,	,,,	39		57.0	··	.,,		
5.	Available Surplus		-									
	(a) Hardwood fore	sts	32.0	,,	,,,	"						· .
	(b) Softwood fores	its	1.8	"	"	>>						
			33.8	**	,,	,,		18.0	•,	,,	19	

TABLE — VI⁵ India's forest wealth as compared with Swedish forest wealth.

tic conditions. The over-mature stock in inaccessible forests in Himalayas comprising fir, spruce and some of the mixed tropical deciduous and evergreen forests of the interior cannot put on proper increment. Proper harvesting and scientific management is likely to raise the production of our forests to its full capacity. The regeneration of forests cannot take place properly owing to dense population in India — human and bovine. This is accelerated by heavy local demands on forests. Forests need protection and intensive management for regeneration.

The estimated growing stock in the forests is about 400 million cubic metres of coniferous species and 2,900 million cubic metres of non-coniferous species. Of these species, more than half are in use in each case, viz., 220 million cubic metres of coniferous species and 1,480 million cubic metres of non-coniferous species.

Next to it in importance is the annual growth increment in forests. The allowable cut should be such that the existing stock may not dwindle. The allowable cut was 44.7 million cubic metres in 1964-65. Leaving a margin for losses by fires and shifting cultivation and other causes, a net growth of 42.25 million cubic metres, inclusive of 3.05 million cubic metres of coniferous species can be assumed safely. Estimated availability for industrial or commercial purposes is 32.2 million cubic metres inclusive of 2.3 million cubic metres of coniferous species. Generally speaking, the annual allowable cut has always been held at 10 per cent below the net annual growth in India. Therefore, it can be said that the allowable cut in hardwoods was 20.3 million cubic metres and 1.50 million cubic metres in coniferous species.

Another important factor to be considered is the technology of pulping the hardwood species and the homogenity of forest species which is coming in the way of pulp making from these species. The properties of one species differ from those of the other, thus making it quite difficult to use all species for pulping purposes: One method of pulping cannot be applied successfully for manufacturing pulp from different species. This is another bottleneck in the way of using hardwood species for the purpose of pulp making.

Coniferous Wood :

Since the exploitation of Himalayan coniferous wood is difficult, these have been termed as inaccessible. Freden Shageive and Chandrasekharan⁶ remarked, "The Himalayan conifers estimated to occupy less than 5 per cent of the total forested area in India, are not only limited in quantity but also largely inaccessible. Unless revolutionary chan-

Ippta, January, February & March, 1971. Vol. VIII, No. 1

ges in the present extraction techniques occur, they are likely to remain so during the foreseable future. Consequently, these forests will have to be ruled out as a major raw material potential for future industrial expansion". Bamboo forests have, on the other hand, been considered to be the only source of long fibred pulp for the future expansion of pulp and paper industry. Shri R. V. Singh⁷ does not share the view of the authors. According to him "such an approach is not correct and may result in neglecting our most important source of long fibred pulpwood — the coniferous forests." But even if this is properly taken into account by paying attention to exploit this source, the demand for pulpwood will not be met fully and, therefore, this can be counted upon as a subsidiary source.

Obviously, the choice lies on the manmade forests, viz., "DYNAMIC PLAN-TATION FORESTRY". This type of plantation can provide wood of similar type and quality throughout the period for pulp manufacture and will also be available on short rotation. Development of eucalyptus provides such an approach.

QUICK GROWING SPECIES (PLANTATIONS)

The total area under eucalyptus plantations in India is 250,500 hectares upto the end of 1969. During the Fourth Plan, the target is to plant 302,540 hectares of quick growing species. This comes to

60,540 hectares per year. Each hectare of this species is likely to give 10 to 20 cubic metres of wood providing 3 to 6 tonnes of bleached sulphate pulp per annum. Eucalyptus is likely to become an important source of raw material for paper and pulp industry in India. If the average annual yield of eucalyptus is taken to be 15 tonnes per hectare, the total area under this species should be of the order of 273,000, 434,000 and 523,000 hectares in 1973-74, 1978-79 and 1980-81 respectively for acquiring the required material of 4,086.9, 6,507.0 and 7,844.7 thousand tonnes respectively. This might be considered to be the bare minimum for saving the paper and pulp industry from starvation and a consequent famine of paper in India in the near fulure. At the same time, eucalyptus gives short-fibred pulp. The cost of planting a hectare of land with eucalyptus comes to about Rs. 750. At this rate the cost of planting 60,000 hectres annually on sustained basis will come to Rs. 45 million yearly-a collosal amount.

CONCLUSION

From the above discussions it can estimated that there may not be any lack of raw material for paper industry even beyond 1980-81, provided eucalyptus continues to be planted at the present rate of 60,000 hectares per year. Since there are no technical difficulties in carrying forward this programme, it apparently looks that there may not be any likelihood of a set-back to the paper industry due to paucity of raw material.

REFERENCES:

- 1. Census of Manufactures and Annual Survey of Industries, Central Statistical Organisation, Government of India.
- 2. The Wealth of India: Industrial Products, Part VI, p. 182 issued by the Council of Scientific and Industrial Research, New Delhi, India.
- 3. Raw Materials for More Paper---Food & Agriculture Organisation of the United Nations, Rome Italy 1953.
- 4. F.A.C.—Timber Trends & Prospectus in the Asia-Pasific Region, 1961.
- 5. Mahalaha, S. H.,—Pulping Material for Tomorrow paper presented at International Seminar on High Yield Pulping of Tropical Raw Materials organized by Indian Pulp and Technical Association, New Delhi, Dec. '69.
- Freden, E., Shageive, V. and Chandrasekhran, C. (1968)—Prospects of establishing hardwood based pulp and paper industries in India. Paper presented at symposium on utilisation of hardwood for pulp and paper, Dehra Dun 1st & 2nd August, 1968.
- 7. Singh, R. V.—Himalayan Conifers as important source of raw material for pulp and paper industry published in Indian Forester 1969, Forest Research Institute, Dehra Dun.

Ippla, January, February & March, 1971. Vol. VIII. No. 1