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**POSSIBILITIES FOR THE DEVELOPMENT  
OF THE PULP AND PAPER INDUSTRY  
IN LATIN AMERICA**



**UNITED NATIONS**



**POSSIBILITIES FOR THE DEVELOPMENT  
OF THE PULP AND PAPER INDUSTRY  
IN LATIN AMERICA**

**A Joint Study by the Economic Commission for  
Latin America and the  
Food and Agriculture Organization of the United Nations**



**UNITED NATIONS  
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## LETTER OF TRANSMITTAL

Santiago, Chile  
November 1953

Sir,

The fourth session of the Economic Commission for Latin America at Mexico City adopted resolution 10 (IV) stating that, "in view of the importance of industrial studies to the economic development of Latin America, . . . studies should be carried out as soon as possible on the steel, wood-pulp and paper, basic chemicals . . . industries". In regard to the proposed study of the pulp and paper industry, the resolution indicated that the Secretariat should seek the collaboration of the Food and Agriculture Organization. Accordingly, after consultation with the Director-General of the Food and Agriculture Organization, a joint study was undertaken, having as its main object to determine:

- a) Present and future demand for paper and for chemical and mechanical pulp;
- b) The region's existing capacity to manufacture these products, and the present and future need for developing such capacity;
- c) The adequacy of potential raw material resources for maintaining the necessary development of the industry; and
- d) The manufacturing methods which can be adapted to Latin-American raw materials.

The results of this study appear in the present report, a preliminary version of which was submitted to the fifth session of the Economic Commission for Latin America, held in Rio de Janeiro in April 1953.

I have the honour to be, Sir,

Yours faithfully,

Raúl PREBISCH  
*Executive Secretary*  
*Economic Commission for Latin America*

The Hon. Dag Hammarskjöld  
Secretary-General  
United Nations  
New York

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### SYMBOLS EMPLOYED

The following symbols have been used throughout this study:

.. = not available

— = nil or negligible



## Chapter I. LATIN AMERICA

### I. Introduction

This report is the result of a preliminary study of the conditions which Latin America can offer for the development of the pulp and paper industry. Its general aims have been to determine the future demand for pulp and paper in the region, and then compare it with the production capacity of the mills already installed and investigate whether the existing resources can, from both technological and economic standpoints, serve as an adequate basis for the development of the production capacity required in the future. Owing to the shortage of available data, most of the figures appearing in the report are estimates subject to wide margins of error. They must only be taken as indications of the order of magnitude of the factors under consideration. The same lack of information has resulted in a more superficial treatment of some countries or zones than of others. Thus the work is also somewhat in the nature of an account of the existing information and consequently indicates the chief gaps in information which will have to be filled in the future before any definite conclusions can be reached as to the possibilities of industrial expansion in a given country.

This survey could subsequently be supplemented by information derived from more detailed investigations which are being carried out in certain countries by specialized missions of the Food and Agriculture Organization of the United Nations, within the Expanded Technical Assistance Programme.

### II. The need to promote the development of the paper industry in Latin America

Latin America today<sup>1</sup> imports over two-fifths of its paper and board and nearly half of its paper-making pulp. It is thus dependent on imported pulp products, in the form either of paper or of raw materials for its manufacture, for about 70 per cent of its paper supplies.

Paper consumption in Latin America has nearly doubled in the course of the last decade and a half, while, as the following figures show, production has almost trebled. Thus, imported paper and board, though increased by 180,000 tons, represents only 44 per cent of total consumption as against 60 per cent in 1935-38.

(Thousand of metric tons, annual average)

	Production	Imports	Apparent consumption	Percentage of consumption represented by imports
1935-38.....	293	436	729	60
1950-52.....	786	614	1,400	44

Production rose rapidly in the immediate pre-war years, from 250,000 tons in 1935 to 450,000 tons in 1941. It fluctuated around this figure in the following

<sup>1</sup> 1950-52.

three years and since 1944 has risen steadily to about 850,000 tons in 1952. Per capita consumption today is just under 9 kilogrammes per capita, as against 6 in 1935-38. During the last five years imports have remained remarkably steady, at around 600,000 tons annually, while production has increased by some 250,000 tons.

This pattern of rapidly increasing domestic production, readily absorbed, accompanied by stability in imports, suggests that, had greater supplies been available, from either domestic or external sources, and had Latin American countries, in the latter case, been able to pay for these supplies, then an even greater rise in consumption would have been recorded than actually took place. An examination of the changes which have taken place in the distribution of world supply and demand for pulp and paper as compared with pre-war, and a consideration of the course of the recent cycle on the international pulp and paper market, serve to confirm this reasoning.

Nine-tenths of the world's paper and board are produced, today as before the war, in Europe and North America (United States and Canada). As the following figures show, Latin America's share in world production, in spite of the increase which has taken place there, has risen only from 1.1 to 1.7 per cent.

World production of paper and board, 1935-38 and 1950-52

	1935-38		1950-52	
	Million metric tons	Percentage	Million metric tons	Percentage
World total.....	27.8	100	46.5	100
of which:				
Europe.....	10.9	39	12.3	27
North America...	14.2	51	28.9	64
Rest of world.....	2.7	10	5.3	9
of which:				
Latin America....	0.29	1.1	0.79	1.7

The rise in North American production has almost exactly paralleled the spectacular increase in demand in that region; in 1950-52 the margin between domestic production and domestic consumption (representing net export availability) averaged only 0.46 million tons as against 0.71 million tons before the war. The former figure, it will be noted, corresponds to only 1.6 per cent of total production within the region.

In Europe, exports to other regions have always played a more important role. The war and its aftermath seriously affected production in Europe, through losses of and damage to capacity, excessive exploitation of forests and loss of traditional pulpwood imports. Though recovery was rapid in the post-war years, the rise in production over the pre-war level achieved by 1950-52 was modest compared with that which had taken place elsewhere. By this time European exports to other regions topped 1 million tons (net) as against 0.79 million tons in 1937-38; these exports corresponded to 8 per cent of the regional production.

Europe and North America are the only two surplus regions of the world, and the figures just quoted serve to underline the marginal nature of the exportable surplus in each of these regions. But though marginal, these exports were neither unimportant nor, certainly in the case of Europe, precarious. The recovery of Europe's overseas markets in the post-war years took place against a background of restrictions on paper consumption in several European countries. Exports represented a substantial trade important to the economies of several countries, and not merely to the wood-surplus countries of Northern Europe.

Alongside these changes in paper production in the two surplus regions there have taken place significant changes in pulp output. Whereas in 1937-38 North America imported on balance a million tons annually (from Europe), it had by 1950-52, become practically self-sufficient in pulp. European net exports of pulp, which had averaged 1.36 million tons in 1937-38, had fallen to 0.62 million tons in 1950-52. Taking pulp and paper together, therefore, the European surplus was down by about half a million tons of pulp equivalent as compared with pre-war, while North America had changed from a net deficit region to a net surplus region.

To the upsurge in world demand for pulp and paper which had been registered in the reconstruction years was added, with the outbreak of the Korean War in 1950, extra demand, partly for stockpiling, generated by that conflict. Though production capacity everywhere was stretched to the limit, it failed to match the sudden rise in demand. Fears of a world shortage, often expressed since the end of the war, were realized. The resultant sharp rise in prices curbed the effective demand both for paper and the raw materials used in its manufacture. The effects were world-wide, especially for newsprint, the production of which is especially concentrated in what are traditionally regarded as the paper-supplying countries. The shortage of newsprint, and its increasing cost, caused reductions in the circulation of daily newspapers and even the closing down of many of the publishing houses which issued them.

It was equally difficult to obtain supplies of other paper and of pulp, and those deficit countries which were able to cover their requirements could do so only by paying prices often twice and sometimes nearly three times those obtaining at the beginning of 1950. In 1952 came the inevitable reaction to the preceding boom; its effects were all the more severe as it coincided with a pronounced slackening in the rate at which industrial activity had been rising in Europe and North America and even, in certain European countries, with a falling-off of industrial activity. Demand declined, buyers struck against prevailing prices and were content to reduce their stocks to more normal levels, and world prices fell almost as precipitately as they had risen. Towards the end of 1952 the long-term trends began to reassert themselves and production began to rise again in response to recovering demand. Demand for newsprint, it should be noted, remained buoyant throughout the recession.

From this necessarily short and inadequate account of the recent paper cycle emerge several points relevant to the present study. North America accounts for nearly two-thirds of total world production and consumption. Any shift in the balance between supply and demand in that region can have serious reper-

cussions on the international market for pulp and paper. Pulp and paper prices are sensitive in the world market and, in times of inflated prices, countries largely dependent on imports of pulp and paper encounter difficulties in satisfying their needs. These difficulties are often aggravated by foreign-exchange shortages. So long as the present imbalance between supply of and demand for pulp and paper as between different regions continues, a recurrence of the difficulties recently experienced is possible.

The marginality of supplies from the old producing centres and possibility of future fluctuations indicate the need for the deficit regions of the world, including Latin America, to diminish their degree of dependence on extra-regional supplies if the satisfaction of their rising requirements is to be free from interruption.

It may be argued that recent difficulties have flowed from special circumstances, a temporary upsetting of the near-balance world demand and the world's ability to satisfy that demand. Is it possible, however, that, in the long term, production in the exporting regions can expand at a rate sufficiently in excess of domestic demand to enable them to satisfy the rising needs of Latin-American countries? The possible future magnitude of those needs is estimated below; it has to be borne in mind that requirements will also rise, perhaps with equal rapidity, in the other regions of the world which are today mainly or partly dependent on imports.

So far as Europe is concerned, this problem was discussed in some detail in the study *European Timber Trends and Prospects*, published jointly by the Economic Commission for Europe and the Food and Agriculture Organization at the beginning of 1953. There the conclusion was reached that, in spite of recent strains on European forest resources, pulp and paper capacity was likely to rise at a rate sufficient to keep pace with rising domestic demand within the region and to permit the recent level of exports of pulp and paper to other regions to be maintained; for various reasons, set out at length in the study, the authors saw no prospect of any considerable increase in the surplus available for export in the coming decades.

In North America the prospects are more difficult to gauge. The striking increase in productive capacity which has taken place in recent decades provides eloquent witness of the dynamic nature of the pulp and paper industry in that part of the world. Technical resourcefulness is likely to prevent raw material supplies from inhibiting any further expansion. Hitherto, however, production within the region has been almost entirely oriented to the satisfaction of domestic demand, and, with certain important exceptions, exports to other regions have never played an important part. This position could change in the immediate future, since there are indications that the rate of increase of North American demand has slackened, while a good deal of additional capacity, planned a year or two ago, will come into operation in the next few years. There is, therefore, the prospect of a marked, if temporary, increase in the continent's available export surplus. Whether this will increase in the long term is more doubtful; it is not even certain to be maintained. It has been estimated by FAO that paper and board requirements in the five deficit regions of the world—Latin America, the Far East, the Near and Middle East, Africa and Oceania—are likely to rise by between



2½ and 3 million tons over their present level by 1960-62. It cannot be expected that the margin between domestic production and domestic requirements in Europe and North America will, by that time, have widened to the point where those regions can satisfy this extra demand in addition to the 1½ million tons they export today.

One important factor militating against an expansion of this order is the limited capacity of the deficit regions to import. For many countries, pulp and paper needs must find their place within a general import programme alongside other items less easily produced from domestic sources. And producers in North America and, to a lesser extent, in Europe, are understandably hesitant about embarking on an expansion programme designed to satisfy markets which experience has shown may be subject to interruption through exchange difficulties. For Latin America, as for other deficit regions, the increase in imports which can take place in the future will be limited, indirectly as well as directly, by the region's capacity to import.

If this is a correct appraisal of the possibilities of obtaining additional supplies of paper and board from the surplus regions, it follows that the extent to which paper and board consumption in Latin America can rise in the future will be primarily determined, as in the past, by the rate at which domestic production expands. It has been pointed out by FAO that, over the last fifteen years, the disparity in consumption per head as between the more highly developed regions and the less developed regions has tended to increase rather than diminish.

Consumption of paper and board  
(Kilogrammes per head)

	1935-38	1950-52	Percentage increase
Europe, North America and Oceania.....	45	73	62
Latin America, Africa, Near, Middle and Far East.....	1.7	2.1	24

Latin America has in fact fared somewhat better than other deficit regions, consumption per head rising over this period from 6.3 to 8.8 kilogrammes, or by about 40 per cent. This may be ascribed to the fact that the expansion of domestic supplies has been more rapid than in other deficit regions. It is difficult to escape the conclusion that the rise would have been greater had production within the region expanded more rapidly.

The *prima facie* need for encouraging a more rapid development of the Latin-American pulp and paper industry may therefore be regarded as established. In order to seek confirmation of this impression and to form an idea of the order of magnitudes involved, an attempt has been made to estimate probable future requirements of paper and board in the region. Strictly speaking, such an estimate should be based on a detailed analysis of the factors influencing the demand for each of the several paper and board end-products in each of the countries within the region. The statistical data presently available are neither sufficiently extensive nor sufficiently accurate to enable such an inquiry to be fruitful. Instead, forecasts have been made based on the relationship which appears to obtain between per capita consumption of paper and board and per capita income.

Details of the approach adopted are set out in annex II. Briefly, analysis of income per head and of consumption per head of newsprint and of other paper and board in Latin-American countries in the year 1949, the year for which most country data were available, revealed a close correlation. This was true for all countries taken together and for the Latin-American countries taken separately. On the basis of the relationship established, the level of future demand was then estimated for each Latin-American country, assuming rates of growth in income per head varying from 1 per cent to 5 per cent. Of the five sets of estimates thus obtained, that corresponding to the middle assumption, a 3 per cent rate of growth, has been used in the remainder of this study to illustrate the likely level of future needs in relation to potential future production. The level of Latin-American demand for paper and board in 1960 corresponding to this assumption was 2.63 million tons, including 0.89 million tons of newsprint; this compares with 1.35 million tons (of which 0.37 million tons of newsprint) in 1950.

So far as at present known, new paper projects now under construction in Latin America, or likely to be realized within the current decade, amount to an annual capacity of only 0.49 million tons, of which 0.23 million tons are for newsprint (see table 8). These additions correspond to less than half of the expected increase in newsprint requirements and to only one-third of the increase in requirements of other paper and board.

A rate of income growth of 3 per cent is believed to be reasonable in the light of the economic progress achieved in Latin America in recent decades. But it should be remarked that, even if the rate of growth were as low as 1 per cent, the expected additions to capacity would fall short of the expected increase in requirements by about 120,000 tons. If, therefore, Latin-American countries are to prevent a sharp rise in their import requirements or—since it may be impossible to obtain all the additional imports they need—if they are to prevent supply limitations from inhibiting the rise in paper and board consumption that would be the natural concomitant of cultural progress and economic advance, it becomes necessary to consider whether a more rapid development of capacity within the region is possible.

### III. Technological possibilities for using the fibrous resources of Latin America in pulp and paper production

Once the urgent necessity for developing Latin-American paper industries has been established, and before referring to the abundance of regional fibrous resources, it is essential to state that techniques permitting the use of Latin-American fibrous raw materials have already been developed. In addition, the direction recently taken by technological research forecasts a shifting of the world pulp industry towards the tropical and sub-tropical forest areas, such as those which constitute 95 per cent of the Latin-American forests.

When, in the last century, wood began to be used commercially as a fibrous raw material for the pulp and paper industry, the latter only called upon those areas where coniferous trees free from resin grew, such as Scandinavia, Canada and the northern United States. The important reason for this limitation lay in the fact that the only economic method for manufac-

turing pulp, known at that time, was the sulphite process,<sup>2</sup> which could only be applied to non-resinous conifers which were abundant in the regions mentioned above. The sulphate process,<sup>3</sup> which was already known, could be used in the treatment of all kinds of wood, including that of resinous conifers, but its heavy consumption of chemicals placed it in a secondary position in relation to that of the sulphite process.

Later, the perfecting of a system for recovering almost all the chemicals used in the sulphate process enabled economical use to be made of resinous conifers, with operations costs even lower than those of the sulphite process, and with better results, as far as the mechanical strength of the pulp is concerned, though not with respect to its colour.

This technological advance extended the frontiers of the utilization of the resources of the countries of supply, and brought about movements of the industry towards those regions in which there were resinous conifers and other woods appropriate to the sulphate treatment. It was in this way that the United States industry shifted towards the south, to be able to draw upon vast new conifer resources, such as the Douglas fir and the southern pine, and plentiful quantities of hardwood species such as birch and beech. It may be said that the greatest expansion of the cellulose industry which has taken place in the last fifteen years, particularly in the United States, is due to the introduction of the sulphate process. Although this process yields pulp of great mechanical resistance, its field of application was at first extremely limited, owing to the difficulty of bleaching the product. With the advent of the continuous bleaching system (in 1930), sulphate not only widened its sphere, but has gradually been ousting sulphite, as it produces pulp as white as that resulting from this latter process, and stronger.

The limited capacity of the coniferous forests of the principal countries of supply, operating in conjunction with the increasing world demand for paper, has led to the investigation of other than coniferous resources. Adaptations of the sulphate process have made possible the increasing use of hardwoods from tropical and semi-tropical regions for pulp production.

<sup>2</sup> The sulphite process consists in the treatment of the wood with a solution of calcium bisulphite, under pressure and at a high temperature. It had its origin in the researches of the chemist Benjamin Tilghman, in the year 1867, and was later industrialized, in 1874, by C. D. Ekman in Sweden, A. Mitscherlich in Germany and C. Kellner in Austria. The pulp substances obtained by this process can be used for a great variety of products, from newsprint to dissolving pulp for the manufacture of rayon or acetate.

<sup>3</sup> The sulphate or "kraft" process, developed by Dahl in Danzig, in 1879, is a variation of the soda treatment, consisting of the introduction of sodium sulphide into the dissolving fluid. Sodium sulphide speeds up the process of delignification, and improves the yield and physical properties of the pulp products obtained. For economical production by this process, it is indispensable that the plants should possess equipment for recovering the chemicals used. For the bleaching of the pulp, a system involving from five to seven stages is necessary; and the use of chlorine dioxide is required when it is desired to obtain a degree of whiteness comparable to that of sulphite pulp. Pulp products made by the sulphate process are characterized by their high strength, for which reason they are chiefly employed in the manufacture of packing- and wrapping paper. They are also used, semi-bleached, to replace unbleached sulphite pulp for newsprint. The bleached product, mixed with other pulp, is used in the manufacture of printing paper, writing paper and other fine quality products. The sulphate process, if preceded by hydrolysis, can be used to obtain high-quality pulp for the rayon industry. It is used in the treatment of almost all types of resinous pine and in that of tropical species of hardwoods.

The technological advance which may be considered as the most important for the extension of the world's supply sources, is the use of tropical and sub-tropical woods in heterogeneous mixtures somewhat similar in composition to those found in the forests where they grow. Among the more interesting research work on this subject is that of a French Government agency, the Régie Industrielle de la Cellulose Coloniale, both in its Paris laboratories and at the pilot mill of Abidjan, French West Africa, where success had been achieved in experiments for the simultaneous cooking of as many as twenty-five broad-leaved species.<sup>4</sup>

The results obtained in West Africa are of prime importance to Latin America since, as noted earlier, more than 95 per cent of this region's forest resources are made up of tropical and semi-tropical broad-leaved species, which generally grow in heterogeneous forest groups. If good results are obtained for the economic production of pulp from mixtures of tropical Latin-American hardwoods it is probable that a new geographical re-location of the paper industries will take place. Thus some areas of the region, which until today have remained entirely inactive, may be exploited, to the advantage of the whole world.

Even if the problem of producing chemical pulp from the broad-leaved species of Latin America were

<sup>4</sup> From the reports submitted by the Régie Industrielle de la Cellulose Coloniale, of the French Government, to the third session of the Latin-American Forestry Commission (F.50/LA. Doc.14) and to the meetings of the Technical Committee on Wood Chemistry held by FAO in Brussels (1949) and at Appleton (1951) the following conclusions may be made. They establish as a possibility the successful use of Latin-American hardwoods in the production of paper and pulp:

(a) The simultaneous cooking of blends of broad-leaved species, not only is a necessity imposed by the present composition of the forests, but also signifies evident improvements in both the quality and the quantity of the product. It has been shown that heterogeneous cooking gives a better yield than the average result when each species is treated individually. It has also been proved that the paper-making qualities of pulp produced by heterogeneous cooking are not only superior to the level of these qualities in the species treated individually, but in certain cases even surpass those considered to be the best.

(b) Contrary to former belief, the length of the fibre does not directly influence the tensile and bursting strength of the product. The first of these properties is directly dependent on a factor which the Régie Industrielle calls "the coefficient of flexibility", and which is the relationship between the diameter of the lumen, or hollow interior of the fibre, and the width of the fibre. This factor also has a considerable effect on bursting strength. Resistance to tearing does not depend directly on the length of the fibres, but on another factor, called by the Régie Industrielle "felting power", which is calculated as the ratio between the length of the fibre and its width. Nevertheless, if the average length of the fibres descends critically (700-900 microns), all the qualities of strength are profoundly affected, and the laws referred to above can no longer be applied.

(c) The determination of the "coefficient of flexibility" and the "felting power" makes it possible to predict, with a good deal of accuracy, the paper-making properties which can be expected from a given species or mixture of species, if the chemical treatment is carried out under the best conditions.

(d) The different morphological characteristics of the fibres of heterogeneous woods make the pulp produced almost universal in its possible applications. The unbleached pulp can be used for almost all types of wrapping and packing-paper, including "kraft" paper for cement bags. The bleached pulp can be used for book paper, blotting paper and fine printings.

(e) The consumption of chemicals by a mixture of species is almost the same as if only the species which consumes the smallest quantity of dissolving agents were treated. The saving in chemicals effected by heterogeneous cooking is as much as 10 per cent and may even exceed this figure.

(f) Although the work of the Régie Industrielle has been mainly concentrated on chemical pulp, experiments have already been carried out in the manufacture of semi-chemical pulps, with satisfactory results as far as yields and paper-making properties are concerned. The colour of the pulps is generally dark.

assumed as solved, another important problem would remain. This would be the production of mechanical pulp, which is the cost-reducing ingredient of paper, since it consists merely of ground wood, requiring the simplest possible manufacturing process and affording a generous yield per ton of raw material used. Until today, there has been considerable difficulty in producing mechanical pulp from the majority of the broad-leaved species, mainly due to their hardness and colour. Fortunately, very substantial progress has been made in developing new processes, such as chemigroundwood<sup>5</sup> and cold caustic soda,<sup>6</sup> which can be used with hardwoods to produce pulps economically equivalent, or almost equivalent, to mechanical pulp. Much research still remains to be carried out in this direction, but the prospects for the production of mechanical pulp equivalents from broad-leaved species are almost as great as those for the production of chemical pulp.

The lack of resources in the paper-producing countries also led to another technological advance by widening the field of application of the semi-chemical processes to the treatment of hardwoods.<sup>7</sup> The aim of the research was to obtain the greatest possible yields from scarce fibrous resources and at the same time to improve the paper-making properties of the products. The economic advantages of this progress, considered from the Latin-American point of view, are of greater significance to the applicability of such processes to regional woods and the increase in production per unit of investment, than to the preservation of natural resources. As in the case of pulp produced from mixed heterogeneous species, it is necessary to stimulate the study of the application of semi-chemical processes to the species of the natural forests of Latin America.

<sup>5</sup> This process consists in the impregnation of pieces of hardwoods with a solution of neutral sulphite, subjecting them successively to vacuum pressure and to cooking at high temperatures, before they are ground on conventional type grinders. It was developed on a semi-industrial scale by the School of Forestry of New York State University. In addition to the qualities of the pulps obtained by this process, its inventors point out the following advantages: (a) the possibility of utilizing a great variety of hardwoods which it has not been possible to use in the manufacture of mechanical pulp; (b) the small amount of electric power used by the grinders, which balances the cost of the chemical raw materials employed; (c) the fact that larger yields per unit of volume of wood are obtained, owing to the possibility of treating denser woods than those which are normally used in mechanical pulp production. The value of the additional pulp produced suffices to compensate the abnormal outlay in steam, power, chemicals and labour which the use of this process requires.

<sup>6</sup> This process was developed in the Forestry Products Laboratory of the United States Department of Agriculture (Madison, Wisconsin). Wood chips are treated with cold caustic soda and afterwards passed through a disc refiner, with the object of obtaining a pulp of the same type as mechanical pulp. This process has been tried on hardwoods of high and low densities, and pulps have been obtained of a similar quality to that ordinarily made from spruce-fir, in the manufacture of newsprint. The pulps turn out slightly darker than normal mechanical pulp and need semi-bleaching if they are to be used for newsprint. Tests carried out on a small scale indicate that it is possible to replace by pulp made through the cold caustic soda process about half the mechanical pulp used for newsprint, and even to reduce the quantity of chemical pulp without apparent detriment to the quality of the paper. Up to now, this process has only been used for the manufacture of corrugated cardboard. But it is very important that it should be recalled when the need arises to use hardwoods in producing those types of paper which contain a high percentage of mechanical pulp.

<sup>7</sup> Semi-chemical processes are mild chemical treatments of woods, designed to separate, in part only, the ligno-cellulose substances. The separation of the fibres is carried out afterwards by means of the mechanical action of a refiner. They were developed in the Forest Products Laboratory of the United States

Industrial processes enabling wheat straw and sugar-cane bagasse to be used economically as raw materials in paper manufacture, open up wide prospects of industrial development for those areas where there are no other fibrous resources.

For Latin America such prospects are of particular interest, not only because they offer an opportunity to make the best use of existing resources, but because owing to the nature of the equipment it is possible to use small mills economically, thus representing a smaller capital outlay per unit of manufactured products. Another advantage which may appear in certain ideally situated locations within the region is the possibility of achieving very low costs, due to the primary character of the supplementary materials required for the industrial processes, that is, salt, water and electric power.

At present the world production of straw pulp is only 1 million tons annually; that is, 3 per cent of the total production of pulp. This figure is surprising, particularly in view of the high degree of technical progress attained in the production of this type of pulp and of the abundance of existing sources for raw materials.

There are various processes for the treatment of straw and of sugar-cane bagasse,<sup>8</sup> and, in different parts of the world, efforts are being made to improve them or to develop new means of converting them into pulp. Such research involves the use of different chemicals and methods of operation, which allow a certain flexibility in the choice of raw materials and other production elements, in accordance with local conditions.

Department of Agriculture. The delignifying liquors may be neutral sulphite or those used in the sulphate process. The treatment produces yields of from 60 to 85 per cent, in pulps from almost all types of wood. The research which led to its discovery was always aiming at the utilization of hardwoods. The pulps obtained by the semi-chemical neutral sulphite process have physical properties very similar to those of the pulp obtained by the sulphate process. Moreover, when completely bleached, they have a tensile strength equal or superior to that of sulphite pulp made from conifers. The unbleached pulps are used in the manufacture of paperboard. The species most used for this process are the temperate hardwoods. Tropical woods having a high content of lignine and soluble matters are not suitable. The pulps produced by semi-chemical sulphate processes differ from those produced by neutral sulphite only in their darker colour and lower strength. The process is applied to the same species which are employed with neutral sulphite, and the uses of the product are identical. The same equipment and plant used for the ordinary sulphate process can be utilized for pulp production by the semi-chemical sulphate process.

<sup>8</sup> Among modern, or modernised, processes, those of prime importance are the semi-chemical neutral sulphite process, that of soda-chlorine and the mecano-chemical process. The common sulphate process, usually applied to conifers can also be used in treating straw or bagasse. The neutral sulphite process is basically similar to that employed for the treatment of hardwoods, with minor modifications in the concentrations of liquids, time of cooking and temperature. The unbleached pulps are used in the manufacture of paperboard and inferior quality wrapping-paper. Bleached and blended with other pulps or pulp products, they can be employed in the manufacture of almost all types of fine-quality paper and also in that of glassine and grease-proof paper. The fibrous raw materials which can be used with this process are principally straw and sugar-cane bagasse. The soda-chlorine, also called the Celdecor-Pomilio process, was developed by the Italian engineer Humberto Pomilio in 1922 and, latterly, modified and improved by a British firm, the Cellulose Development Corporation. Fundamentally, this process consists in the continuous cooking of the fibrous materials in a diluted soda solution at a temperature of approximately 100° C. This is followed by treatment with gaseous chlorine, and other phases of chemical treatment for bleaching purposes. The pulp product obtained by this process can be used, with few exceptions, for all types of fine-quality paper. The fibrous raw materials employed are cereal

#### IV. Comparison of the needs for development in Latin America with the possibilities offered by its fibrous resources

In 1950, Latin America consumed about 1,348,000 tons of paper and paperboard,<sup>9</sup> of which 28 per cent, or 375,000 tons, consisted of newsprint. Regional production was able to satisfy only 12 per cent of the demand for newsprint and 70 per cent of the requirements for other types of paper and paperboard (see table 1). Present installed capacity, calculated on the basis of 1952 data, is 48,000 tons annually in the case of newsprint and 941,000 tons for other types of paper and paperboard.

The industry produces almost all the mechanical pulp which it consumes (134,000 tons), but supplies only 40 per cent of the 428,000 tons of chemical pulp which is required annually. Except for small quantities, the remainder of the fibrous raw materials, such as waste paper and rags, are obtained domestically.

As may be seen in table 2, the industry comprises 190 mills, mainly concentrated in Argentina, Brazil, Chile and Mexico—these countries together possessing 86 per cent of the total capacity. Most of the mills are very small and are mainly engaged in producing cardboard from waste products. Thirty-one paper mills produce their own chemical pulp and thirty produce their own mechanical pulp. There are, moreover, especially in the south of Brazil, many mills which produce small quantities of mechanical pulp for sale only.

Estimates of future consumption of paper, chemical pulp and mechanical pulp appear in table 3. If they are compared with statistics for installed capacity, it is evident that, for the Latin-American industry to be able to supply all its needs, an increase in its paper manufacturing capacity of 916,000 tons up to 1955,<sup>10</sup> of 1,640,000 tons by 1960 and of 2,648,000 tons by 1965 would be required (see table 4). Simultaneously, the capacity for producing chemical pulp would have to increase by 600,000 tons up to 1955, 923,000 tons by 1960 and 1,375,000 tons by 1965. To mechanical pulp capacity it would be necessary to add 467,000 tons by 1955, 730,000 by 1960 and 1,091,000 tons by 1965.

The enlargement of the industry to cover the entire requirements of the Latin-American market would require, in approximate figures, more than 2½ million tons of pulpwood annually by 1955 and more than 5 million tons by 1965 (see table 5). The potential resources of Latin America are considerably in excess of these requirements and allow for an export industry which could substantially assist in supplying other parts of the world.

straw, esparto grass and sugar-cane bagasse. The mecano-chemical process was first realised in the Northern Regional Research Laboratory at Peoria, Illinois. It consists in delignifying the fibrous raw material in a hydropulper at atmospheric pressure. The same chemicals are used as in the sulphate or the soda processes. The duration of treatment is quite short, from an hour to an hour and a half; the consumption of steam is high, and the product requires subsequent refining. The unbleached pulp can be used for paperboard and wrapping paper; the bleached pulp is used in several types of fine-quality paper. The process is suitable for the treatment of straw, cane bagasse and probably grasses.

<sup>9</sup> Statistics for production, imports and apparent consumption to be found in tables 1, 2 and 3 of annex I.

<sup>10</sup> Productive capacity figures in this summary, expressed in tons alone, should be considered as tons of production annually.

Although the data included in this survey refer only to particular areas of certain Latin-American countries, the potential aggregate, at a very conservative estimate, would be sufficient to produce more than 8.8 million tons of fibrous material (see table 6); i.e., they would be more than ample to satisfy the domestic requirements of Latin America. (See table 7.)

For the paper industry to develop sufficiently to cover the entire needs of Latin America, it would be necessary, between now and 1965, to establish more than fifty large<sup>11</sup> pulp and paper mills in the most suitable sites in regard to markets and raw materials. A programme of this nature would involve investments of about 1,000 million dollars. It would also require the installation of about 600,000 kilowatts of electric power capacity and availability of fuel exceeding 600,000 tons of coal each year. It would also be necessary to ensure chemicals, abundant water supply and considerable mileage of roads and railways to obtain ready access to the forests and to transport finished products.

The size of the industrial development expressed by the above figures justifies a careful study of the available resources, of the financing possibilities and of the prospects provided by probable future technological advances.

#### V. General conclusions

1. The rate of growth of paper consumption in Latin America has been slower than it would have been had there been available greater supplies of domestically produced pulp and paper.

2. The gap between prospective manufacturing capacity and future Latin-American demand for pulp and paper indicates that the region will continue to need increasingly larger amounts of imported pulp and paper products, even if an effort is made to carry out the present plans for industrial expansion.

3. There is no reason to suppose that the great paper-producing centres of the world will, in the future, be able to increase their production to a degree capable of wiping out the supply difficulties likely to be experienced in Latin America and other paper-deficit regions of the world. This implies that Latin America will have to make a deliberate effort to enlarge its production of pulp and paper over and above the present plans for expansion. The aim should be to create sources of supply which will allow future consumption to remain in its appropriate proportion to the level of real income, in other words in sound relationship to industrialization and educational and cultural progress.

4. Latin America in general, and most of its countries individually, have sufficient fibrous resources to meet domestic consumption requirements. Several countries will be capable of exporting pulp and paper to their Latin-American neighbours. It is also conceivable that in one or two exceptionally favourable areas, the possibility of exporting to other regions may arise. The region's most important resources are the tropical and sub-tropical forests of hardwoods. But even the coniferous forests, constituting only 5 per cent of the Latin-American forest area, could, with adequate forest management, prove sufficient to meet the entire needs of the region.

<sup>11</sup> Mills with an annual productive capacity for 50,000 tons of paper, plus the essential capacity for chemical and mechanical pulp.

5. Apart from the forest resources which already exist in Latin America, it is possible to create others, almost anywhere, by means of afforestation of suitable species. This solution allows the establishment of natural resources in locations previously selected for their accessibility and proximity to paper markets. The experience gained by some countries, such as Argentina, Brazil and Chile, where extensive afforestation has been carried out, should be made known to the rest of Latin America by means of publications or the visits of technicians. The experience of Brazil in planting eucalyptus is of special interest, as these species can be used not only to form new sources of pulping raw materials but also to create supplies of fuel wood close to urban centres, thus assisting to avoid the destruction of a large number of natural forests. Argentina has gathered much knowledge of the planting of salicaceous species, such as willows and poplars; these species are of very rapid growth and may be used to produce mechanical pulp. Similarly, it should be noted that considerable experience has been acquired in Chile of plantations of *pinus radiata*, a species which can probably be acclimatized to various areas of Latin America as successfully as it has been done in the Chilean zone.

6. The most important recent technological advance, as far as paper is concerned, has been the discovery of processes which enable wood from tropical forests to be used in producing chemical pulp and pulps similar to mechanical pulp. Since these new processes have been developed outside Latin America, research and experiment are needed in order to adapt them to Latin-American resources or to test the universality of their application.

7. Sugar-cane bagasse also offers a substantial source of fibrous raw material for those countries which do not have sufficient forests at their disposal. The technical and economic problem of bagasse conversion into chemical pulp may be considered as definitely solved, except for a few details such as the economic elimination and subsequent use of the pith, which has a detrimental effect upon the quality of the paper produced. Sugar-cane bagasse as a raw material for pulp has a higher value than its use as a fuel; however, this value depends on the technical condition of the equipment used and on the local possibilities of obtaining cheap fuel.

8. In countries where forest resources exist in abundance, these should be given a priority over other raw materials for producing pulp and paper; the establishment of large mills in itself represents a guarantee that the forests will be preserved and enriched, in contrast to the destruction of resources which has characterized the exploitation of lumber in Latin America.

9. Since industrial processes for producing chemical pulp from straw have attained a high technical level and the resulting product may be used to manufacture high-quality grades of paper, it is hoped that this raw material will in due course be more extensively employed in those countries where insufficient wood for pulp production exists but where straw can be collected at a reasonable and more or less stable cost.

10. Since most Latin-American forests comprise a mixture of species, among which are to be found some of great value for other uses than the production of

pulp and paper, it is important to study the possibilities of creating industries integrated with those for paper and which will allow a rational utilization of the forests and a reduction in the cost of pulp products. A vital aspect of such a study would be an examination of the possibilities of being able to rely upon permanent markets for such integrated industries.

11. The types of wood which the forests can provide should be systematically studied in order to determine to what uses they can best be put. Certain facilities already exist within the region, and extra-regional facilities can be called upon in many cases. The establishment of laboratories to undertake this kind of research involves a certain capital outlay. Moreover, the supply of skilled personnel to man them is not unlimited. Thus, where additional facilities are considered necessary, it may be appropriate, in certain cases, to establish these on a co-operative basis, designed to serve the needs of several neighbouring countries.

12. Any project to exploit existing forest resources must be on a sustained-yield basis, and must be accompanied by a plan for the management, preservation and enrichment of the forest zones.

13. The supply of private investment capital in Latin America is limited; pulp and paper projects have to compete with development projects in many other fields. It is therefore important that a detailed study of potential pulp and paper projects be made in order that capital be attracted into those projects which offer prospects of producing pulp and paper under the best possible economic conditions. Determining factors are: the prospective size of the domestic market; export possibilities; availability of water, power, fuel and chemicals; accessibility of the forest resources; continuity of raw material supplies, having regard to sustained-yield principles; suitability of the raw materials for the manufacture of various grades of paper; adequacy of communications, social services, etc. Only by assembling and making available to interested parties information on all these points, will it be possible to ensure that available capital is directed into the most productive channels, and to avoid the establishment of uneconomic enterprises whose viability cannot be assured without permanent artificial support.

Public capital, no less than private capital, is the object of competing claims. And in this domain profitability is not the sole, nor even necessarily the most important, criterion. It becomes necessary to consider carefully, for each individual development project, the influence which that project will have on the general economic development of the country concerned. There will be cases where pulp and paper investment can most usefully accompany investment in other projects as part of a general development plan embracing power, communications, forest protection, immigration, etc. Saving of foreign exchange is a matter of great importance for most of the Latin-American countries.

14. Any preliminary project for industrial development requires specialized research into the composition and density of the forests, as well as into the possibilities for the economic conversion of the forest resources into chemical, mechanical or semi-chemical pulps for different grades of paper and cardboard. It is thus desirable to support and expand the action of

international bodies<sup>12</sup> which can carry out such work on behalf of any one of the countries at considerably lower cost than if every individual country established its own specialized body. It would also be possible to

<sup>12</sup> FAO has created already an Advisory Board on Pulping Tests. The main tasks of this Board are: (a) to advise FAO on investigations concerning the pulping of raw materials, procedures and testing methods; (b) to establish a list of research institutes of high scientific standing and with adequate equipment and personnel to execute the investigation programs of the organization; and (c) to act as a centre for the exchange of information and auxiliary research means.

carry out, on a co-operative basis, surveys of regional or world markets, without which plans for the development of the industry could not be made.

15. Apart from research related to specific projects, it is also necessary to promote systematic research, aimed at developing equipment and production processes better adapted to Latin-American conditions. This should not only take into account the need for more rational use of existing natural resources but should also aim at reducing the investment required per unit of output and reducing the size or capacity necessary for the mills to operate on an economic basis.

TABLE 1  
*Latin America: Relationship between production, imports and consumption of paper and paperboard, 1950*

	Production		Imports		Consumption	
	Tons	%	Tons	%	Tons	Per capita
Argentina .....	211,407	52	195,325	48	406,732	23.77
Bolivia .....	518	12	3,754	88	4,272	1.41
Brazil .....	247,895	78	70,394	22	318,289	6.33
Chile .....	44,829	67	21,821	33	66,650	11.47
Colombia .....	..	..	61,720	100	61,720	5.48
Costa Rica .....	..	..	3,342	100	3,342	4.20
Cuba .....	34,349	25	102,550	75	136,899	25.95
Dominican Rep. ....	196	3	5,895	97	6,091	2.88
Ecuador .....	367	3	11,039	97	11,406	3.57
El Salvador .....	..	..	3,872	100	3,872	2.08
Guatemala .....	..	..	5,846	100	5,846	2.08
Haiti .....	..	..	2,144	100	2,144	0.62
Honduras .....	..	..	1,766	100	1,766	1.15
Mexico .....	131,464	75	44,093	25	175,557	6.92
Nicaragua .....	..	..	1,894	100	1,894	1.80
Panama .....	..	..	6,463	100	6,463	8.07
Paraguay .....	..	..	1,766	100	1,766	1.26
Peru .....	16,546	57	12,473	43	29,019	3.48
Uruguay .....	30,000	55	24,143	45	54,143	22.73
Venezuela .....	7,718	15	42,680	85	50,398	10.72
<b>LATIN AMERICA</b>	<b>725,289</b>	<b>54</b>	<b>622,980</b>	<b>46</b>	<b>1,348,269</b>	<b>8.83</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization of the United Nations.

Notes: In 1950, Brazil, Chile and Mexico produced a total of 45,716 tons of newsprint, or 12 per cent of the region's consumption. These were the only countries producing newsprint. The production of other papers and paperboard met 70 per cent of Latin America's consumption.

TABLE 2

Latin America: Geographical distribution and installed capacity of the pulp and paper industry<sup>a</sup>

(Capacity in thousands of metric tons annually)

Countries	Number of mills					Capacity of the paper industry <sup>b</sup>			Capacity of the chemical pulp industry			Capacity of the mechanical pulp industry		
	Paper only	Paper and chem. pulp	Paper and mech. pulp	Paper, chem. and mech. pulp	Mech. pulp only	Total capacity	No. of mills	Average capacity per mill	Total capacity	No. of mills	Average capacity per mill	Total capacity	No. of mills	Average capacity per mill
Argentina.....	41	6	3	—	2	270.0	50	5.4	43.0	6	7.2	31.0	5	2.8
Bolivia.....	1	—	—	—	—	0.6	1	0.6	—	—	—	—	—	—
Brazil.....	38	5	8	10	66	266.5	61	4.4	73.5	15	4.9	124.9	83	1.5
Chile.....	24	—	1	1	—	67.9	26	2.7	6.0	1	6.0	23.0	2	11.5
Colombia.....	1	1	—	—	—	24.0	1	24.0	—	—	—	—	—	—
Costa Rica.....	—	1	—	—	—	3.0	1	3.0	..	1	..	—	—	—
Cuba.....	2	—	—	—	—	45.0	2	22.5	—	—	—	—	—	—
Dominican Rep.....	1	—	—	—	—	0.4	1	0.4	—	—	—	—	—	—
Ecuador.....	1	—	—	—	—	0.6	1	0.6	—	—	—	—	—	—
El Salvador.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Guatemala.....	1	—	—	—	—	..	1	..	—	—	—	—	—	—
Haiti.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Honduras.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mexico.....	15	3	6	1	—	240.0	25	10.0	93.0	4	23.0	63.0	7	9.0
Nicaragua.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Panama.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Paraguay.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peru.....	4	2	—	—	—	25.0	6	4.2	13.0	2	6.5	—	—	—
Uruguay.....	10	1	—	—	—	37.5	11	3.7	9.0	1	9.0	—	—	—
Venezuela.....	2	—	—	—	—	8.0	2	4.0	—	—	—	—	—	—
<b>TOTAL</b>	<b>141</b>	<b>19</b>	<b>18</b>	<b>12</b>	<b>68</b>	<b>988.5</b>	<b>189</b>	<b>5.2</b>	<b>238.1</b>	<b>31</b>	<b>7.7</b>	<b>241.9</b>	<b>97</b>	<b>2.5</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization of the United Nations.

<sup>a</sup> Data on installed capacity comes from information obtained early in 1953.<sup>b</sup> Installed capacity to produce newsprint stands at 48,000 tons annually.

TABLE 3

## Latin America: Estimated future demand for paper, chemical pulp for paper and mechanical pulp

(Thousands of metric tons annually)

	Years	Per capita demand for paper (kg.)	Total demand for paper	Total demand for mechanical pulp <sup>c</sup>	Total demand for chemical pulp <sup>c</sup>
Newsprint.....	1950 <sup>a</sup>	2.46	375	345	49
	1955 <sup>b</sup>	3.86	648	596	84
	1960	4.78	886	815	115
	1965	5.93	1,212	1,115	158
Other papers and paperboards..	1950 <sup>a</sup>	6.38	973	119 <sup>d</sup>	601 <sup>d</sup>
	1955 <sup>b</sup>	7.49	1,257	113	754
	1960	9.41	1,743	157	1,046
	1965	11.86	2,425	218	1,455
<b>TOTAL</b> .....	1950 <sup>a</sup>	8.84	1,348	464	650
	1955 <sup>b</sup>	11.35	1,905	709	838
	1960	14.19	2,629	972	1,161
	1965	17.79	3,637	1,333	1,613

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total and per capita demand for paper for 1950 are taken from annex I.<sup>b</sup> The estimates of demand for 1955, 1960 and 1965 were obtained by correlating on a world scale the per capita consumption of paper and Latin-American per capita income. The complete procedure and its results may be found in annex II. For the sake of simplicity only the figures, for an average rate of growth of per capita income equal to 3 per cent were used here.<sup>c</sup> For calculating total demand for mechanical and chemical pulp, the following conversion average factors were used, which were approved for use by FAO at two international conferences on forestry statistics, held in Washington and Rome, 1947.

Mechanical pulp: newsprint	x 0.92	Chemical pulp: newsprint	x 0.13
other papers	x 0.09	other papers	x 0.68
paperboard	x 0.07	paperboard	x 0.32

As "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used for this over-all figure, weighted with Latin-American consumption figures:

Mechanical pulp: other papers and paperboards	x 0.09
Chemical pulp: other papers and paperboards	x 0.60

<sup>d</sup> Estimates based on data from the industry.



TABLE 4  
*Latin America: Expansion needs of the pulp and paper industry*  
 (Thousands of metric tons annually)

	Present demand <sup>a</sup>	Installed capacity <sup>b</sup>	Expansion required now	Expansion needed in the future		
				Total to 1955	Total to 1960	Total to 1965
<b>Newsprint:</b>						
Latin-American.....	46					
Imported.....	329					
<b>TOTAL FOR NEWSPRINT</b>	<b>375</b>	<b>48</b>	<b>327</b>	<b>600</b>	<b>838</b>	<b>1,164</b>
<b>Other papers and paperboards:</b>						
Latin-American.....	679					
Imported.....	294					
<b>TOTAL OTHER PAPERS AND PAPERBOARDS</b>	<b>973</b>	<b>941</b>	<b>32</b>	<b>316</b>	<b>802</b>	<b>1,484</b>
<b>TOTAL FOR PAPER AND PAPERBOARD</b>	<b>1,348</b>	<b>989</b>	<b>359</b>	<b>916</b>	<b>1,640</b>	<b>2,648</b>
<b>Chemical pulp:</b>						
Consumption of domestic pulp.....	171					
Consumption of pulp imported as raw material <sup>c</sup> .....	257					
To replace the raw material contained in imported paper.....	222					
<b>TOTAL CHEMICAL PULP FOR PAPER</b>	<b>650</b>	<b>238</b>	<b>412</b>	<b>600</b>	<b>923</b>	<b>1,375</b>
<b>Mechanical pulp:</b>						
Consumption of domestic pulp.....	117					
Consumption of imported pulp <sup>c</sup> .....	17					
To replace raw material contained in imported paper.....	330					
<b>TOTAL MECHANICAL PULP</b>	<b>464</b>	<b>242</b>	<b>222</b>	<b>467</b>	<b>730</b>	<b>1,091</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures based on data for 1950.

<sup>b</sup> Figures based on information gathered during 1952.

<sup>c</sup> Data obtained in the course of the study, supplemented by information from *Wood Pulp Statistics*, United States Pulp Producers Association, Inc., August 1951.

TABLE 5  
*Latin America: Quantity of wood required annually to satisfy the demand of the paper industry<sup>a</sup>*  
 (Thousands of metric tons annually)

	1952	1955	1960	1965
<i>For existing industry:</i>				
Chemical pulp.....	528	528	528	528
Mechanical pulp.....	269	269	269	269
<b>TOTAL</b>	<b>797</b>	<b>797</b>	<b>797</b>	<b>797</b>
<i>For the increases in capacity required to satisfy the domestic market:</i>				
Chemical pulp.....	941	1,332	2,049	3,053
Mechanical pulp.....	268	518	810	1,211
<b>TOTAL</b>	<b>1,209</b>	<b>1,850</b>	<b>2,859</b>	<b>4,264</b>
<b>GRAND TOTAL</b>	<b>2,006</b>	<b>2,647</b>	<b>3,656</b>	<b>5,061</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> This table is based on data for installed capacity and the capacity increases required to satisfy future domestic demand shown in table 4. The amounts of wood were calculated at the rate of 2.22 tons per ton of chemical pulp, and 1.11 tons per ton of mechanical pulp.



**TABLE 6**  
*Latin America: Potential of certain fibrous raw material sources*  
 Potentials which could be estimated numerically  
 (Thousands of metric tons of resources annually)

Country	Zone	Coni-ferous	Euca-lyptus	Hard-woods	Wheat straw	Bag-asse <sup>a</sup>	Sub-total	Total
Argentina:								1,932
	Misiones . . . . .	78	—	—	—	—	78	
	Wheat area . . . . .	—	—	—	1,786	—	1,786	
	Tucumán . . . . .	—	—	—	—	68	68	
Bolivia . . . . .		—	—	—	—	—	—	
Brazil:								1,706
	Amazonia . . . . .	—	—	67	—	—	67	
	São Paulo . . . . .	—	484	—	—	—	484	
	Paraná . . . . .	702	—	—	—	—	702	
	Santa Catarina . . . . .	306	—	—	—	—	306	
	Rio Grande do Sul . . . . .	147	—	—	—	—	147	
	Pernambuco . . . . .	—	—	—	—	—	—	
British Guiana . . . . .		—	—	—	—	—	—	
Chile:								2,821
	Concepción . . . . .	2,171 <sup>c</sup>	—	—	—	—	2,171	
	Valdivia . . . . .	—	—	650	—	—	650	
Colombia . . . . .		—	—	400	—	—	—	400
Costa Rica . . . . .		—	—	—	—	—	—	
Cuba:								448
	Camagüey . . . . .	—	—	—	—	80	80	
	Oriente . . . . .	—	—	—	—	75	75	
	Cienfuegos . . . . .	—	—	—	—	293	293 <sup>b</sup>	
Dominican Republic . . . . .		—	—	—	—	38	—	38
Ecuador . . . . .		—	—	400	—	—	—	400
El Salvador . . . . .		—	—	—	—	—	—	
French Guiana . . . . .		—	—	—	—	—	—	
Guatemala . . . . .		—	—	110	—	—	—	110
Haiti . . . . .		—	—	—	—	—	—	
Honduras . . . . .		—	—	—	—	—	—	
Mexico:								930
	Chihuahua . . . . .	160	—	—	—	—	160	
	Durango . . . . .	125	—	—	—	—	125	
	Michoacán . . . . .	120	—	—	—	—	120	
	Guerrero . . . . .	200	—	—	—	—	200	
	Yucatán . . . . .	—	—	325	—	—	325	
Nicaragua . . . . .		—	—	—	—	—	—	
Panama . . . . .		—	—	—	—	—	—	
Paraguay . . . . .		—	—	—	—	—	—	
Peru . . . . .		—	—	30	—	—	—	30
Surinam . . . . .		—	—	—	—	—	—	
Uruguay . . . . .		—	—	—	—	—	—	
Venezuela . . . . .		—	—	—	—	—	—	
	<b>TOTAL</b>	<b>4,009</b>	<b>484</b>	<b>1,982</b>	<b>1,786</b>	<b>554</b>		<b>8,815</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Only the fibre in cane bagasse.

<sup>b</sup> In this area only, total utilization of bagasse was considered for making chemical pulp.

<sup>c</sup> Estimated potential for 1965.

TABLE 6-A

*Latin America: Potential of certain fibrous raw material sources*  
 Other large potentials, the extent of which was not estimated

<i>Country</i>	<i>Zone</i>	<i>Coniferous</i>	<i>Hardwoods</i>
Argentina:	Misiones.....		Species found with pine
	Wheat area.....		
	Tucumán.....		
Bolivia.....			More than requirements
Brazil:	Amazonia.....		Practically unlimited
	São Paulo.....		
	Paraná.....	Other forests not considered	Species found with pine
	Santa Catarina.....	Other forests not considered	Species found with pine
	Río Grande do Sul.....	Other forests not considered	Species found with pine
	Pernambuco.....		
British Guiana.....			Extensive natural forests
Chile:	Concepción.....		Other rich natural forests
	Valdivia.....		
Colombia.....			Extensive forests in other zones
Costa Rica.....			Extensive natural forests
Cuba:	Camagüey.....		
	Oriente.....		
	Cienfuegos.....		
Dominican Republic.....			
Ecuador.....			
El Salvador.....			
French Guiana.....			Extensive natural forests
Guatemala.....		Very plentiful coniferous forests	Other extensive natural forests
Haiti.....			
Honduras.....		More than requirements	
Mexico		Forests in other states	
	Chihuahua.....	Other coniferous forests	
	Durango.....	Other coniferous forests	
	Michoacán.....		
	Yucatán.....		Other forests not considered natural forests
Nicaragua.....			
Panama.....			
Paraguay.....			Extensive natural forests
Peru.....			Species other than "cético"
Surinam.....			Extensive natural forests
Uruguay.....			
Venezuela.....			Extensive natural forests

TABLE 6-B

*Latin America: Potential of certain fibrous raw material sources*  
 Other large potentials, the extent of which was not estimated

Country	Zone	Non-forestry resources
Argentina:		Caña de Castilla and tacuara cane
	Misiones . . . . .	Straw from other cereals
	Wheat area . . . . .	
	Tucumán . . . . .	
Bolivia . . . . .		
Brazil:	Amazonia . . . . .	
	São Paulo . . . . .	Cane bagasse
	Paraná . . . . .	
	Santa Catarina . . . . .	
	Rio Grande do Sul . . . . .	
	Pernambuco . . . . .	Very plentiful bagasse
British Guiana . . . . .		
Chile:	Concepción . . . . .	
	Valdivia . . . . .	
Colombia . . . . .		Cane bagasse
Costa Rica . . . . .		Residues of abacá
Cuba:	Camagüey . . . . .	
	Oriente . . . . .	
	Cienfuegos . . . . .	
Dominican Republic . . . . .		
Ecuador . . . . .		
El Salvador . . . . .		
French Guiana . . . . .		
Guatemala . . . . .		
Haiti . . . . .		Cane bagasse
Honduras . . . . .		Canes and bamboos
Mexico:		Cane bagasse
	Chihuahua . . . . .	
	Durango . . . . .	
	Michoacán . . . . .	
	Yucatán . . . . .	
Nicaragua . . . . .		
Panama . . . . .		
Paraguay . . . . .		
Peru . . . . .		Cane bagasse
Surinam . . . . .		
Uruguay . . . . .		Wheat straw
Venezuela . . . . .		Cane bagasse

TABLE 7

*Latin America: Calculated potential of certain fibrous raw material sources compared with future requirements*

(Thousands of metric tons annually)

	1960	1965
Potential of some sources of raw material for pulp and paper <sup>a</sup> . . . . .	7,959	8,815
Equivalent in paper of average composition . . . . .	5,720	6,340
Consumption of paper in Latin America <sup>b</sup> . . . . .	2,629	3,637
Surplus in tons of paper of average composition . . . . .	3,091	2,703

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> See table 6.

<sup>b</sup> See table 3.

TABLE 8

List of Latin-American pulp and paper projects under construction or likely to be constructed during 1950-1960  
(Capacity in thousands of metric tons annually)

Country	Site	Capacity					Process <sup>a</sup>	Raw material for pulp	Remarks
		News-print	Other papers and boards	Mechanical pulp	Chemical pulp	Dissolving pulp			
Argentina	Zárate	50	—	44	—	—	1	Salicaceous species	20,000 tons constructed
	Puerto Piray	—	—	—	30	—	2	<i>Araucaria angustifolia</i>	Under construction
Brazil	Others	—	120	—	60	9	..	..	Argentine 5-year plan
	São Paulo	—	11	—	7	—	..	Bagasse	
	São Paulo	—	6	—	—	—			Extensions
	Paraná	—	22	—	—	—			Extensions
	São Paulo	—	—	—	114	—	..	Eucalyptus	Three projects
	São Paulo	97	—	—	—	—	..	<i>Araucaria angustifolia</i>	Two projects
Chile	Paraná	—	—	—	27	—	..	<i>Araucaria angustifolia</i>	
	São Paulo	—	—	—	—	15	..	Eucalyptus	
Colombia	Valdivia	—	5	—	—	—			Already built
	Concepción	44	11	40	50	6	1 + 2	<i>Pinus insignis</i>	
Costa Rica	Cali	—	24	—	—	—			Already built
	Cali	—	12	—	—	—			Extension
Cuba	Puerto Boyacá	20	—	20	—	—	..	Mixed tropical woods	
	Pacuare River	—	3	—	3	—	3	Abacá fibres	Already built
Dominican Republic	Not given	—	20	—	15	—	..	Bagasse	
Ecuador	Rio Haina	—	10	—	7	—	5	Bagasse	
	Latacunga	—	3	—	3	—	..	Agriculture residues	Already built
Mexico	Chihuahua	—	—	—	26	20	2	Conifers	Under construction
	Chihuahua	—	—	10	—	—	1	Conifers	
	Durango	—	—	60	—	—	1	Conifers	
	Michoacán	—	—	—	30	—	4	Conifers	
	Ayotla	—	—	—	9	—	5	Bagasse	Machinery purchased
	Mexico	—	—	—	12	—	4	Conifers	Extension project
Peru	Pucallpa	15	3	10	5	—	1 + 4	<i>Cecropia spp.</i>	
Venezuela	Not given	—	12	—	10	—	5	Bagasse	
TOTAL LATIN AMERICA		226	262	184	408	50			

Source: Economic Commission for Latin America and Food and Agriculture Organization.

\* 1. Mechanical process. 2. Sulphite process. 3. Soda process. 4. Sulphate process. 5. Caustic soda-chlorine process.

## Chapter II. ARGENTINA

### I. Summary and conclusions

This study may be considered as a preliminary statement of the factors involved in supplying Argentina's market for paper, chemical and mechanical pulp from domestic production. The figures used in comparing requirements and future possibilities presuppose a normal development of demand and must only be taken as a general indication, since there are many factors which may have an unpredictable influence on the future market.

Since it is but a general study, only those sources for raw materials which appear to be the most important have been taken into account, such as Misiones pine, salicaceous species from the Paraná delta, wheat straw and sugar-cane bagasse. But this does not imply that native hardwoods or Castilla cane should be overlooked, since their use might be justified, and recommended in later and more detailed studies.

The present per capita consumption of paper and paperboard in Argentina is more than 24 kilogrammes, representing a total consumption of 428,000 tons per year.<sup>1</sup> Although these figures are the highest for any Latin-American country, the paper industry occupies a less important place in relation to domestic demand in Argentina than in any of the other big consumers in the region—Brazil, Mexico or Chile. The installed capacity for paper production in Argentina might possibly meet 63 per cent of consumption, while the output of chemical pulp is less than 33 per cent of the industrial requirements and less than 22 per cent of the needs of the entire country if the pulp content of imported paper is taken into account. The present production capacity for mechanical pulp might meet the greater part of industrial demand in 1952, but only constitutes 23 per cent of total consumption including that which is imported in manufactured paper.

The dependence upon foreign sources for the supply of paper and fibrous raw material, together with the difficulties experienced in importing these items, has resulted in a very slow rate of increase in per capita consumption of paper during recent years. In the case of newsprint, which was all imported until 1951, there has been a notable decrease since 1938.

It has always been assumed that Argentina could not achieve any great expansion in paper production capacity because of the shortage of forest resources suitable for chemical and mechanical pulp. But, while it is true that the accessible wooded regions which could be utilized are small in relation to the volume of pulpwood required by the industry, the capacity for expansion must not be measured in terms of existing natural resources only. The possibilities for afforestation, close to the principal markets, must also be considered as a potential economic source of supply, as well as other fibrous products which can profitably be used in the production of pulp and paper.

<sup>1</sup> 1951 statistics.

The natural pine forests of the Misiones Territory, which are the most suitable for the paper industry and at the same time the most accessible for the market, can only supply 78,000 tons of pulpwood as against the present paper demand for 589,000, rising to 1,835,000 in 1965. Though prospects from natural forests are poor, there are considerable areas close to the paper-consuming centres of Argentina where forests of quick-growing indigenous and exotic trees could be planted and where rivers would considerably simplify the transport problem.

Typical of these areas is the Paraná delta, relatively near to Buenos Aires, where there are excellent river facilities for transporting pulpwood, other raw materials and finished products. The most serious problem is the draining of flooded areas, but this could be solved by the use of adequate mechanical equipment. By expanding existing salicaceous plantations (willow, poplar, hybrid poplars), this region alone could fully supply the mechanical pulp requirements of the Argentine market. The pulpwood yield per hectare is at least ten times greater than that of the Scandinavian countries; a low-cost raw material could thus be ensured even though considerable investment would be necessary for afforestation and the preparation of the land.

The Misiones Territory is another area suitable for development as a source of fibrous raw material. The natural forests there provide a starting point for the supply of pulpwood for chemical pulp, but more important is the possibility of their reafforestation with Misiones pine and of obtaining from this species a volume of wood per unit area almost as great as that which may be obtained from the Paraná delta. The Misiones Territory is more distant and less accessible from the large consuming centres, but communications, mainly by river, are good and there are better possibilities for the development of hydro-electric power than in almost any other part of Argentina.

The industrial development policy of the Argentine Government is at present encouraging private companies to undertake afforestation and to instal pulp and paper mills in these two areas. The outcome of this policy may be seen in thousands of hectares already planted, in innumerable requests for credit facilities for planting, and in the construction of a large pulp mill at Puerto Piray in the Misiones Territory.

It has been estimated that paper output needs to be increased by some 441,000 tons of paper<sup>2</sup> up to 1955, 719,000 up to 1960 and 1,103,000 up to 1965. Any industrial plan designed to meet this demand domestically must of necessity include the supply of mechanical pulp to meet expanding manufacturing requirements, in quantities varying from 271,000 tons per year in 1955 to 544,000 in 1965. Approximately

<sup>2</sup> All measurements of production capacity in this report which are expressed in tons must be considered as tons produced in one year.

234,000 tons of chemical pulp will be required annually by 1955, rising to 496,000 in 1965.

If it is assumed that existing plantations of salicaceous species in the Paraná delta are only sufficient to supply the established box and mechanical pulp industries, an adequate supply of mechanical pulp for any future development of capacity would not be available until 1963, that is to say in ten years, from a new afforestation programme commencing in 1953. In order to meet the development requirements of the domestic mechanical pulp industry, the reafforestation rate should be around 4,780 hectares per year, in 1953, increasing to more than 8,100 in 1965.

It may be assumed that a constant rate of cutting would commence in the natural pine forests of Misiones as from 1955, which would ensure the supply to industry of approximately 35,000 tons of chemical pulp per year for ten years. Beginning from 1963 the deficiency could be met by production from Misiones pine plantations which would have to commence in 1953<sup>8</sup> at a rate of 7,200 hectares per year. Thus, by 1965, reafforestation should have already risen to more than 13,000 hectares annually.

There are two important factors limiting the reafforestation rate of Misiones pine: the difficulty in obtaining seed, and the short time for which this seed retains its germinating power. One method for reducing the rate of planting pine would be a partial substitution by another raw material suitable for pulping, such as wheat straw, which is produced in large quantities in the provinces of Buenos Aires, Córdoba, Santa Fé and Entre Ríos. The potential output of straw in these four provinces could be sufficient to produce almost 700,000 tons of pulp per year, of which only a limited quantity could be absorbed by the Argentine market since it is not used in the manufacture of all types of paper. For this reason there might be some saving of Misiones pine and a reduction in the required reafforestation rate of this species to only 4,055 hectares per year in 1953 and something over 7,700 in 1965.

An improvement in the thermal efficiency of the generation and utilization of steam could produce an excess of bagasse in the Tucumán region, which, added to the use of straw, could increase chemical pulp production by 34,000 tons. The required reafforestation rate of Misiones pine could thus be reduced still further, to approximately 3,500 hectares per year in 1953 and over 7,100 in 1965.

The importance of the use of these alternative raw materials lies not only in the reduction of the rate at which it will be necessary to plant pine but also in the possibility for reducing considerably the imports of chemical pulp during the ten-year period before the new planted forests come into production.

Summarizing, Argentina is faced with the serious problem of supplying fibrous raw material to an industry which, if it is to meet the requirements of an important domestic market, must be considerably expanded. Unlike other countries, such as Chile and Mexico, regeneration cannot depend on natural reproduction, and the fibrous sources must be renewed through an increasing planting programme. Fortunately, the problem is eased because there are large areas where high plantation yield coincides with other essential factors of production and distribution. There

<sup>8</sup> See section III.

is also an excellent forest administration backed by satisfactory forest legislation.

As an important world producer of wheat, Argentina must also devote more attention to the expansion of pulp production from wheat straw, thereby reducing the reafforestation rate required for industrial development.

## II. Productive capacity and consumption

### A. PRODUCTIVE CAPACITY AND CONSUMPTION OF PAPER

According to statistics, Argentina consumed, in 1951, 428,000 tons of paper and paperboard and produced 231,000, that is, approximately 54 per cent of the total demand. Although in previous years there had been an intermittent production of small quantities of newsprint, it may be considered that the total requirement (109,000 tons) was imported up to 1951. At the beginning of 1952, a mill came into operation at Zárate, in the province of Buenos Aires, with an initial capacity of 20,000 tons of newsprint per year, to be increased later to 30,000.

The paper industry comprises fifty mills, mainly concentrated in the province of Buenos Aires, although there are also large mills in Santa Fé (see table 9). The annual productive capacity is estimated at 27,000 tons, the main difference between this and the 1951 volume being the inclusion of certain mills which were not then operating.

From table 6, annex I, it may be seen that the per capita consumption of paper, apart from newsprint, has shown a steady increase except during the war period, when dependence upon imported raw materials, cut off by the war, was responsible for a reduction. The per capita consumption of newsprint has declined considerably since 1938 (table 5, annex I), mainly due to the difficulties of obtaining imports; in recent years the shortage of foreign exchange in Argentina has also been a limiting factor.

Because of the depressed level of consumption in Argentina in 1950, the estimate of the future demand for newsprint has been based not on actual per capita consumption for this year, but on the projection of the rising trend for 1925-39 (see table 5 of annex II). The figures for future demand were calculated assuming various rates of increase of income per capita and some income-elasticity of consumption, determined through a correlation of consumption and income figures for thirty-one countries including all the Latin-American republics. The future demand for paperboard and papers other than newsprint was calculated in the same manner, in that basic data for 1950 was made to agree with the rising trend of consumption from 1935-50.

To simplify, in this part of the report only estimates based on a future rate of increase of income per capita of 3 per cent per year have been used (see table 10); this is slightly lower than the rate for Argentina in the period 1940-50. According to these estimates, if Argentina is to supply the domestic market for newsprint it will be necessary to increase capacity by 272,000 tons between now and 1955, increasing further to 383,000 tons in 1960 and 534,000 tons in 1965. For other types of papers and paperboard the increases should be 169,000 tons by 1955, 336,000 tons by 1960 and 569,000 by 1965 (see table 11). Under the second Argentine Five-Year Plan, it is proposed to increase the production of newsprint to 50,000 tons and to

add 120,000 tons to that of other papers and paper-board, between 1953 and 1957. As will be seen later in this report, the shortage of natural resources prevents the preparation of industrial development programmes which would allow the country to become self-sufficient in the near future.

#### B. PRODUCTIVE CAPACITY AND CONSUMPTION OF CHEMICAL PULP FOR PAPER

Argentina's annual consumption of chemical pulp for paper is approximately 133,000 tons, of which 34,000, or 25 per cent, are from domestic production.<sup>4</sup> If the amount of chemical pulp contained in imported paper is taken into account, then the total consumption is 196,000 tons per year, and on this basis domestic production only supplies 17 per cent.

To carry out an expansion programme of the paper industry sufficient to satisfy the domestic market completely, it would be necessary to increase chemical pulp production capacity from the present 43,000 tons per year to 234,000 in 1955, 343,000 in 1960 and 496,000 in 1965. The second Five-Year Plan includes projects for the addition of 100,000 tons to the production of chemical pulp for paper. It is proposed to continue increasing the capacity for the output of this raw material until such time as the country is self-sufficient. As will be explained later, great efforts must be made in Argentina if this self-sufficiency is to be attained, since the present forest resources are inadequate and the greater part of future industrial expansion must therefore be based on an increased rate of planting.

Argentina is the largest Latin-American producer of chemical pulp made from straw<sup>5</sup> and for more than twelve years has also been using bagasse. Experiments have been carried out in the mills, and there has even been some production using other raw materials such as Castilla cane (*Arundo donax*) bamboo, tacuara cane, picanilla cane, *insignis* pine, Misiones pine, eucalyptus and other broad-leaved indigenous species including timbó and curupí.<sup>6</sup>

Experiments have been carried out in the laboratories of the National Forest Administration (Administración Nacional de Bosques), and also in those of

<sup>4</sup> Argentine consumption of chemical pulp is made up approximately as follows:

	Tons	Percentage
Domestic chemical pulp made from straw . . .	24,000	18
Domestic chemical pulp made from bagasse	3,000	2
Other domestic chemical pulp . . . . .	7,000	5
Imported bleached chemical pulp . . . . .	27,000	20
Imported unbleached chemical pulp . . . . .	72,000	55
<b>TOTAL</b>	<b>133,000</b>	<b>100</b>

<sup>5</sup> Argentina produces 24,000 tons per year of straw pulp by the Pomilio process, although with slight local modifications to the equipment. Brazil, Chile, and Uruguay produce 2,500 tons, 6,000 tons and 6,000 tons respectively per year.

<sup>6</sup> The firm Celulosa Argentina S.A. has obtained the following results from some of these raw materials:

Raw materials	Strength (metres)	Industrial yield	
		Unbleached chemical pulp	Bleached chemical pulp
Cane bagasse . . . . .	7,600	58.1%	45.8%
Wheat straw . . . . .	7,700	49.8%	42.5%
Bamboo . . . . .	8,900	56.2%	48.1%
Picanilla cane . . . . .	8,000	55.5%	47.9%
Castilla cane . . . . .	7,500	51.0%	45.3%
Rye straw . . . . .	7,300	49.0%	42.0%
Misiones pine . . . . .	8,100	49.7%	44.6%

(Ing. Silvio Galiardi, "Bagazo y Papel en la Argentina", *La Nación*, 26 February 1952.)

one of the more important industrial concerns, to determine the paper-making characteristics of the majority of indigenous and some foreign species (see tables 13 and 14).

#### C. PRODUCTIVE CAPACITY AND CONSUMPTION OF MECHANICAL PULP

In 1951 Argentina's consumption of mechanical pulp was approximately 30,000 tons, of which it is estimated that only 7,000 were from domestic production. It is thought that this consumption was abnormally high, since the shortage of waste paper caused by the reduction of newspaper circulation and size compelled the manufacturers to import more mechanical pulp than they would normally have used. If the mechanical pulp contained in imported paper is also taken into account, 1951 consumption becomes 138,000 tons (see table 11).

The production capacity for mechanical pulp, including machinery producing newsprint which came into use at the beginning of 1952, is 31,000 tons per year, which might meet the present demand. But, if the home market is to be supplied entirely from domestic production, it will be necessary to increase the capacity to 271,000 tons in 1955, 337,000 in 1960 and 544,000 in 1965.

The greater part of the government project for the expansion of the paper industry consists of increases in the capacity for the production of mechanical pulp from the salicaceous plantations in the Paraná delta. Under the second Five-Year Plan the present 31,000 ton capacity will be increased by approximately 20,000 tons.

#### D. PRODUCTIVE CAPACITY AND CONSUMPTION OF DISSOLVING PULP

Argentina's requirements for dissolving pulp are almost 9,000 tons (see table 12), of which approximately 60 per cent is produced within the country by the conversion of cotton linters. There is no production from pulpwood, but there is a project for the installation, in the near future, of sufficient capacity to cover present domestic requirements. The supply of raw materials for this project will not present any problem, since there is an adequate production potential from eucalyptus wood, which is suitable for this type of pulp.

### III. Forest resources in Argentina for the future development of the paper industry

For some years Argentina has been attempting to solve the problem of the supply of fibrous raw materials for the present and future paper industry.<sup>7</sup> In 1948 Law No. 13.272 for the Conservation of the Forest Resources was passed, defining the official development policy. One immediate result, the formation of the National Forestry Administration, led to the adoption of a series of measures designed to make the best possible use of Argentina's forests, including a system of bank credits to encourage forest industries.

<sup>7</sup> Work on a co-ordinated solution of this problem began in 1943 with a study written by engineer Lucas A. Tortorelli, *Los Bosques Argentinos en la Industria del Papel de Diarios* ("Argentine Forests in the Newsprint Industry"), published by the University of Buenos Aires. The author, who is at present the National Forest Administrator (*Administrador Nacional de Bosques*), made an analysis of the problem and suggested a basis for planning the development of the paper industry.

Basic plans were later made for the supply of raw materials to the paper mills which the Argentine Government had decided to establish. As part of the government policy, Decree No. 8594 of 1949 called for public tenders for the erection or expansion of mills, with the following facilities: (a) foreign exchange permits for machinery and accessories; (b) duty-free import of this equipment, (c) priority in the allotment of quotas for fuel and power; (d) supply of raw materials at the lowest possible price; (e) facilities for the immigration of technicians and specialized workers, and (f) declaration that the industry would be considered to be in the national interest. As a result of this policy, a mill with an annual capacity for the production of 30,000 tons of sulphite pulp is being installed in Puerto Piray, Misiones Territory.

The technical problem of the supply of raw materials for the industry was first attacked by studying the paper-making characteristics of the more abundant indigenous species, such as Misiones pine, Neuquén pine and certain broad-leaved species, together with certain exotic species suitable for the manufacture of paper, such as poplar, willow, willow-poplar, eucalyptus and *insignis* pine. Later, afforestation experiments were carried out with these species to discover which would grow most rapidly in the various parts of Argentina, especially in those areas which, because of their transport facilities and proximity to the more important consuming centres, appeared to be most suitable as mill sites.

The general conclusions reached regarding the use of Argentine resources for the manufacture of paper and chemical pulp are as follows:<sup>8</sup>

(1) Of the eight indigenous conifers, only the Misiones pine (*Araucaria angustifolia*) and the Neuquén pine (*Araucaria araucana*) are important, these species have excellent paper-making characteristics (see table 13) and are found in relatively large quantities.

(2) The Neuquén pine, however, is found only in sites which are relatively distant and inaccessible (the Patagonian forests of the Neuquén territory) from the important paper-consuming centres; moreover, this high-quality wood is more important in the veneer and plywood industries which at the same time would give a better opportunity for reafforestation with trees which grow slowly in soil subject to erosion.

(3) Although the xylotechnological characteristics of Misiones pine are not quite as good as those of Neuquén pine, it is more accessible from the paper-consuming centres. It also grows more rapidly than Neuquén pine and would allow quicker reafforestation than the latter species.

(4) The salicaceous family, such as the willow-poplar, indigenous poplar, hybrid willow and hybrid poplar "A.M.", which grow quickly in the area of the Paraná delta, should be used for the production of mechanical pulp, not only because their paper-making characteristics are well adapted to this purpose (see table 13), but also because they could supply cheap raw materials close to the important consuming centres, with good river transport facilities.

<sup>8</sup> Lucas A. Tortorelli, *Op. cit.*, University of Buenos Aires, 1943. *Possibilities of Argentine Forests for the Production of Pulp and Paper*, a report presented by the National Forest Administration at the fourth session of the Latin-American Forestry Commission, Buenos Aires, 1952.

(5) It is possible that the hardwoods which grow intermingled with the Misiones pine would also provide a good source of raw material for the paper industry. Although some progress has been made in studies to this end (see table 14), occasional use having been made of these species in pulp production, more complete studies are required as to their use in the form of mixtures in the same proportion as the composition of the natural forest.

(6) Natural regeneration of Misiones pine also presents difficulties, mainly because of the small quantity and poor dispersal of the seed,<sup>9</sup> and also due to the competition of the hardwoods growing in the same forest, which are propagated by wind-borne seeds. Artificial regeneration is relatively simple, its only limitation on a large-scale being the shortage of seeds and the limited period for which these retain their germinating power.

(7) Misiones pine may be expected to give 230 cubic metres of pulpwood per hectare, in ten-year cycles, which gives a constant output of 23 cubic metres per hectare annually.

(8) Salicaceous species can produce 250 cubic metres of pulpwood in an eight-year to ten-year period, which gives a constant output of 25 cubic metres per hectare annually.

(9) Approximately 234 kilogrammes of chemical pulp could be manufactured from each cubic metre of Misiones pine, or 467 kilogrammes of mechanical pulp. The salicaceous species will give 405 kilogrammes of mechanical pulp per cubic metre of wood.

(10) The natural pine forests of the Misiones Territory contain approximately 3 million cubic metres of wood of which 1,500,000 cubic metres could be used for chemical pulp, leaving the remainder for other uses, principally the manufacture of veneers and plywood.<sup>10</sup> This quantity of available raw material would be sufficient to provide a constant supply for a chemical pulp mill with a capacity of 35,000 tons, always assuming that, at the same time as cutting was commenced, a planting programme was begun at the rate of 650 hectares per year.

<sup>9</sup> These are dioecious species and the proportion of seed-bearing trees is low. The seeds are extremely heavy and cannot be dispersed naturally far from the parent tree. Moreover, they are affected by the undergrowth and by the demand for them as food both for birds and human beings.

<sup>10</sup> The National Forest Administration states that "the present total of wood of *Araucaria angustifolia* contained in trees having a diameter not less than 0.20 metre has been calculated at 3 million cubic metres, of which 1,900,000 metres are in government-owned forests and 1,100,000 cubic metres are privately owned. Since it is estimated that four-fifths of the raw materials extracted will be used in the manufacture of paper, the remaining one-fifth may be used in the manufacture of plywood. Nevertheless, the quantities indicated above cannot be distributed accurately in this manner, because the Misiones pine in the Manuel Belgrano Government Colony, and also a part of that in private forests, is used exclusively to supply the plywood factories which have been operating for some considerable time in the Territorio Nacional de Misiones. Consequently, the volume of wood from Misiones pines available for the manufacture of chemical pulp is estimated at 1,900,000 cubic metres, of which 1,500,000 cubic metres are situated in the San Pedro Government Colony, and the remaining 400,000 cubic metres in privately owned forests. After deducting the one-fifth which will be used in the manufacture of plywood, approximately 1,500,000 cubic metres of Misiones pine remain, from which 340,000 tons of chemical pulp may be manufactured". (*Possibilities of Argentine Forests for the Production of Pulp and Paper*, a report presented by the National Forest Administration to the fourth session of the Latin-American Forestry Commission, Buenos Aires, 1952.)



(11) Existing salicaceous species, which cover an area of more than 60,000 hectares, can give an annual output of approximately 1,500,000 cubic metres of wood, which at present is almost entirely used for the manufacture of boxes. The large area available in the Paraná delta and the success of the government programme encouraging afforestation have ensured that the area planted can be considerably increased in the future to supply the requirements of the mechanical pulp industry.

#### IV. Domestic supply possibilities of fibrous raw material compared with future requirements of the chemical and mechanical pulp industries

The development of the paper industry, which has already been discussed in section III of this chapter, will require approximately 821,000 tons of pulpwood in 1955, 1,190,000 in 1960 and 1,705,000 in 1965 (see table 15), if it is intended that the entire Argentine industry is to be supplied exclusively from domestic raw materials. These figures are greater than the potential output of existing accessible resources since, as noted earlier, the natural forests of Misiones pine could only give 78,000 tons of wood per year (150,000 cubic metres), while the output of the artificial salicaceous forests is required, almost entirely, for the manufacture of boxes and to meet the needs of other manufacturing activities, including the present mechanical pulp industry. This disparity between existing accessible resources and the requirements of industrial development leads to the conclusion that Argentina must base future development programmes on an increased rate of planting. Even assuming that this is commenced on a large scale in 1953, the country could not become self-sufficient in these raw materials before 1963.

In the succeeding pages, the future requirements of the industry are discussed in terms of rates of planting; these are the terms to which any raw material supply programme must eventually be reduced. The argument is based on the use of salicaceous species for mechanical pulp and Misiones pine for chemical pulp, but the possibilities are also discussed of using wheat straw and cane bagasse in order to reduce the reforestation rate of Misiones pine, which, as may be seen later, would prove to be extremely high.

##### A. PRODUCTION OF CHEMICAL PULP

Table 16 compares the quantities of chemical pulp required by the expansion of the paper industry up to 1965 with the possibility of its production from natural forests and reforestation of Misiones pine. It has been assumed that a constant rate of cutting of the national forests would begin in 1955, and that in 1953 reforestation would commence which would, ten years later, meet the deficiency of raw material. The table shows that it would be necessary to continue importing chemical pulp in quantities varying between 196,000 tons in 1953 and 308,000 tons in 1960. To become self-sufficient, as from 1963, it would be necessary to plant Misiones pine at a rate rising from 7,200 hectares per year in 1953 to more than 13,000 hectares per year in 1965.<sup>11</sup>

<sup>11</sup> No attempt has been made to give paper consumption figures farther ahead than 1965, and for this reason it is not possible to estimate accurately reforestation rates subsequent to 1955.

Apart from the large volume of investment and the considerable effort necessary to carry out a reforestation programme at these rates, it is probable that the development of the programme would be limited by the difficulty of obtaining and sowing large quantities of seed during the short duration of its germinating power.

One means of reducing the reforestation rate of Misiones pine without affecting the development programme would be the pulping wheat straw, which is abundant in Argentina. It may be seen from table 17 that, if only 15 per cent of the wheat straw which is produced in the Provinces of Buenos Aires, Córdoba, Entre Ríos and Santa Fé were used, it would be possible to manufacture almost 714,000 tons of chemical pulp per year; this is more than the probable aggregate demand in Argentina in 1965. Unfortunately, chemical pulp produced from straw cannot be used alone in the manufacture of all the types of paper required by the Argentine market, and only a part of this potential could be used to meet domestic requirements. It has been estimated that the expansion of the paper industry could absorb quantities of straw chemical pulp varying between 94,000 tons per year in 1955 and 198,000 tons per year in 1965<sup>12</sup> (see table 18). If these production figures are actually achieved, the demand for chemical pulp made from Misiones pine would be considerably less, and the reforestation rate of this species could consequently be reduced to approximately 4,055 hectares per year in 1953 and something over 7,700 in 1965 (see table 19). It is possible that the production of straw chemical pulp may be considered less economical than that from pulpwood. Other arguments may be raised against this type of chemical pulp, such as the difficulty of collecting the straw and irregularities of the supply sources. But, in any case, the foregoing estimates show that there are great possibilities that wheat straw might help to solve the problem of the domestic supply of chemical pulp.

Cane bagasse might provide a third means for reducing the afforestation rate of Misiones pine. It is of less importance than straw, however, and its inaccessibility from the consumer centres also tends to make it of secondary importance. But perhaps the future decentralization of industry may permit the manufacture of products for consumption close to the bagasse-producing area, although distant from Buenos Aires and the other large paper-consuming centres.

In calculating the bagasse potential as a source of raw material for the production of pulp and paper (see table 20), figures have been given covering the possibility of employing a fuel other than the bagasse at present used in the sugar mills, and also for the alternative of producing chemical pulp only from the bagasse surplus after feeding the boilers of the mills under the best conditions of thermal efficiency in the production and use of steam. It is considered that only the latter possibility is practicable in Argentina for the time being, since the country is at present importing more than 60 per cent of the fuel oil and coal required to meet the more urgent needs of energy.

If all the plants were to achieve the highest possible thermal efficiency in their boilers and in their steam-using equipment, the potential domestic surplus of cane bagasse would be sufficient to manufacture 59,000 tons of chemical pulp per year. In this report,

<sup>12</sup> These are conservative estimates, assuming that the paper industry could use forty tons of straw chemical pulp to each sixty tons manufactured from other materials.

only the output of the mills for four districts of the Province of Tucumán has been considered; these are responsible for 60 per cent of the cane production. Given the conditions mentioned earlier, the surplus of bagasse from these four districts would be sufficient to produce 34,000 tons of chemical pulp per year (see table 20). This, together with the straw chemical pulp which the industry could absorb, would help to lower the reforestation rate of Misiones pine to approximately 3,500 hectares in 1953, and something over 7,100 hectares per year in 1965 (see table 21).

Even though Argentina should wish to commence, in 1955, to use all the surplus bagasse from the four Tucumán regions mentioned, and at the same time could increase production capacity of straw chemical pulp to the maximum required by industry, it would still be necessary to import chemical pulp at a rate rising from 71,000 tons in 1955 to 137,000 in 1960. After 1963 self-sufficiency for chemical pulp might be achieved, always assuming that the reforestation of Misiones pine proceeded at the rate previously indicated.

#### B. PRODUCTION OF MECHANICAL PULP

Table 22 compares the quantities of mechanical pulp which the expansion of the paper industry should require up to 1965 with the production possibilities, based on pulpwood from plantations of salicaceous species in the Paraná delta. It has been assumed that existing growth will meet the requirements of the present industry, both for mechanical pulp and the manufacture of boxes and other items, and that any future industrial expansion will have to be supplied with raw materials from afforestation begun in 1953.

Between 1953 and 1962 any fresh expansion of the paper industry will have to use imported mechanical pulp, or at least a mixture of this and waste paper, although it may also be possible to manufacture a small amount of pulp from the present wood surplus in box manufacture. The possibility of using certain hardwoods found in natural forests of Misiones pine has not been raised in this report, but it is feasible that these trees might provide a source of mechanical pulp, or a substitute such as semi-chemical pulp. The possibility of producing mechanical pulp from Misiones pine has not been discussed either, because this species would be reserved exclusively for the output of chemical pulp, which is required in greater quantities by Argentine industry.

If the expansion of the paper industry is to satisfy the domestic market completely, afforestation with salicaceous species for mechanical pulp will be necessary at a rate increasing from 4,780 hectares per year in 1953, to more than 8,100 in 1965.<sup>13</sup>

The area required, in order to attain a rate of planting of the order of those mentioned earlier, is less than that available in the Paraná delta (500,000 to 1,000,000 hectares), and it is thought that the measures taken by the Argentine Government to encourage afforestation in the delta may be sufficient to provide salicaceous planting rates capable of meeting the requirements of future expansion of the paper industry. Some indication of this may be seen from the fact that, since

<sup>13</sup> The possibility of reducing this rate of planting by a partial substitution of mechanical pulp by semi-processed straw pulp (unbleached or mechanical-chemical) in the manufacture of some types of paper and paperboard has not been taken into account. It is believed that this would not result in any appreciable reduction.

the passing of Law No. 13.273 (*Defensa de la Riqueza Forestal*), afforestation plans have already been approved to the extent of over 24,000 hectares and the Banco de la Nación Argentina has received credit applications amounting to more than 53 million Argentine pesos.

### V. Accessibility of resources and availability of other factors of production

#### A. MISIONES PINE REGION

The Misiones Territory lies in the extreme north-east of Argentina, on the borders of Paraguay and Brazil. Communication with Buenos Aires is by the Paraná river, which is navigable to Puerto Eva Perón (ex Iguazú), apart from two or three months in the year, when navigation becomes difficult, especially between Posadas and Corrientes. Between these two points (300 kilometres approximately) there is an unpaved road, as well as the General Urquiza railway from Posadas to Buenos Aires, running through the provinces of Entre Ríos and Corrientes.

On the Paraná river, there are the large towns of Corrientes, Paraná, Rosario and Santa Fé, and also Puerto Piray, where a large chemical pulp mill is already being established. This same river later reaches the delta—where the salicaceous plantations are found—and also touches Zárate, the site chosen for the production of mechanical pulp for newsprint.

Two main roads run the full length of the Misiones Territory; one of these (route No. 12) follows the Paraná river from Puerto Eva Perón to Posadas, passing through Puerto Piray. The other joins Puerto Eva Perón with Puerto Irigoyen (route No. 101) continuing to Posadas (route No. 14) and running through the central part of the territory, along the divide of the Sierra de Misiones.

Except for Tierra del Fuego, Misiones has the greatest hydro-electric potential per unit area (27 kilowatts per square kilometre)<sup>14</sup> of any region in Argentina. The most important hydro-electric resources within the territory are the waterfalls of Iguazú and Apipé, of which studies have been made for the supply of 163,800 and 176,225 kilowatts respectively.<sup>15</sup> In view of the location of these falls (Iguazú on the borders of Paraguay and Brazil; Apipé in the north of Corrientes Province), the use of the former may be considered for the northern area of Misiones, and of the latter for the south. Apart from these two potential sources of power, which, for various reasons, would take some considerable time to develop, there are several valleys in Misiones which have not yet been studied and which might probably provide hydro-electric power for future development of the paper industry in this region.

There are no fuel deposits in the Misiones Territory or in adjacent provinces, but it is possible to use waste wood from the forests, especially that from the broad-leaved species which are unsuitable for pulping. If chemical recovery systems are installed at the mills, fuel requirements will be less, since the whole of the thermal energy in the wood will be used.

<sup>14</sup> According to Adolf Niebuhr, quoted by another engineer, Pedro Brunengo, in his study *Energía Hidroeléctrica*, Argentina Committee of the World Power Conference, Buenos Aires, 1951.

<sup>15</sup> The studies of two engineers, Bamberale and Mermoz, quoted by Brunengo (*Energía Hidroeléctrica, op. cit.*), give such figures, although the engineers also state that the output of Iguazú and Apipé could be raised to 395,000 kilowatts respectively by the use of a greater volume of water.

There are many rivers in the Misiones Territory with a volume of water sufficient for pulp production, but, up to the present, it is not known if other raw materials essential for the chemical treatment of the wood, such as sodium sulphate, lime and sulphur, are available in this area.

Salt is plentiful in other parts of Argentina, such as the provinces of Eva Perón (ex La Pampa), San Luis, Córdoba and Buenos Aires. The Misiones mills will probably be supplied from Salinas Grandes, in Córdoba, or from Bahía Blanca, in Buenos Aires Province.

Elsewhere in Argentina there are excellent sources of supply of sodium sulphate, both pure and mixed with other salts. In the department of Lavalle, Mendoza, it is found 95.38 per cent pure,<sup>16</sup> and in Laguna Colorada Chica (Eva Perón) and in Lake Uyamampa (Santiago del Estero) is found mixed with other salts. Lime may be obtained from the south of the Province of Buenos Aires or near the capital of Córdoba, and there is also an abundant supply close to the capital of Mendoza.<sup>16</sup> Although some sulphur deposits are being worked in Argentina, at Socampa, Salta Province, on the Chilean border, the output is not as yet sufficient to satisfy the domestic market. Should mills be installed for production of sulphite pulp, the sulphur would probably have to be imported.

#### B. PARANÁ DELTA

An outstanding characteristic of the Paraná delta is the ease with which pulpwood can be extracted and transported by river to any point within the same region, as can finished products, also by river, to the federal capital (approximately 100 kilometres) or to the paper-making centres of the Santa Fé and Buenos Aires Provinces.

Water for manufacturing purposes is available in unlimited quantities from the Paraná river or from the branches of the delta, although it must be purified. It is not expected that hydro-electric power can be supplied to the delta in the near future, but it may be possible when use is eventually made of the Salto Grande of the Uruguay river. This will not be for some considerable time, but, when accomplished, it would

<sup>16</sup> Armour Research Foundation, *Technological and Economic Survey of Argentina Industries*, 1943.

be able to supply all the needs of future industrial development in this area.

#### C. STRAW-PRODUCING REGION

The wheat-growing area considered in this study is connected by rail and road with the Paraná river and the city of Buenos Aires. The gathering of the straw would be by the same mechanized process as is at present in use in Argentina.<sup>17</sup> Transport to the mills would be relatively simple, since the terrain is flat and roads can easily be constructed.

Electric power would have to be generated by oil-burning thermic plants. Salt would come from Salinas Grandes (Córdoba); sodium sulphate, from Lavalle (Mendoza) or from Uyamampa (Santiago del Estero), and the lime from the outskirts of the capital of Córdoba.

#### D. CANE BAGASSE REGION

Tucumán Province, which has been considered as the most probable location for future expansions of capacity for the manufacture of pulp from cane bagasse, is at a very considerable distance from the city of Buenos Aires (1,000 kilometres by road and 1,600 kilometres by rail) and also very distant from the other centres of pulp consumption, such as the mills situated on the banks of the Paraná. But, it is probable that Tucumán would find a market in the nearer provinces, which would be a move towards the decentralization of Argentina's pulp industry.

There is little hydro-electric potential in the area, but charcoal from the provinces of Chaco, Santiago del Estero and Salta could be used, and also petroleum from the last-mentioned district.<sup>18</sup>

It will, however, be necessary to undertake a careful study of the availability of water for manufacturing in those areas which are otherwise suitable for mills to ensure that the industry would be adequately supplied.

Salt may be obtained from Córdoba, and sodium sulphate from Santiago del Estero, while it is probable that sufficient sulphur would be available from Socampa, in Salta Province.

<sup>17</sup> Argentine industrialists have perfected machines which simultaneously cut, garner and bind the straw residue after harvesting.

<sup>18</sup> To the present output of Salta, the recently discovered deposits of Campo Durán will be added in the future.

TABLE 9

*Argentina: Geographic distribution and installed capacity of the pulp and paper<sup>a</sup> industry in 1951*

(Thousands of metric tons annually)

Province	Number of mills		Capacity of the paper industry		Capacity of the chemical pulp industry	Capacity of the mechanical pulp industry
	Paper	Chemical and mechanical pulp	Total capacity	Average capacity per mill		
Federal capital.....	8	1	25	3.1	} 7	31 <sup>b</sup>
Buenos Aires.....	26	2	180	6.9		
Córdoba.....	4	—	5	1.3	—	—
Santa Fé.....	8	8	50	6.3	33	—
Tucumán and Mendoza.	4	1	10	2.5	3	—
TOTAL	50	11	270	5.4	43	31

Source: The number of mills was taken from the *Censo Industrial* of 1946, to which was added a factory in Tucumán producing chemical pulp from cane bagasse. The total capacity for paper was estimated from production statistics. The capacity for chemical pulp was obtained from the Ministerio de Industria y Comercio de la Nación. The total capacity for mechanical pulp was obtained from a combination of data from the Ministerio de Industria y Comercio de la Nación and information from the industry itself. The breakdown of the total capacities was estimated from various sources.

<sup>a</sup>Includes paperboard.

<sup>b</sup>Includes mechanical pulp capacity used in newsprint production.

TABLE 10

*Argentina: Estimated future demand for paper, chemical pulp for paper and mechanical pulp*

(Thousands of metric tons annually)

		Per capita demand for paper (kg.)	Total demand for paper	Total demand for mechanical pulp <sup>c</sup>	Total demand for chemical pulp <sup>c</sup>
Newsprint.....	1950 <sup>a</sup>	5.92	101	93	13
	1951 <sup>a</sup>	6.18	109	100	14
	1955 <sup>b</sup>	15.34	292	269	38
	1960	18.97	403	371	52
	1965	23.46	554	510	72
Other papers and paperboards..	1950 <sup>a</sup>	17.85	305	24	174
	1951 <sup>a</sup>	18.08	319	38 <sup>d</sup>	182
	1955 <sup>b</sup>	21.99	419	33	239
	1960	27.61	586	47	334
	1965	34.65	819	65	467
TOTAL	1950 <sup>a</sup>	23.77	406	117	187
	1951 <sup>a</sup>	24.26	428	138	196
	1955 <sup>b</sup>	37.33	711	302	277
	1960	46.58	989	418	386
	1965	58.11	1,373	575	539

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup>The total and per capita demands for paper in 1950 were taken from tables 4, 5 and 6 of annex I; those for 1951 came from the *Síntesis Estadística Mensual de la República Argentina*, May 1952.

<sup>b</sup>The estimates of demand for 1955, 1960 and 1965 were made by relating the world per capita consumption of paper to per capita income and by assuming various rates of annual increase of per capita income in Argentina. The complete procedure and the results may be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup>In calculating the total demand for mechanical and chemical pulp the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947.

Mechanical pulp: Newsprint x 0.92      Chemical pulp: Newsprint x 0.13  
 Other papers x 0.09                      Other papers x 0.68  
 Paperboard x 0.07                        Paperboard x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Argentine consumption.

Mechanical pulp: Other papers and paperboard x 0.08  
 Chemical pulp: Other papers and paperboard x 0.57

<sup>d</sup>The theoretical figure is 25,000 tons per year, which differs from the true amount because abnormally large quantities of mechanical pulp were imported, due to the shortage of waste paper, caused in turn by the reduction of the number of copies and the number of pages of the newspapers.

TABLE 11  
*Argentina: Expansion needs of the pulp and paper industry*  
 (Thousands of metric tons per year)

	Present demand <sup>a</sup>	Installed capacity <sup>b</sup>	Expansion required now	Expansion needed in the future		
				Total up to 1955	Total up to 1960	Total up to 1965
<b>Newsprint:</b>						
Domestic.....	—					
Imported.....	109					
TOTAL NEWSPRINT	<u>109</u>	<u>20</u>	<u>89</u>	<u>272</u>	<u>393</u>	<u>534</u>
<b>Other papers and paperboard:</b>						
Domestic.....	231					
Imported.....	88					
TOTAL OF OTHER PAPERS AND PAPERBOARD	<u>319</u>	<u>250</u>	<u>69</u>	<u>169</u>	<u>336</u>	<u>569</u>
TOTAL OF PAPER AND PAPERBOARD	<u>428</u>	<u>270</u>	<u>158</u>	<u>441</u>	<u>719</u>	<u>1,103</u>
<b>Chemical pulp:</b>						
Consumption of national chemical pulp.....	34					
Consumption of chemical pulp imported as raw material.....	99 <sup>c</sup>					
To replace raw material contained in imported paper.....	63					
TOTAL CHEMICAL PULP FOR PAPER	<u>196</u>	<u>43</u>	<u>153</u>	<u>234</u>	<u>343</u>	<u>496</u>
<b>Mechanical pulp:</b>						
Consumption of national mechanical pulp.....	7					
Consumption of mechanical pulp imported as raw material.....	23					
To replace raw material contained in imported paper.....	108					
TOTAL MECHANICAL PULP	<u>138</u>	<u>31</u>	<u>107</u>	<u>271</u>	<u>387</u>	<u>544</u>

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures based on statistics for 1951.

<sup>b</sup> Figures taken from table 9.

<sup>c</sup> It was estimated that imports in 1951 (128,747 tons) were greater than true consumption, and therefore an average was taken of 1950-1951.

TABLE 12

*Argentina: Apparent consumption of rayon and acetate, and its equivalent in filament and dissolving pulp*  
(Metric tons annually)

Year	Output			Imports			Exports			Equivalent in dissolving pulp <sup>a</sup>				Equivalent of the total expressed in filament <sup>b</sup>	
	Filament	Yarn	Fabric	Manu- factured goods	Yarn	Fabric	Manu- factured goods	Output	Imports	Exports	Total	Per capita (grammes)	Total		
1931.....	—	1,074	138	522	—	—	—	—	1,975	—	1,975	161	1,896		
1932.....	—	1,472	132	474	—	—	—	—	2,347	—	2,347	188	2,253		
1933.....	—	2,285	114	528	—	—	—	—	3,284	—	3,284	258	3,153		
1934.....	—	3,569	93	510	—	—	—	—	4,650	—	4,650	359	4,464		
1935.....	—	3,443	106	446	—	—	—	—	4,450	—	4,450	337	4,272		
1936.....	204	4,649	110	342	—	—	—	213	5,653	—	5,866	435	5,631		
1937.....	839	5,234	132	371	7.1	0.5	0.8	874	6,357	9	7,222	524	6,933		
1938.....	1,225	2,239	140	381	10.1	—	—	1,276	3,087	11	4,352	309	4,187		
1939.....	2,631	2,368	131	253	11.5	0.2	0.2	2,740	3,061	13	5,788	404	5,556		
1940.....	2,694	1,575	96	132	58.6	0.4	1.5	2,806	2,001	67	4,740	324	4,551		
1941.....	3,445	1,113	52	74	71.1	3.6	12.9	3,589	1,372	98	4,863	326	4,669		
1942.....	3,781	1,334	124	57	25.0	49.7	68.0	3,938	1,678	168	5,448	359	5,231		
1943.....	3,218	398	62	27	—	118.6	323.9	3,352	543	531	3,363	218	3,228		
1944.....	3,894	20	64	13	—	10.5	60.2	4,056	111	86	4,081	260	3,918		
1945.....	4,329	49	155	12	—	7.9	5.6	4,510	248	16	4,742	296	4,552		
1946.....	4,565	936	415	31	—	39.3	5.7	4,755	1,543	52	6,246	383	5,996		
1947.....	4,883	283	1,683	101	—	7.1	2.6	5,087	2,368	11	7,444	448	7,146		
1948.....	4,708	1,573	977	37	—	5.1	—	4,904	2,896	6	7,794	460	7,483		
1949.....	6,718	5,049	77	—	—	—	—	6,998	5,637	—	12,635	727	12,130		
1950.....	7,972	124	363	—	—	—	—	8,304	553	—	8,857	497	8,502		

Sources: Imports and exports: *Anuarios Estadísticos de la República—Comercio Exterior* (Foreign Trade Annuals). Output: *Statistical Yearbook*, United Nations, 1951; *World Fibre Survey*, Food and Agriculture Organization, 1947; *Wood Pulp Statistics*, United States Pulp Producers Association, Inc., 1951.

<sup>a</sup> In order to obtain the equivalents in dissolving pulp, the quantities of filament, fibre, yarn, etc., were multiplied by the following factors: filament, 1.04; fibre, 1.05; yarn, 1.10; fabric, 1.15; manufactured goods, 1.22.

<sup>b</sup> The total equivalent of chemical pulp was converted into filament by multiplying by 0.96.

TABLE 13

## Argentina: Average dimensions of tracheids and fibres of pulping species

Common name	Scientific name	Length (mm.)	Width (microns)	Ratio of length to width
NATIVE CONIFERS				
Pino de Misiones.....	<i>Araucaria angustifolia</i>	3-4.5	35	107
Araucaria de Neuquén.....	<i>Araucaria araucana</i>	3-4.5	20-25	170
Alerce.....	<i>Fitzroya cupressoides</i>	3	25	120
Ciprés.....	<i>Libocedrus chilensis</i>	3	20	150
Ciprés.....	<i>Pilgerodendron wuiferum</i>	2.5-3.5	20	150
Mañiu.....	<i>Saxegothaea conspicua</i>	2.5	25	100
Pino tucumano-salteño <sup>a</sup> .....	<i>Podocarpus parlatorei</i>	2.5	20	120
Mañiu.....	<i>Podocarpus nubigenus</i>	2-3	20	120
Lleuque.....	<i>Podocarpus andinus</i>	2-3	20	120
FOREIGN CONIFERS				
European spruce.....	<i>Picea excelsa</i>	3-4.5	20	185
Canadian spruce.....	<i>Picea glauca</i>	3.5	25	160
Bidwillii pine.....	<i>Araucaria bidwillii</i>	3	30	100
Silver spruce.....	<i>Abies pectinata</i>	3	25	120
Insignis pine.....	<i>Pinus radiata</i>	2.5-3	25-30	100
NATIVE HARDWOODS				
Sauce criollo.....	<i>Salix humboldtiana</i>	1-1.6	25	52
Iba-poy.....	<i>Ficus monckii</i>	0.8-1	30	30
Laurel blanco.....	<i>Nectandra angustifolia</i>	0.9-1.1	25	40
Ceibo.....	<i>Erythrina cristagalli</i>	0.8-1	30	40
Rabo macaco.....	<i>Lonchocarpus albiflorus</i>	0.7	30	23
Tipa blanca.....	<i>Tipuana tipu</i>	0.7-0.9	35	23
Aliso del río.....	<i>Tessaria integrifolia</i>	0.5-0.9	30	25
FOREIGN HARDWOODS				
Willow-poplar <sup>a</sup> .....	<i>Salix alba, var. caerulea</i>	0.9-1.1	25	40
Italian poplar <sup>a</sup> .....	<i>Populus nigra, var. italica</i>	0.9-1.1	25	40
Carolina poplar <sup>a</sup> .....	<i>Populus carolinensis</i>	1-1.2	25	55
Canadian poplar.....	<i>Populus canadensis</i>	0.9-1.1	25	40
White eucalyptus.....	<i>Eucalyptus alba</i>	0.8-1	20	45
Saligna eucalyptus.....	<i>Eucalyptus saligna</i>	0.9-1.1	20	50
Brachichiton poplar.....	<i>Brachychiton populneum</i>	1.5-1.7	30	53
Castor-oil palm.....	<i>Ricinus communis</i>	0.4-0.6	30	17
Laurel laurifolia.....	<i>Populus sp.</i>	0.6-0.9	35	21
Hybrid willow.....		1	25	40
Hybrid poplar (A. Mussolini) <sup>a</sup> .....	<i>Populus nigra var. stela x Populus canadensis</i>	0.7-0.9	25	32

Source: Lucas A. Tortorelli, *Los Bosques Argentinos en la Industria de Papel de Diarios*, Instituto de Fruticultura y Silvicultura, University of Buenos Aires, 1943.

<sup>a</sup> Species most used for mechanical pulp.

TABLE 14

## Argentina: Chemical analysis of certain native woods

(Percentage based on oven-dry wood)

Species	Ash	Solubility in alcohol benzene	Cellulose	Lignin	Pentosans	Solubility in water
Pino de Misiones ( <i>Araucaria angustifolia</i> ).....	0.65	2.06	50.45	27.50	11.40	2.10
Canela guaica ( <i>Helietta</i> ).....	0.40	4.60	..	18.55	21.40	4.69
Fumo bravo ( <i>Solanum auriculatum</i> ).....	1.01	1.23	52.31	27.02	17.08	2.56
Perdiguero bravo ( <i>Prunus subcoriacea</i> ).....	0.35	..	51.40	..	19.26	11.93
Trementina ( <i>Schinus polygamus</i> ).....	1.84	11.05	47.29	17.28	..	7.31
Laurel amarillo ( <i>Nectandra lanceolata</i> ).....	0.35	3.20	54.78	28.55	17.96	2.75
Laurel negro ( <i>Nectandra saligna</i> ).....	1.14	2.85	54.18	27.45	19.18	3.26
Winal ( <i>Prosopis ruscifolia</i> ).....	2.62	4.10	47.46	25.50	16.75	6.45
Quebracho blanco ( <i>Aspidosperma q. blanco</i> ).....	1.20	..	41.47	..	13.60	4.02
Espina corona ( <i>Gleditschia amorphoides</i> ).....	1.32	..	53.03	..	21.80	8.03
Lapacho amarillo ( <i>Tecoma achracea</i> ).....	0.76	..	40.35	..	15.87	15.02
Lapacho negro ( <i>Tecoma ipe</i> ).....	0.70	4.85	50.43	25.10	18.72	5.20
Guayaibí ( <i>Patagonula americana</i> ).....	1.35	9.16	49.13	21.35	19.74	19.09
Carne de vaca ( <i>Styrax leprosum</i> ).....	1.18	0.96	52.61	27.62	18.92	2.36
Coihue ( <i>Nothofagus dombeyi</i> ).....	0.22	8.48	45.21	24.34	16.02	3.63
Rauli ( <i>Nothofagus nervosa</i> ).....	0.43	4.44	47.66	26.32	16.88	2.10
Anchico colorado ( <i>Piptadenia rigida</i> ).....	1.08	10.09	41.09	27.75	15.80	20.94
Cebil colorado ( <i>Piptadenia macrocarpa</i> ).....	1.35	6.39	44.36	20.20	19.40	15.39
Cebil moro ( <i>Piptadenia aff macrocarpa</i> ).....	3.45	6.86	38.60	24.22	20.14	22.83

Source: Data supplied in June 1952 by the Administración Nacional de Bosques del Ministerio de Agricultura y Ganadería de la República Argentina. (National Forest Administration of the Ministry of Agriculture and Livestock of the Argentine Republic.)

TABLE 15

*Argentina: Quantity of wood required annually to satisfy the demands of the paper industry<sup>a</sup>*

(Thousands of metric tons annually)

	1951	1955	1960	1965
<i>For the existing industry:</i>				
For chemical pulp . . . . .	96	96	96	96
For mechanical pulp . . . . .	34	34	34	34
TOTAL	130	130	130	130
<i>For the increase of capacity required to satisfy the domestic market:</i>				
For chemical pulp . . . . .	340	520	760	1,100
For mechanical pulp . . . . .	119	301	430	605
TOTAL	459	821	1,190	1,705
GRAND TOTAL	589	951	1,320	1,835

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> This table is based on data of installed capacity and necessary increases in capacity which appear in table 11. The quantities of wood were calculated on the basis of 2.22 tons of wood per ton of chemical pulp and 1.11 tons per ton of mechanical pulp.

TABLE 16

*Argentina: Determination of the afforestation rate necessary to supply future expansion of capacity of chemical pulp, assuming the sole utilization of Misiones pine*

	1953	1955	1958	1960	1963	1965
<i>Average expansion needs of the industry</i> (in thousands of tons of chemical pulp per year) <sup>a</sup> . . . . .	196	234	296	343	421	496
<i>Sources of supply</i> (in thousands of tons of chemical pulp per year):						
Natural forests <sup>b</sup> . . . . .	—	35	35	35	35	35
Afforestation with Misiones pine . . . . .	—	—	—	—	386	461
Imports of paper or chemical pulp . . . . .	196	199	261	308	—	—
<i>Afforestation rate necessary</i> (in hectares per year):						
To replace natural forests <sup>c</sup> . . . . .	—	650	650	650	650	650
For additional afforestation with Misiones pine <sup>c</sup> . . . . .	7,200	8,600	More than 9,400 <sup>d</sup>	More than 10,500 <sup>d</sup>	More than 11,700 <sup>d</sup>	More than 12,400 <sup>d</sup>
TOTAL AFFORESTATION RATE . . . . .	7,200	9,250	More than 10,000	More than 11,100	More than 12,300	More than 13,000

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures from table 11, interpolated for 1953, 1958 and 1963.

<sup>b</sup> The National Forest Administration estimates that 1,500,000 cubic metres of Misiones pine are available for the manufacture of paper, which, if used up in a period of ten years would yield 150,000 cubic metres of wood per year, equivalent to 78,000 tons of wood (specific weight=0.52) or 35,000 tons of chemical pulp for paper manufacture (conversion yield=0.45).

<sup>c</sup> According to data obtained from the National Forest Administration, one hectare of Misiones pine can yield 230 cubic metres of wood in ten years, equivalent to 120 tons (specific weight=0.52) or 53.8 tons of chemical pulp (conversion yield=0.45).

<sup>d</sup> No attempt has been made to give paper consumption figures beyond 1965, and for this reason it is impossible to accurately estimate afforestation rates after 1955.



TABLE 17

*Argentina: Calculated potential of wheat straw as raw material for pulp in the Provinces of Buenos Aires, Córdoba, Entre Ríos and Santa Fé*

(Thousands of metric tons annually)

Province	Production of wheat 1949-50 (a)	Equivalent in straw (b = 2.33 a)	Straw available for chemical pulp (c = 0.15 b)	Chemical pulp (d = 0.40 c)
Buenos Aires .....	1,894	4,413	664	265
Córdoba .....	1,740	4,054	607	243
Entre Ríos .....	174	404	61	24
Santa Fé .....	1,301	3,030	454	182
TOTAL	5,109	11,904	1,786	714

Source: Economic Commission for Latin America and Food and Agriculture Organization.

Note: The production of wheat from the 1949-1950 harvest was taken from *Síntesis Estadística Mensual de la República Argentina*, February 1951.

TABLE 18

*Argentina: Total potential of wheat straw as a raw material for pulp, and amount which could be absorbed by the future expansion of the industry*

(Thousands of metric tons annually)

Year	Potential of the provinces of Buenos Aires, Córdoba, Entre Ríos and Santa Fé <sup>a</sup>	Amount which could be absorbed by a future expansion of the paper industry <sup>b</sup>
1955 .....	714	94
1958 .....	714	118
1960 .....	714	137
1963 .....	714	168
1965 .....	714	198

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> See calculation in table 17.

<sup>b</sup> Because of limitations on the use of straw pulp in the production of certain types of paper, it has been assumed that future expansion of the paper industry will only be able to absorb 40 tons of straw pulp for each 60 tons of other types.

TABLE 19

Argentina: Determination of the afforestation rate necessary to supply future expansion of capacity of chemical pulp, assuming the utilization of both Misiones pine and wheat straw as raw material

	1953	1955	1958	1960	1963	1965
Average expansion needs of the industry (in thousands of tons of chemical pulp per year) <sup>a</sup> .....	196	234	296	343	421	496
Sources of supply (in thousands of tons of chemical pulp per year):						
Natural forests <sup>b</sup> .....	—	35	35	35	35	35
Wheat straw <sup>c</sup> .....	—	94	118	137	168	198
Afforestation of Misiones pine.....	—	—	—	—	218	263
Imports of paper or chemical pulp.....	196	105	143	171	—	—
Afforestation rate necessary (in hectares per year):						
To replace natural forests <sup>d</sup> .....	—	650	650	650	650	650
For additional afforestation of Misiones pine <sup>d</sup> ...	4,055	4,890	More than 5,400 <sup>e</sup>	More than 6,000 <sup>e</sup>	More than 6,700 <sup>e</sup>	More than 7,100 <sup>e</sup>
TOTAL AFFORESTATION RATE	4,055	5,540	More than 6,000	More than 6,600	More than 7,300	More than 7,700

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures from table 11 interpolated for 1953, 1958 and 1963.

<sup>b</sup> The National Forest Administration estimates that 1,500,000 cubic metres of Misiones pine are available for manufacture of paper, which, if used up in a period of ten years, would give 150,000 cubic metres of wood per year, equivalent to 78,000 tons (specific weight=0.52) or 35,000 tons of chemical pulp for paper manufacture (conversion yield=0.45).

<sup>c</sup> See tables 17 and 18.

<sup>d</sup> According to data obtained from the National Forest Administration, one hectare of Misiones pine could yield 230 cubic metres of wood in ten years, equivalent to 120 tons (specific weight=0.52) or 53.8 tons of chemical pulp (conversion yield=0.45).

<sup>e</sup> No attempt has been made to give paper consumption figures beyond 1965, and for this reason it is impossible to estimate afforestation rates after 1955 accurately.

TABLE 20

Argentina: Calculated potential of sugar-cane bagasse as raw material for chemical pulp

(Thousands of metric tons)

	Number of sugar mills	Ground cane (a)	Wet bagasse (b=0.25a)	Dry bagasse (c=0.50b)	Usable fibre (e=0.65c)	Chemical pulp	
						If an alternative fuel is used for the boilers (f=0.50e)	If only the surplus bagasse is used for chemical pulp (g=0.20f)
<b>NATIONAL POTENTIAL</b>							
<i>Provinces:</i>							
Tucumán.....	27	4,980	1,245	623	405	203	41
Salta.....	2	527	132	66	43	21	4
Jujuy.....	4	1,328	332	166	108	54	11
Santa Fé.....	3	235	59	29	19	10	2
Chaco.....	1	145	36	18	11	5	1
NATIONAL TOTAL	37	7,215	1,804	902	586	293	59
<b>POTENTIAL OF THE FOUR DISTRICTS OF TUCUMÁN</b>							
<i>Districts:</i>							
Cruz Alta.....	8	1,575	394	197	128	64	13
Famailla.....	5	1,271	318	159	103	51	10
Monteros.....	5	712	178	89	58	29	6
Río Chico.....	4	666	166	83	54	27	5
TOTAL	22	4,224	1,056	528	343	171	34

Source: Economic Commission for Latin America and Food and Agriculture Organization.

Notes: The number of sugar mills and the amounts of ground cane were taken from the 1950 statistics published by the Centro Azucarero Argentino in its monthly publication, *La Industria Azucarera*, January 1951.

It was estimated that dry bagasse contains 65 per cent fibre, 25 per cent pith and 10 per cent dirt and material soluble in water. Although some methods of conversion include both bagasse and pith, the general opinion is that better results may be obtained by eliminating a large proportion of the pith.

TABLE 21

Argentina: Determination of the afforestation rate necessary to supply future increases of capacity of chemical pulp, assuming the utilization of Misiones pine, wheat straw and cane bagasse as raw material

	1953	1955	1958	1960	1963	1965
Average expansion needs of the industry (in thousands of tons of chemical pulp per year) <sup>a</sup> . . . . .	196	234	296	343	421	496
Sources of supply (in thousands of tons of chemical pulp per year):						
Natural forests <sup>b</sup> . . . . .	—	35	35	35	35	35
Wheat straw <sup>c</sup> . . . . .	—	94	118	137	168	198
Cane bagasse <sup>d</sup> . . . . .	—	34	34	34	34	34
Afforestation of Misiones pine . . . . .	—	—	—	—	184	229
Imports of paper and chemical pulp . . . . .	196	71	109	137	—	—
Afforestation rate necessary (in hectares per year):						
To replace natural forests <sup>e</sup> . . . . .	—	650	650	650	650	650
For additional afforestation of Misiones pine <sup>e</sup> . . . . .	3,500	4,500	More than 5,000 <sup>f</sup>	More than 5,500 <sup>f</sup>	More than 6,000 <sup>f</sup>	More than 6,500 <sup>f</sup>
TOTAL AFFORESTATION RATE	3,500	5,150	More than 5,600	More than 6,100	More than 6,600	More than 7,100

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures from table 11 interpolated for 1953, 1958 and 1963.

<sup>b</sup> The National Forest Administration of the Ministry of Agriculture and Livestock estimates that 1,500,000 cubic metres of Misiones pine are available for the manufacture of paper, which, if used up in a period of ten years, would yield 150,000 cubic metres of wood per year, equivalent to 78,000 tons of wood (specific weight=0.52) or 35,000 tons of chemical pulp for paper manufacture (conversion yield=0.45).

<sup>c</sup> See tables 17 and 18.

<sup>d</sup> See table 20.

<sup>e</sup> According to data obtained from the National Forest Administration of the Ministry of Agriculture and Livestock, one hectare of Misiones pine could yield 230 cubic metres of wood in ten years, equivalent to 120 tons (specific weight=0.52) or 53.8 tons of chemical pulp (conversion yield=0.45).

<sup>f</sup> No attempt has been made to give paper consumption figures beyond 1965, and for this reason it is impossible to estimate afforestation rates after 1955 accurately.

TABLE 22

Argentina: Determination of the afforestation rate for salicaceous species (poplar and willow) required to supply future expansions in the capacity to produce mechanical pulp

	1953	1955	1958	1960	1963	1965
Average expansion needs of the industry (in thousands of tons of mechanical pulp per year) <sup>a</sup> . . . . .	213	271	336	387	478	544
Source of supply (in thousands of tons of mechanical pulp per year):						
Afforestation of salicaceous <sup>b</sup> . . . . .	—	—	—	—	478	544
Imports of paper and mechanical pulp . . . . .	213	271	336	387	—	—
Afforestation rate necessary (in hectares per year): <sup>c</sup> . . . . .	4,780	5,440	More than 6,200 <sup>d</sup>	More than 6,700 <sup>d</sup>	More than 7,500 <sup>d</sup>	More than 8,100 <sup>d</sup>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures from table 11 interpolated for 1953, 1958 and 1963.

<sup>b</sup> Although over 60,000 hectares are already planted, with a production potential of approximately 1,500,000 cubic metres of wood, the greater part of this output is at present used for the manufacture of boxes. It has been assumed that any excess is used in the existing mechanical pulp industry, and that future increases in mechanical pulp capacity will, as from 1963, be supplied from new afforestation commenced in 1953.

<sup>c</sup> In accordance with information received from the National Forest Administration of the Ministry of Agriculture and Livestock, the afforestation rate was calculated on the assumption that the yield per hectare in ten years is 250 cubic metres of wood, giving 0.4 ton of mechanical pulp per cubic metre (specific weight=0.45, conversion yield=0.90).

<sup>d</sup> No attempt has been made to give paper consumption figures beyond 1965, and for this reason it is impossible to accurately estimate afforestation rates after 1955.

## Chapter III. BRAZIL

### I. Summary and conclusions

The main purpose of this chapter is to estimate the development that would be required in Brazil's paper industry to satisfy future demand and to compare the corresponding raw material needs with the available natural resources. The figures shown in these pages merely indicate the scale of the problem, since the vast extent of Brazil's territory and the complexity of its natural resources make it impossible to obtain more precise data within the short time available to complete this preliminary report.

Domestic paper production covers 40 per cent of the 92,000 tons of newsprint consumed annually in the country and almost 100 per cent of the 226,000-ton consumption of other types of paper and paperboard.

If Brazil wishes to cover its domestic consumption of newsprint, it will have to install a manufacturing capacity of about 88,000 tons<sup>1</sup> between the present date and 1955, 133,000 tons prior to 1960 and 192,000 tons by 1965. Projected extensions would add 97,000 tons of newsprint production to the industry's annual capacity. If carried out, domestic production in 1955 will meet the domestic demand for this product; there may even be a small exportable surplus.

Installations for other types of paper and paperboard will also be required, amounting to 82,000 tons by 1955, 199,000 tons by 1960 and 361,000 tons by 1965. Current development plans envisage only 48,000 tons annually, indicating a deficiency of 34,000 tons by 1955.

Brazilian production of chemical pulp for paper covers approximately 52 per cent of the demand in the existing paper industry and 47 per cent of the 155,000 annual tons consumed, including that imported in the form of manufactured paper. In drawing up a programme to meet Brazil's future domestic demand for chemical pulp for paper, it would be necessary to allow for capacity increases amounting to some 142,000 tons annually by 1955, 223,000 by 1960 and 334,000 by 1965. If existing plans are carried into effect, so that within a short period a capacity of 150,000 tons is installed, it is likely that in 1955 Brazil will have a small exportable surplus of this type of pulp.

Brazil's capacity to produce mechanical pulp exceeds the current requirements of the paper industry and, in fact, supplies 92 per cent of total consumption of mechanical pulp, including that contained in imported paper. However, a substantial part of the mechanical pulp industry is made up of very small units which, owing to their small size, their dispersal on the high southern plateau and the difficulty of obtaining adequate energy and transport facilities, cannot produce economically except when conditions on the market are particularly favourable. Even regarding all existing nominal capacities as effective, Brazil would still have to add a further 17,000 tons

by 1955, 69,000 tons by 1960 and 138,000 tons by 1965, in order to satisfy domestic needs.

The dissolving-pulp industry manufactures approximately one-third of the 18,000 tons represented by rayon and acetate textile products consumed in Brazil. If it is assumed that consumption will continue to rise at the same rate as in the past, Brazil will have to increase its installed capacity to reach a level of 14,000 tons annually by 1955, 19,000 tons by 1960 and 33,000 tons by 1965. Since industrial requirements for this type of pulp are small, and taking into consideration that at least one serious project has already been put forward for the installation of a mill with a productive capacity of 27,000 tons annually, this branch of industry presents few problems.

Brazil's forest resources are more than adequate to supply the country with pulp and paper, whether in the short term or the long term.

For short-term development the most promising resources are eucalyptus in São Paulo and Paraná pine in the high southern plateau.

Taken as a whole, the three eucalyptus zones of São Paulo, which have been selected as probably offering the best locations for the industry—referred to in this report as "Rio Claro", "Vale do Paraíba" and the "Zona Norte"—could meet capacity increments amounting to 250,000 tons of pulp for paper, 360,000 tons of semi-chemical pulp or 180,000 tons of dissolving pulp for acetate and rayon, even if only 30 per cent of the sustained forest yield were employed. From the standpoint of accessibility, the São Paulo eucalyptus is the best of Brazil's forest resources, since it is located near the largest markets and ports, and is linked to them by first-class highways and railways. However, this source is inadequate to supply the volume of consumption which Brazil is likely to reach within the next five to ten years. Moreover, it cannot meet all the market's requirements since its use is still limited to only some products. It is not suited for the manufacture of newsprint or strong wrapping and packing papers. The most important problem in connection with São Paulo's woodpulp production is the present shortage of cheap electric power. However, as indicated elsewhere in this report, this might become available within the course of the next few years if certain electrification projects planned by the State Government are carried out.

Paraná pine, obtained from natural forests considered in this report as probably being good locations for the industry, i.e., in Paraná, Santa Catarina and Rio Grande do Sul, could meet an expansion of productive capacity of around 520,000 tons of chemical pulp for paper, or a combination of 260,000 tons of chemical pulp and 520,000 tons of mechanical pulp, although the pulp producers would employ only 25 per cent of the existing resources. These vast potentials alone could satisfy expanding industry up to 1965 and even allow a surplus of 120,000 tons of chemical pulp annually for export. However, it should be emphasized

<sup>1</sup> In this report all the measurements of productive capacity, expressed merely as tons, are tons of annual production.

that the maintenance of these reserves on a sustained-yield basis would require reforestation programmes amounting to about 11,000 hectares annually.

The Paraná pine resources are not as accessible as the eucalyptus of São Paulo, since the main stands are located in outlying regions where there are few or only poor communications with ports and potential markets. Because of the topographical features of Brazil's southern high plateau, rivers flow away from the sea, and sharp escarpments hamper the building of roads and highways. As a raw material, Paraná pine has the advantage of providing chemical and mechanical pulp which may be used almost universally, that is to say, it can be used in the manufacture of most types of paper and paperboard required by the market, particularly newsprint and strong kraft wrapping paper. This advantage, in addition to the substantial volume of wood available and the privileged location of the main pine areas as regards potential sources of fuel and electric power, somewhat offsets the difficulties of accessibility. The pine region thus becomes one of the foremost fibrous resources over the short-term and long-term period, not only in Brazil, but in Latin America as a whole.

A further reason for the need to formulate projects for a greater use of Paraná pine is the urgency for protecting existing forests against irrational exploitation. Experience has shown that the establishment of large mills, which would be required if the pine from regions of limited accessibility were used, ensures the protection of these resources, since the companies themselves are concerned to carry out reforestation programmes at the same time as they are felling.

In comparing the pine resources of the three southern States, from the standpoint of the existing volume of wood, the most important is Paraná, although its development involves greater problems of accessibility. In Rio Grande do Sul there are fewer resources but they are considerably easier to reach from Pôrto Alegre—a good market and a large port. Lastly, Santa Catarina is in an intermediary position between the two, both as regards resources and accessibility. Paraná might perhaps require the establishment of large mills to compensate the difficulties of accessibility by the advantages of large scale production. On the other hand, the projects for Santa Catarina and Rio Grande do Sul would have to be comparatively smaller.

A third resource, which might be considered in the short term, is the sugar-cane bagasse from the State of São Paulo. It may become extremely important in Brazil, because it is accessible to the leading ports and markets and used for a number of different types of paper. As a raw material it requires little man-power and equipment for collection and transport.

As regards the long-term utilization of existing resources, the Amazon basin undoubtedly offers unlimited possibilities. Three types of utilization have been considered, namely, soft woods of one or several species in the low flooded areas near the Amazon river and its tributaries, from Santarem toward the Bolivian and Colombian frontiers; the heterogeneous forests located near important potential sources of electric power such as the Tapajoz, Xingu and Tocantins rivers; and lastly, the heterogeneous forests in the Amapá Territory.

The first area mentioned is probably the least to be recommended, since it would be only used for the manufacture of pulp and paper. These products have too low an economic value to counterbalance high

operating and financial costs, in competition with those manufactured in areas close to ports and markets. The utilization of heterogeneous forests near substantial sources of electric power undoubtedly seems a wiser solution, provided that the manufacture of pulp and paper is considered as part of an integrated forest industry, including the lumbering of valuable timber for export purposes, the manufacture of plywood and veneers and, probably, chemical wood processing other than the manufacture of pulp.

The best solution for early adoption is the utilization of heterogeneous species from the Amapá Territory, not only owing to their proximity to the sea, but also to the fact that this region is already undergoing an intense process of economic development. In view of the existence of manganese mines and projects to work iron ore, this territory enjoys various means of transport, its population is growing at an increasing rate, and plans have been made for the immediate utilization of several sources of hydro-electric power near the highways. The Amazon region must be included among the feasible sources of pulp and paper on long term, though more accessible regions are more important in the short term. This region, or at least the Amapá Territory, should be included among the projects for immediate study since it is very probable that it could offer excellent raw materials to manufacture almost every type of paper required by the market. The French Government has already successfully treated tropical African species which resemble those of Brazil. Before undertaking any industrial project for the Amazon district, however, it would be necessary to carry out a series of experiments with the wood from this region. To this end, it is recommended that a pilot mill be installed at some suitable site in the valley. It would also be necessary to carry out surveys to determine the best locations for pulp and paper mills. Furthermore, it would be necessary to study the composition of the forests, the quantity of wood available and the possible uses, other than for pulping, of each species.

The utilization of the fibrous residues of the sugar industry of north-eastern Brazil, in combination with the vast hydro-electric potential of Paulo Afonso, would be of even greater importance than the utilization of bagasse from the São Paulo area. Nevertheless, in contrast with the latter, Paulo Afonso has been included among the long-term resources, owing to its distance from domestic consumer centres.

Other important resources, which could be used within either shorter or longer periods, are the pine plantations which are at present being developed in some parts of the southern plateau of Brazil, for the exclusive use of the paper industry. The Klabin plantations at Monte Alegre alone could be used in the future to produce about 94,000 tons of chemical pulp annually, or 187,000 tons of mechanical pulp.

A comparison of available resources with raw-material requirements shows that, even in 1965, Brazil could, subject to capacity being developed, meet its domestic demand for pulp and paper and even be able to export about 370,000 tons of woodpulp annually, using only two of the resources considered as accessible in the short-term period. These are the main pine forest stands of the southern plateau,<sup>2</sup> and the euca-

<sup>2</sup> It is assumed that the utilization of these resources would be effected on a sustained-yield basis. In the case of pine trees, a reforestation of about 11,000 hectares annually would have to be maintained.

lyptus of São Paulo. This is without counting the utilization of sugar-cane bagasse, of additional forest plantations and of the resources of the Amazon basin.

## II. Productive capacity and consumption

### A. PRODUCTIVE CAPACITY AND CONSUMPTION OF PAPER

Brazil's annual paper consumption is about 320,000 tons, one-third of which consists of newsprint (see table 18 and 24 of annex I). The installed capacity for paper (266,000 tons<sup>3</sup>) consists of sixty-one mills. Output supplies only 40 per cent of newsprint consumption but, broadly speaking, is adequate at the present time to provide the country with all the remaining paper and cardboard it requires, with the exception of small amounts of special papers which must be imported (see table 23).

With the exception of three mills in São Paulo and one in Paraná, the rest of the industry is made up of small-size units which are generally located near consumer centres and somewhat distant from the forest resources which provide the fibrous raw material. Their concentration in the larger cities is due not only to the attraction of the market but also to the convenience of being near the ports where the imported raw materials, which were formerly consumed in substantial quantities, arrived.

Table 7 of annex II contains various estimates of Brazil's paper consumption for the years 1955, 1960 and 1965. To simplify this part of the report, the only figures taken from table 7 are averages representing an annual rate of per capita income expansion of 3 per cent (table 24), although it is believed that actual future consumption will be closer to the maximum rather than the minimum figures shown.

According to the data contained in table 25, based on average future consumption estimates, it is believed that Brazil's current capacity to manufacture newsprint will have to be increased now by 56,000 tons and that the future expansion should be of the order of 88,000 tons by 1955, 133,000 tons by 1960 and 192,000 by 1965. Although production and consumption of cardboard and paper are today almost equal, further increases in productive capacity would be required, amounting to 82,000 tons by 1955, 199,000 by 1960 and 361,000 by 1965. These figures give some idea of the effort which Brazil must make if it is to cover its future domestic needs; they also indicate, as will be seen later, the need for measures to utilize natural resources in a manner which will ensure a constant or rising level of output without exhausting the forest capital.

There are three serious projects to install new paper mills in São Paulo, with capacities of 10,500 tons of fine-quality bagasse paper and 30,000 and 67,000 tons of newsprint. By the end of 1952, one mill already established in São Paulo will have increased its production of fine-quality paper by 6,000 tons. In 1953, it is expected that another mill in Paraná will add 18,000 to 27,000 tons to its cardboard production capacity. If these plans are actually carried out, Brazil should have an exportable surplus of newsprint by 1955, but it will have to add about 36,000 tons capacity to meet consumption in 1960 and 95,000 tons to meet demand in 1965. Existing projects for other types

<sup>3</sup> All measurements of productive capacity, expressed in tons in this report, should be considered as annual production tonnages.

of paper and cardboard exceed current requirements, but there would nevertheless be a deficit of 39,000 tons in 1955, 156,000 in 1960 and 318,000 tons in 1965. These figures indicate that, over the long term, the promotion of new projects for newsprint manufacture is less important than plans for manufacturing other types of paper.

### B. PRODUCTIVE CAPACITY AND CONSUMPTION OF CHEMICAL PULP FOR PAPER

Brazil consumes approximately 160,000 tons of pulp annually, of which 47 per cent is manufactured in fifteen domestic mills and 44 per cent is imported in the form of raw materials. The remainder is made up of the pulp content in imported paper (see table 25). To satisfy all domestic needs in accordance with the estimates for future paper consumption, installed capacity would have to reach a total of 147,000 tons by 1955; by 1960 it would need to be raised to 223,000 tons, and by 1965 to 334,000 tons. Fortunately, as may be seen below, Brazil's natural resources are more than adequate to supply the fibrous raw material required if they are employed rationally. At the present time, there are at least five definite projects for building new pulp mills, the total capacity of which will be about 142,000 tons annually.<sup>4</sup> Three of these projects will be integrated with new paper mills. In addition, a mill already established in Paraná proposes to extend its productive capacity in order to manufacture 8,000 tons of semi-chemical pulp. If all these plans are actually carried out, Brazil will be able to meet its woodpulp requirements by 1955, but new projects will be required in the future, involving 73,000 tons for 1960 and 184,000 tons for 1965.

### C. PRODUCTIVE CAPACITY AND CONSUMPTION OF MECHANICAL PULP

It is difficult to estimate Brazilian consumption of mechanical pulp with any degree of accuracy, principally because no production data are available from the paper mills manufacturing this product for their own consumption. In addition, consumption in many small units is not recorded statistically. It may nevertheless be estimated that Brazil consumes about 136,000 tons of mechanical pulp annually, 59 per cent of which is produced in eighty-three mills (tables 23 and 25), and the remainder consists of the amount contained in imported paper. The estimated productive capacity is believed to be 125,000 tons, which would appear excessive as compared with the amount consumed by the domestic paper industry (80,000 tons annually). However, the full installed capacity for the production of mechanical pulp cannot be accepted as an indication of the importance of this branch of the industry, since, in the southern part of the country, there are numerous small mills each producing about 750 tons annually. Because of their small size, their dispersal on the southern plateau and the considerable transport difficulties involved, they are not always in a position to place their products at the paper mills requiring them, and therefore remain idle for considerable periods.

No programmes have been drawn up for the installation of mills for the exclusive production of mechanical pulp, since this type of process would be integrated in paper factories requiring such product, that is those

<sup>4</sup> 7,500 tons using sugar-cane bagasse; 15,000, 33,000 and 60,000 tons respectively using eucalyptus, and 27,000 tons using Paraná pine.

using Paraná pine as a raw material. Hence, there are no promotion problems in connection with mechanical pulp alone, but it would be difficult to reorganize the current structure of a non-integrated industry, which, as was stated earlier, is overburdened with problems and constantly undergoing crises.

#### D. PRODUCTIVE CAPACITY AND CONSUMPTION OF DISSOLVING PULP

Brazilian demand for dissolving pulp for the manufacture of rayon and acetate may be estimated at 18,200 tons annually, 33 per cent of which is supplied by raw materials which the artificial fibre factories prepare from cotton linters within their own manufacturing processes. Imports supply 61 per cent of raw material and the remainder consists of pulp contained in manufactured rayon and acetate textiles. (See table 26.) Up to the present, no mill in Brazil has produced dissolving woodpulp, and of the four artificial fibre mills already established, two are using imported pulp alone while the remaining two also employ linters.

If demand for dissolving pulp continues to expand at the same rate as during the past few years, Brazil will have to install a productive capacity of about 14,000 tons between now and 1955, a further 19,000 tons by 1960 and 23,000 tons by 1965,<sup>5</sup> in order to meet domestic demand for this raw material. There appears to be nothing to prevent the development of this capacity since mills could be established in the vicinity of the city of São Paulo, with eucalyptus as their raw material. At present, there is a project to install a mill with an annual productive capacity of 15,000 tons; another project envisages the production of about 12,000 tons of dissolving pulp instead of paper pulp, if the market is favourable. Since the total capacity implied in these projects will exceed the country's requirements, even in 1965, there is at present no question of further developments in this branch of the industry.

### III. Development possibilities in the Paraná pine region

#### A. GENERAL INFORMATION ON PARANÁ PINE

Paraná pine, or *Araucaria angustifolia* (Bert.) O. Kuntze, is found in the region extending from the Serra da Mantiqueira, in the southern part of the State of Minas Gerais, to the mountainous zone of north-eastern Rio Grande do Sul and the Argentine Territory of Misiones. It is particularly abundant in Brazil only in the high plateau areas of the States of Paraná, Santa Catarina and Rio Grande do Sul.<sup>6</sup>

This conifer is indigenous to this region. Fully grown, it averages 20 to 25 metres in height (maximum about 50 metres) and has an average diameter

<sup>5</sup> These figures are based simply on projections of the trend of growth of apparent consumption.

<sup>6</sup> Paraná pine grows between altitudes of 500 to 1,100 metres above sea level. According to Beneval de Oliveira's work, "As regiões de ocorrência normal de araucária" ("Regions of normal habitat of the Araucaria"), *Anuário Brasileiro de Economia Florestal, 1948*, this pine requires a mesothermal climate. It predominates principally where temperature averages between 20° C. and 21° C. in the summer and 10° C. and 11° C. in the winter. It develops best in regions where the rainfall is evenly distributed throughout the year. Pedological research has thus far shown that this pine prefers highly acid soils with a pH of less than 6. Deep silica clay soil offers the best conditions for its development, but this soil must be hygroscopic and more or less porous.

of 50 to 90 centimetres (maximum about 2 metres). The trunk is erect and the corymbiform boughs make the tree top resemble a parasol. The wood is white and yellowish, becoming slightly pink after felling and exposure to the weather. However, when the pine is used for manufacturing mechanical pulp, which requires white wood,<sup>7</sup> the heartwood of fully grown trees must be hacked away, since it is too dark.

Paraná pine is found in dense forest stands which are more or less homogeneous, but appears also in scattered thin forests, generally pure. In the dense forests it is found as the predominant tree, surrounded by palms, lianas, ferns, bamboos and broad-leaved trees, among which are some of considerable commercial value such as imbuia (*Phoebe porosa*), the peroba rosa (*Aspidosperma polyneuron*), red cedar (*Cedrela fissilis*) and laurel (*Cordia*). In some places, maté (*Ilex paraguariensis*) is also found in the forests. The Klabin mill uses as fuel the broad-leaved species of little commercial value, which occur in araucaria forests and has done considerable research with the aim of using them in paper production. Generally speaking, it has been found that any species with a specific weight of less than 0.70 can easily be converted into woodpulp.

In dense virgin forests, there are about fifty Paraná pines per hectare, of which some thirty have sufficient diameter (more than 45 centimetres) to be used in the saw mills. Generally, one Paraná pine from the virgin Brazilian forests supplies 2 cubic metres of sawn logs, plus ½ cubic metre<sup>8</sup> of pulpwood, or 2½ cubic metres of pulpwood. Of these 2½ cubic metres, only 50 per cent can be used for mechanical pulp and the rest for chemical pulp.

The Paraná pine plantations have been very successful in those regions of Brazil's southern plateau which many years ago were covered by forest of this species.<sup>9</sup> The National Pine Institute of Brazil has four experimental plantations;<sup>10</sup> the firms Indústrias Klabin do Paraná de Celulose S.A., Gordinho Braune and Melhoramentos de São Paulo have large plantations which, within a few years, should become permanent sources of raw material. Other industries and private individuals have likewise sown pine as an investment for the future.

The yield from the older pine plantations, in which the trees are generally spaced fairly far from one

<sup>7</sup> The Indústrias Klabin do Paraná de Celulose S.A. make current use of the lighter part of the wood (about 50 per cent) for the manufacture of groundwood, and employ the darker part in the production of sulphite pulp for paper. According to the experts of this company, trees grown on plantations have no dark heartwood, at least not before the age attained at present.

<sup>8</sup> One cubic metre of Paraná pine is equivalent to approximately 1.43 steres or cubic metres of piled roundwood.

<sup>9</sup> Natural reafforestation with pine is deficient and cannot be relied on as a permanent source of wood supply. The principal causes for this deficiency are the shortage of seeds (the pine is a dioecious species with a low proportion of feminine plants), the high level of consumption of humans and birds, and the competition of the undergrowth. The pine trees produce very few seeds which, in view of their weight, cannot be propagated far from the tree producing them (they are planted, so to speak, by the parakeets, which bury a certain amount of seeds in order to store them for food). On the other hand, most of the surrounding species produce large quantities of anemophilous seeds which can be easily propagated.

<sup>10</sup> One in Minas Gerais (Mantiqueira), one in the State of São Paulo (Itanguá), two in Paraná (Romário Martins y Manoel E. da Silva), one in Santa Catarina (J. Fiuza Ramos) and three in Rio Grande do Sul (J. F. Assis Brasil, Eurico Gaspar Dutra y Passo Fundo). Altogether, about 70 million pines have been planted.

another, is generally 7 to 14 cubic metres per hectare per annum, depending on the class of forest.<sup>11</sup> (See table 27.) Experiments which were successfully carried out on the Klabin plantations, with initial spacings of 1.20 metres by 0.80 metres (10,000 seeds per hectare), lead to the assumption that, in future, average yields of about 13 cubic metres per hectare per annum can be obtained.<sup>12</sup> In the Misiones Territory of Argentina, where the *Araucaria angustifolia* is found, it is expected to attain a total of 230 cubic metres per hectare in ten years, that is, an average annual yield of 23 cubic metres per hectare.<sup>13</sup> For purposes of estimating the rate of planting Brazilian areas, an average yield of 12 cubic metres per hectare was assumed, with seventeen-year rotations.

According to the preceding figures, the growth in the Paraná pine plantations should be 4.5 to 7.5 times greater than in the Swedish forests,<sup>14</sup> thus offering a great economic advantage for the southern high plateau of Brazil, which would probably counteract other relative disadvantages (referred to below) arising from inaccessibility.

The specific weight of air-dried Paraná pine is 0.52 (10 per cent moisture; green-wood volume). The average length of the fibres is 4 millimetres and the diameter is 35 microns. Experiments at the Klabin mill<sup>15</sup> indicate that the fibres, though longer than those of some European conifers, are stiffer and of darker colour. When higher strength is attained, the colour and the surface of the paper products are of a lower quality.

The average yields which may be expected from the *Araucaria angustifolia* when it is converted into pulp are as follows:<sup>16</sup> mechanical pulp, 90 per cent; semi-chemical pulp, 75 per cent; chemical pulp for paper, 50 per cent.

In studying the Paraná pine area with a view to the development of domestic pulp and paper industry, only the States of Paraná, Santa Catarina and Rio Grande do Sul were taken into account, because they contain the largest pine reserves, although there are also possibilities in São Paulo and Minas Gerais, particularly as regards future plantations. Attention has been centred on the utilization of the araucaria in view of the great existing volume of this species and its good paper-making qualities. It is suggested that any studies following this preliminary survey should also examine the possibilities of the broad-leaved species which are encountered in the Paraná pine forests. Many of them are burned at present or used as firewood; others have great value for purposes other than the production of woodpulp, and their utilization, integrated to pulpwood extraction, would tend to reduce total manufacturing costs.

<sup>11</sup> I. Kissin: "Crescimento e Produção do Pinheiro Brasileiro", *Anuário Brasileiro de Economia Florestal*, year 3, N° 3, 1950.

<sup>12</sup> Zygmunt Wieliczka: "Compasso, Qualidade e Rendimento das Plantações da Araucária Brasileira", *Comemorações da Festa da Arvore*, Curitiba, 1951.

<sup>13</sup> *Posibilidades de los bosques argentinos para la producción de pulpa y papel* ("Possibilities for the production of pulp and paper from Argentine forests"), report presented by the National Forest Administration of the Ministry of Agriculture and Livestock of the Argentine Republic at the fourth meeting of the Latin-American Forestry Commission, Buenos Aires, 1952.

<sup>14</sup> Th. Streyffert, in his book *The Forests of Sweden*, states that the annual growth of the forests of northern Sweden is 1.58 cubic metres per hectare; that of the central and southern regions is 2.82 cubic metres per hectare.

<sup>15</sup> Information supplied by Dr. L. Rys, General Manager of Indústrias Klabin do Paraná de Celulose S.A.

## B. UTILIZATION OF THE NATURAL FORESTS OF THE STATE OF PARANÁ

The State of Paraná has the largest natural reserves of *Araucaria angustifolia*<sup>17</sup> despite the intensive consumption of this raw material over a period of many years. Unfortunately, the utilization of the most important forests, that is, those in the zone comprising the municipalities<sup>18</sup> of Laranjeiras do Sul, Guarapuava and Clevelândia, in the south-west of the State, is hampered by the great distance which separates that zone from the sea and the main paper markets and also by the characteristic topography of the Paraná plateau, which hinders transport from the interior to the coast. In fact, travelling through the State from east to west, that is from Paranaguá, which would be the normal port for pulp products and the gateway for certain raw materials and fuels, one encounters a series of rising steps corresponding to the coastal plain and then the plateaux of Curitiba, Campos Gerais and Guarapuava. These, by reason of their geological formation,<sup>19</sup> begin with fairly steep escarpments, followed by plains which slope down towards the interior. Hence, although some rivers are born near the coast, most of them flow in the opposite direction. This, together with the fact that the principal rivers are often broken by rapids and waterfalls, prevents the inland waterway system from providing a natural means of transport for lumber and pulp products towards Brazilian ports.

The topography of the escarpments presents difficulties for overland transport, particularly in the Serra do Mar, which separates the coastal plain from the Curitiba plateau and where the difference in level between the very low gorges and the plateau is about 900 metres. The plateaux, on the other hand, generally consist of rolling lands, where the majority of the main rivers form valleys which tend to converge towards Curitiba, the capital of the State, near the port of Paranaguá. These two features favour the building of communication links between the sea and the pine forests of Laranjeiras, Clevelândia and Guarapuava, and moreover partly counterbalance the transport difficulties occurring on the steep slopes between the plateaux.

However, the most important problem in connection with the accessibility of the pine forests is their distance from the sea and from the principal paper markets. If the choice of a possible area for a mill were to fall on the triangle Cascavel-Laranjeiras-Clevelândia, the distance to the sea at Paranaguá would be 600 kilometres and the distance to the market of São Paulo would be more than 1,200 kilometres.

Despite this remoteness, it is considered that the pine forests of the State of Paraná, particularly those in the area formed by Laranjeiras, Clevelândia and Mangueirinha, are among the sources of raw materials

<sup>16</sup> Average figures of the Klabin mill.

<sup>17</sup> According to the inventory of araucaria carried out by the Instituto Nacional do Pinho in 1949-50, in Paraná there are, in round figures, 151 million trees of less than 40 centimetres in diameter and 60 million trees of more than 40 centimetres. Santa Catarina has 38 million trees of 20 to 40 centimetres in diameter and 34 million of more than 40 centimetres. In Rio Grande do Sul there are 5 million trees with a diameter of 20 to 40 centimetres and 10 million with more than 40 centimetres.

<sup>18</sup> Municipalities correspond approximately to counties.

<sup>19</sup> The soil on the coastal plain is quaternary, while that of the high plateaux of Curitiba, Campos Gerais and Guarapuava is primitive, primary and secondary, respectively.



which deserve the utmost attention in view of their short-term development potentialities. The following reasons justify this choice:

(a) Although there is an abundance of natural resources for woodpulp production in South America, only the Paraná pine and the *Pinus insignis* of Chile can be considered as outstanding sources of the type of pulp required for certain grades of papers characterized by mechanical strength.<sup>20</sup> In other words, although many South American countries could cover their demand for other types of pulp, they would still offer good market possibilities for the conifer pulp, which only Chile and Brazil can produce in sufficient quantities to allow for an exportable surplus. Brazil itself, even producing eucalyptus pulp and manufacturing pulp from its tropical and semi-tropical broad-leaved species, would probably still require pine woodpulp for mixtures to produce highly resistant types of paper. It is likewise difficult to obtain mechanical pulp from the majority of the broad-leaved species or eucalyptus (with the exception of certain varieties such as *Eucalyptus regnans*, *E. gigantea* and *E. obliqua*). Consequently, regions with conifers have a further advantage, since they are better able to undertake economic production of some papers, such as newsprint, which require substantial proportions of groundwood.

(b) The trees in the area comprising Laranjeiras do Sul, Clevelândia and Mangueirinha<sup>21</sup> could be used as a basis for an annual production of up to 316,000 tons of chemical pulp for paper, or a combination of 158,000 tons of chemical and 316,000 tons of mechanical pulp, even assuming that 75 per cent of the existing wood is used for purposes other than the manufacture of pulp and paper, and assuming likewise that to ensure a sustained-yield of the raw material, the best land in the zone is replanted at the rate of 6,600 hectares annually, solely for the paper industry.

(c) There do not appear to be any estimates regarding the cost of extracting the pulpwood, but it is not believed to be very high, owing to the high density of trees per hectare and the slight inclination of the slopes.

(d) The water required for manufacture and for the removal of the waste can certainly be obtained from the Iguaçu, or perhaps from some of its tributaries which have not yet been studied.

(e) Thus far there has been no utilization of electric power, but it should be noted that within the zone there are at least four large waterfalls (Faradaí with 27,500 kilowatts, Caxias with 21,000 kilowatts, Ozorio with 66,000 kilowatts and Santiago with 16,400 kilowatts), which could well supply mills with the capacities indicated. The Ozorio falls, which are the largest and most central in the area, will probably be the main factor in determining the industrial location.

(f) From the standpoint of communications, the area will be served by the most important trunk highway planned for the State of Paraná (roads HT-1 or

BR/35) linking Paranaguá-Curitiba with the junction of the Iguaçu and Paraná rivers (Foz do Iguaçu), passing through Guarapuava, Laranjeiras do Sul and Cascavel. At the present time, this road has been completed between Curitiba and Iratí, and between Relógio and Laranjeiras do Sul, while work is going ahead on the remainder. The Government of Paraná attributes considerable importance to this highway, and it is therefore assumed that it will be one of the first to be finished in the interior. The building of other roads has also been planned, such as parallels 6 and 7 and the termination of trunk road 7, which will increase the accessibility of the region.

### C. FUTURE POSSIBILITIES OF THE STATE OF PARANÁ, ON THE BASIS OF PINE PLANTATIONS

Independently of the utilization of existing forest stands in south-west Paraná, long-term projects based on pine plantations might be considered on sites with ideal soil, climate and transport conditions, located near the sea.

In the first place, possible extensions of the productive capacity of the Klabin mill at Monte Alegre should be considered. This enterprise has not only created a very important industrial centre, provided with energy, transport and every other class of service, but since 1945 it has also undertaken a vast reforestation programme. More than 40 million pines have so far been planted; the firm is continuing to plant at the rate of 2,000 hectares annually, which will probably represent an expansion of pine availability of 10 to 12 million trees annually.

Based on a conservative estimate that each planted hectare may ultimately yield 200 cubic metres of wood for the paper industry, or enough raw materials for 47 tons of chemical pulp or 94 tons of mechanical pulp, the Klabin mill will probably be able to increase its capacity by 94,000 tons of chemical pulp annually,<sup>22</sup> or 187,000 tons of mechanical pulp. The capacity of its hydro-electric plant at Mauá could be expanded by approximately 10,000 kilowatts, and supplemented by thermo-electric power from coal found in the neighbouring basin of the Peixe or Laranjeiras river.

Although the Klabin mill is not ideally located as regards proximity to the sea (579 kilometres, by railway, to Paranaguá) or to the important market of São Paulo (641 kilometres), it is connected to both these cities by railway lines.<sup>23</sup> Moreover, about 250 kilometres of roads have been built, principally for the transport of pulpwood.

On a much longer term—twenty to twenty-five years—the installation of mills in the southern part of the Campos Gerais plateau should be studied. This zone is approximately contained within the triangle formed by União da Vitória, Iratí and São Mateus do Sul. Few natural pine woods remain, but the area offers excellent conditions for installing pulp industries on the basis of future plantations, for the following reasons:

(a) Reforestation of pine is easy because the soil is deep, and the altitude and climate are appropriate for the proper development of this species.

<sup>22</sup> At the present time, Klabin proposes to double or even treble its pulp manufacturing capacity.

<sup>23</sup> At the present time, the branch line of the Rêde Viação Paraná-Santa Catarina, which starts at Joaquim Murtinho, reaches a point 25 kilometres from the mill, but work on the remaining stretch is under way and should be completed in 1953.

<sup>20</sup> As may be seen from chapter I of this report, it is not precisely the length of the fibre but a combination of its morphological characteristics which determines the strength of the paper. However, where production is limited to one or only a few types of short-fibred woodpulp, it would be necessary to mix it with pine pulp to manufacture certain grades of paper.

<sup>21</sup> According to the forestry census taken by the Instituto Nacional do Pinho, in 1950, Laranjeiras do Sul has 14,380,000 pine trees; Clevelândia, 11,778,000; Mangueirinha, 2,415,000, and Guarapuava, 5,850,000. *In toto*, these four municipalities may be considered as having the densest covering of Paraná pine in Brazil.

(b) The topography of this region features low rolling hills, facilitating the building of highways and the introduction of mechanized timber extraction methods.

(c) União da Vitória is linked directly by railway with the sea port of Paranaguá (483 kilometres) and São Francisco do Sul (453 kilometres), the latter being in the State of Santa Catarina. There is also a railway to Curitiba (373 kilometres), joining the northern Paraná network and extending as far as São Paulo and Rio de Janeiro.

(d) The navigable stretches of the Iguaçu river, linking União da Vitória with Pôrto Amazonas (316 kilometres) and of the Rio Negro which connects the Iguaçu river to the outlying districts of the city of Rio Negro (177 kilometres), could probably be used for the cheap transport of raw materials and output. Both Pôrto Amazonas and the city of Rio Negro are connected with the Paraná-Santa Catarina railway and, consequently, to the railway network of the north and south. The federal highway, uniting the southern States with the capital of the republic, passes through the city of Rio Negro.

(e) União da Vitória and Iratí are linked by railway and highway and are also connected with a number of points on the Guarapuava plateau near natural pine forests which could probably be used as a source of raw material when the industry begins operating, or which might be considered as a reserve in the event of a pulpwood shortage.

(f) In the neighbourhood of União da Vitória some 35,000 to 40,000 kilowatts of hydro-electric power can be obtained from the waters of the Iguaçu river (Salto Grande) and the Palmital river.

(g) According to the highway plan of the State of Paraná, the zone is to be served by several highways, built by both State and federal authorities.

It is, as yet, impossible to estimate the potentiality of this zone as a source of raw materials for pulp, since no information exists regarding the area available for plantation purposes.

#### D. SUPPLY OF NON-FIBROUS RAW MATERIALS IN THE STATE OF PARANÁ

Paraná can supply its own limestone requirements, since there are excellent deposits in Rio Branco do Sul, near Curitiba, which are connected by rail both with the southern part of Campos Gerais and with Monte Alegre. Coal is found in northern Paraná, in the Rio Peixe basin. Studies are being carried out to obtain salt in the neighbouring State of Santa Catarina, but at all events this raw material could be brought from Torres, in northern Rio Grande do Sul, where the salt marsh projects are further advanced. The possibility of sulphur from the pyrites of the Rio Peixe basin, or, alternatively, from the coal fields of Santa Catarina, has yet to be studied.

#### E. UTILIZATION OF THE NATURAL FORESTS OF SANTA CATARINA

There are fewer pine trees in Santa Catarina than in Paraná.<sup>24</sup> The forests of Santa Catarina have been

<sup>24</sup> According to the inventory of araucaria carried out by the Instituto Nacional do Pinho in 1949-50, in Paraná there are, in round figures, 151 million trees of less than 40 centimetres in diameter and 60 million trees of more than 40 centimetres. Santa Catarina has 38 million trees of 20 to 40 centimetres in diameter and 34 million of more than 40 centimetres. In Rio Grande do Sul, there are 5 million trees with a diameter of 20 to 40 centimetres, and 10 million with more than 40 centimetres.

seriously overcut and no reafforestation has been undertaken to compensate for these losses. However, an important pulp and paper industry could be developed in the southern part of the plateau of Santa Catarina, which is closer to the sea than the industries mentioned in the section on Paraná.

The vegetation in the northern and eastern sector of this State is principally made up of pine forests. The central part, comprising Campos Novos, Curitiba, Bom Retiro, Lajes and São Joaquim, is the richest from the standpoint of pine production, since its forests are denser, although it contains substantial agricultural and pastoral areas, as well as wasteland.

The ideal location for the industry would probably be within the region comprising the municipalities of Lajes and São Joaquim. The standing volume could probably supply raw material for 138,000 tons of chemical pulp per year, or a combination of 69,000 tons of chemical pulp and 138,000 tons of mechanical pulp,<sup>25</sup> providing that when these resources are drawn upon, a programme for pine reforestation is begun, of about 2,900 hectares annually, and solely for pulp and paper production.

Although Lajes and São Joaquim are situated close to the Atlantic, problems of access would have to be solved, similar to those mentioned in connexion with the State of Paraná. Between the plateau and the ports that could be used for shipping pulp products—Laguna and Imbituba<sup>26</sup>—although the horizontal distance to be covered is less than 80 kilometres, there are the steep escarpments of the Serra Geral that hamper transport and cut this region off from the coastal plain.<sup>27</sup> However, this difficulty might be overcome with special means of transport, such as aerial cableways, which have been used to solve similar problems in other parts of the world. The alternative port would entail covering a long distance in order to cross the mountain range near Florianópolis, making use of the highway which at present links Lajes with that city.

The region of Lajes and São Joaquim has a good highway network which could be used for transporting pulpwood to the industrial site. Federal highway BR-2, cutting Brazil from north to south and passing through the principal cities, in fact, just by-passes Lajes.

There are also several rivers in this region, such as the Lavatudo, Pelotas and Caveiras, which could probably supply water for the mill.<sup>28</sup> There are several waterfalls, but they are small, and it would probably be necessary to assume that the electric power plants would require coal, which fortunately is found in abundance close to this area.

<sup>25</sup> In making this estimate, it was assumed that average volumes of wood, measuring 0.5 cubic metre for trees with a diameter of less than 40 centimetres, and 2 cubic metres for those with more than 40 centimetres in diameter, would be available. In addition, it was estimated that only 25 per cent of existing wood would be used for the manufacture of paper.

<sup>26</sup> In the National Coal Plan, formulated by the Presidential Secretariat in 1951, funds to the amount of 160 million cruzeiros were set aside for port works at Imbituba, in order to provide facilities for ships of up to 10 metres draught. The installations of this port were designed chiefly for mechanical loading of coal.

<sup>27</sup> In the project submitted in 1951 by the Transport, Communications and Public Works Commission to the Brazilian Chamber of Deputies, it was proposed to link the towns of Tubarão and Lajes by means of a highway over the mountain range. However, it is impossible to foresee the date of its execution.

<sup>28</sup> No data are available regarding the volume of water in these rivers.

There is limestone in the Brusque region which can be reached by highway. Sulphur can probably be derived from the pyrites obtained from washing coal at Tubarão, near the site examined. The possibility of obtaining salt in Santa Catarina is being studied. Should this not be possible, the Torres salt mine project (in the north of Rio Grande do Sul) would provide raw materials in the neighbourhood of the Lajes-São Joaquim district; but it would be distant from likely sources of cheap hydro-electric power.

#### F. UTILIZATION OF THE NATURAL FORESTS OF RIO GRANDE DO SUL

Rio Grande do Sul has fewer natural pine forests than either Paraná or Santa Catarina. On the other hand, the accessibility of the plateau where these species grow offers no difficulties such as those encountered in the other two States. In this case the conifers are located fairly close to the modern city of Pôrto Alegre, with which the area is linked by good roads that can be used throughout the year. The Paraná pine in Rio Grande do Sul is found in the north-eastern sector of the State—particularly in the extreme south—along the southern limits of the plateau, comprising the municipalities of São Francisco de Paula, Farroupilha, Caxias, Flores da Cunha, Alfredo Chaves, Antonio Prado, Prata, Vacaria, Lagôa Vermelha, Passo Fundo, Soledade, Encantado, Carasinho, Cruz Alta, Getúlio Vargas, Palmeira, Ijuí, Aparados da Serra, Tres Pasos, Sarandí, Erechim y Marcelino Ramos. Although this area is fairly extensive, it cannot be considered uniform in value as a source for raw materials for pulp and paper. A good deal of it consists of green fields which are bare of trees. In the natural forests, Paraná pines do not always predominate; it is often the secondary species mixed with other semi-tropical trees.<sup>29</sup> Pines are sometimes found standing alone in open fields.

The most suitable zone for the location of a paper industry is the eastern part of the plateau of Rio Grande, comprising the municipalities of Lagôa Vermelha, Vacaria, Aparados da Serra, Nova Prata and São Francisco de Paula.<sup>30</sup> This area is comparatively richer in pine than the western part of the plateau and has the advantage of being closer to Pôrto Alegre. The capital of the State of Rio Grande do Sul is not only an excellent market for paper, but it is one of the most important ports in the country and is located alongside very promising coal fields.

This area contains 4,103,000 pines with a diameter of 20 to 40 centimetres and 8,517,000 pines with a diameter of more than 40 centimetres<sup>31</sup> making up a total of 19,000,000 cubic metres of wood.<sup>32</sup> If it is

<sup>29</sup> See P. Balduino Rambo: *A Fisionomia do Rio Grande do Sul*.

<sup>30</sup> In the municipality of São Francisco de Paula there are three mills with an annual output of 6,000 tons of chemical pulp and 350 tons of mechanical pulp.

<sup>31</sup> According to the census carried out by the National Pine Institute in 1949-50, the number of pines in the area selected was as follows:

Municipality	No. of pines 20 to 40 centimetres in diameter (thousands)	No. of pines of more than 40 centimetres in diameter (thousands)
Lagôa Vermelha . . . . .	853	2,030
Vacaria . . . . .	944	1,387
Aparados da Serra . . . . .	1,244	2,980
Nova Prata . . . . .	110	173
São Francisco de Paula . . . . .	952	1,947
	4,103	8,517

<sup>32</sup> To reach this figure a conservative estimate was made by assuming that, in the case of pines with a diameter of less than

assumed that only 25 per cent of the pines are used for the paper industry, it will be found that the capacity of the zone is sufficient to feed an industry with an annual output of 66,000 tons of chemical pulp for paper, or a combination of 33,000 tons of chemical pulp and 66,000 tons of mechanical pulp. In making this estimate, it was naturally assumed that, as soon as the industry enters operation, a programme for reafforestation, covering 1,400 hectares annually, could be undertaken to ensure the future continuity of supplies. It is also assumed that the area chosen for afforestation, or reafforestation, would be the best for pine plantations. There are prospects for the development of hydro-electric power, plans having been made for plants on the Rio das Antas, on the Rio Tainhas and also at Canastra and Laranjeiras. It is believed that the last two may supply 40,000 and 7,400 kilowatts respectively. The salt works which are to be set up at Torres would be close to this area. Moreover, as already pointed out, coal can be brought in the future from deposits near Pôrto Alegre, and sulphur can probably be obtained from the pyrites. Limestone exists in the municipalities of São Gabriel (Vacacaí), Arrôio Grande (Palmas), Rio Pardo (Cativarita), Encruzilhada, Bagé, São Jerônimo (Leão) and Piratini.<sup>33</sup>

#### G. POSSIBILITIES OF UTILIZING OTHER FOREST SPECIES IN RIO GRANDE DO SUL

Although, in this study, attention was principally given to Paraná pine, since this is the most important tree for paper manufacture, it should be recalled that there are other species, associated with the pine forests, which can also be entirely used for the production of woodpulp.

The waste from lumber of high commercial value can also be considered as a source of fibrous raw material.<sup>34</sup> It should also be pointed out that the National Pine Institute is interested in pine reforestation<sup>35</sup> and that the Government of this State has undertaken a campaign to stimulate the plantation of certain exotic species. Thus far, about 30 million "acacia negra" (*Acacia decurrens*) trees have been planted in the neighbourhood of Pôrto Alegre. The bark of this tree is rich in tannin. More than 100 million eucalyptus trees have been planted, and these, as in the case of São Paulo, can also be used in pulp production.

40 centimetres, a total volume of more than ½ cubic metre per tree could be obtained, whereas with trees of over 40 centimetres in diameter, the average yield per tree would be 2 cubic metres each.

<sup>33</sup> There are 3,000,000 tons in São Gabriel with 7 per cent of magnesium carbonate, and 3,600,000 tons in Rio Grande with more than 20 per cent magnesium carbonate. The limestone deposits of Bagé contain more than 20 per cent magnesium carbonate.

<sup>34</sup> The following are the principal species found together with pines: ipê amarelo (*Tecoma rigida*), ipê roxo ou preto (*Tecoma ipe*), angico vermelho (*Piptadenia rigida*), louro (*Cordia hypoleuca*), cedro (*Cedrela odorata*), grapiapinha (*Apuleia praecox*), cangerana, agoita cavalo (*Luhea divaricata*), pau ferro, canela (*Nectandra sp.*), cabreúva (*Microcarpus frondosus*), cocão (*Eutroxyon peleterianum*), guajuvira (*Patagonula americana*), alecrim do norte (*Vitex agrostastus*), araca (*Psidium araca*), algarobo (*Prosopis algarrobilla*), canafístula (*Cassia ferruginosa*), caroba (*Jacaranda apiana*), coentrilho (*Fagara xanthoxylon*), corticeira (*Erithrina crista-galli*), guabijú (*Eugenia pungens*), guamirim (*Eugenia spp.*), tajuva (*Machura xanthoxylon*), timbó (*Piptadenia spp.*).

<sup>35</sup> The forest reserves of the National Pine Institute are located at J. Francisco Assis Brasil, Eurico Gaspar Dutra and Passo Fundo, and contain a total of nearly 4,000,000 trees.

#### IV. Development possibilities in São Paulo

##### A. GENERAL INFORMATION

The State of São Paulo was considered one of the most interesting areas in Brazil for short-term development of the pulp and paper industry. The principal reasons for this view lie in the extensive plantations of eucalyptus<sup>36</sup>—more than 1,000 million trees—and its proximity to the largest markets in the country, namely Rio de Janeiro and São Paulo. In this area there are also small stands of Paraná pine and extensive sugar cane plantations, the bagasse of which could be used as a fibrous raw material. The use of Paraná pine was dealt with in detail in connexion with the studies of Paraná, Santa Catarina and Rio Grande do Sul, but in the case of São Paulo it is of little relative importance.

Broadly speaking, it may be said that at present this State has no available electric power for new undertakings. However, projects for the construction of hydro-electric plants are under way, and in the near future sufficient energy should be available to meet an appreciable industrial expansion.

For purposes of this report it may be assumed that it is possible to produce pulp and paper economically from the two main species of eucalyptus found in São Paulo, i.e., *Eucalyptus saligna* and *E. tereticornis* (sin: *E. umbellata*).<sup>37</sup> The firm Indústrias Reunidas Francisco Matarazzo S.A. has recently installed a mill (now operating) in São Caetano, to produce 20 tons of bleached eucalyptus pulp daily, and is using this raw material for the manufacture of fine papers. This firm also proposes to install another mill, to produce 50 tons a day of eucalyptus pulp for rayon. Parsons & Whittemore, Inc., of New York, after surveying conditions, are about to establish a mill for the Companhia Paulista de Celulose which will have a daily output of 50 tons of bleached pulp for paper or 35 tons of dissolving pulp for rayon, using eucalyptus treated by the sulphate process, with alkali recovery. The experts working on the present report were permitted to examine the estimates made by Thela Comercial S.A., of São Paulo, which showed that there is an ample margin between the cost of eucalyptus pulp and the current price for the imported commodity.

The yield of eucalyptus pulp depends principally upon the species cultivated, the type of soil, the system of plantation and the industrial process employed for the treatment. In calculating the potentiality of the raw material sources indicated below, use was made of the following figures, which represent the average results obtained by planters and researchers in São Paulo:

<sup>36</sup> The planting of these eucalyptus reserves, undoubtedly the most extensive in Latin America, was due to the effort of Edmundo Navarro de Andrade, who, in 1903, began to plant these trees in the neighbourhood of Jundiá, with a view to supplying wood for the Companhia Paulista de Estradas de Ferro (São Paulo Railway). Under his direction, and that of his successor, Armando Navarro Sampaio, the Forestry Service of the São Paulo Railway experimented with about 150 varieties of eucalyptus, with a view to determining their acclimatization features in different areas, as well as yield, applicability for various industrial purposes, and other useful data concerning methods of cultivation, genetics and disease control.

<sup>37</sup> São Paulo also has *Eucalyptus kertoniana*, *E. alba* and *E. citriodora*, which are appropriate for the manufacture of pulp. *Eucalyptus regnans*, which can be used for mechanical pulp, has not grown satisfactorily in São Paulo.

Yield (in steres) of green roundwood per hectare (six-year-old-trees) . . . . .	240
Weight (in metric tons) of dry wood contained in one stere . . . . .	0.36
Yield (in metric tons) of dry wood per hectare, in six years . . . . .	86.4
Annual yield (in metric tons) of dry wood, per hectare . . . . .	14.4
Average number of trees per hectare, in São Paulo (the majority were planted with a spacing of 2 x 2 metres) . . . . .	2,280
Annual yield (in kilogrammes) of dry wood per tree . . . . .	6.3
Yield (in metric tons) of semi-chemical pulp per ton of dry wood . . . . .	0.75
Yield (in metric tons) of chemical pulp for paper per ton of dry wood . . . . .	0.42
Yield (in metric tons) of pulp for rayon per ton of dry wood . . . . .	0.37

Although eucalyptus trees are found in nearly every municipality, and they grow quite satisfactorily in most of them, their utilization for the paper industry was only considered in those areas of greatest concentration, located close to the main thoroughfares.

##### B. UTILIZATION OF EUCALYPTUS PLANTATIONS IN THE RIO CLARO ZONE

A dense concentration of eucalyptus makes the Rio Claro Zone<sup>38</sup> particularly important. These trees were mostly planted by the Companhia Paulista de Estradas de Ferro, near the railway lines. Within this area, there are at present 184,122,000 eucalyptus trees representing a potential total of 1,160,000 tons of dry wood annually. Assuming conservatively that 70 per cent of the lumber is used for fuel, sleepers or other purposes, there would still remain sufficient raw materials to manufacture either 146,000 tons of pulp for paper annually, or 261,000 tons of semi-chemical pulp or 129,000 tons of dissolving pulp for rayon or acetate. The area has excellent communications with São Paulo and Santos by broad-gauge electrified railways. There are also first-class highways to both these cities, as well as good secondary roads and railways which lead into the main transport arteries.

The limits of the Tietê and Piracicaba rivers, or some of their tributaries, could be used as a basis for determining the ideal location of the mills from the standpoint of water supply. The waters of the Ribeirão do Quilombo, flowing through Americana (where there are dense eucalyptus forests) have the least amount of foreign matters. Their utilization might be studied in combination with the water from the Piracicaba river, which could be used for factory waste disposal.

At present, although there is no electric power available, the project could be based on future supply from the Pardo river plant (in the municipality of São José de Rio Pardo), which is now being built and which should provide 45,000 kilowatts in 1955 or 1956. Alternatively, power might be obtained from the Barra Bonita plant in the municipality of that name, which, if the plan is properly carried out, should produce 70,000 kilowatts by 1956 or 1957. Since the pro-

<sup>38</sup> For the purposes of this report, the designation "Rio Claro Zone" has been taken to include the following municipalities: Aguaí, Americana, Amparo, Analândia, Anhembi, Araçoiaba da Serra, Araras, Artur Nogueira, Boituva, Cabreúva, Campinas, Capivari, Casa Branca, Cerquillo, Conchas, Cordeirópolis, Corumbataí, Cosmópolis, Cotia, Elias Fausto, Ibiúna, Indaítuba, Itapetininga, Itapira, Itirapina, Itu, Jundiá, Laranjal Paulista, Leme, Limeira, Lindóia, Mogi, Guacu, Mogi Mirim, Monte Alegre do Sul, Monte-Môr, Pereiras, Piraicaba, Piracununga, Pôrto Feliz, Rio Claro, Rio das Pedras, Santa Bárbara do Oeste, Santa Cruz das Palmeiras, Santa Gertrudes, São Carlos, São Pedro, São Roque, Sarapuí, Serra Negra, Socorro, Sorocaba, Tatuí y Tietê.

posed zone would be located approximately in the centre of the area where these and other intended power plants would be interconnected, it is quite likely that, in the near future, there will be sufficient electric power to meet the requirements of industrial development.

#### C. UTILIZATION OF THE EUCALYPTUS PLANTATIONS IN THE ZONE OF THE RIO PARAÍBA VALLEY

In the Paraíba river valley there are at present 44,026,000 eucalyptus trees planted, representing a total potential of 276,000 tons of dry wood annually. If 70 per cent of the wood available is set aside for other purposes, such as fuel and the manufacture of sleepers, adequate raw materials would still remain to supply a mill with an annual output of 35,000 tons of chemical pulp for paper, or 62,000 tons of semi-chemical pulp or 31,000 tons of dissolving pulp for rayon or acetate. The greatest density of eucalyptus is found in the municipalities of Pindamonhangaba, Caçapava, Guaratinguetá, Jacareí, Guararema, Taubaté, Tremembé, Lorena y Aparecida, all of which are served by the government-owned Central Railway of Brazil, joining Rio de Janeiro and São Paulo.<sup>39</sup> The excellent new highway (President Dutra), which also links these two cities, passes through this zone and is fed by several short lateral roads. Several points along the banks of the river Paraíba, near the railway and the highway, might be considered as ideal locations for a pulp and paper mill, especially in view of the accessibility of the fibrous raw material, water supply and transport to the two most important markets in Brazil.

The deficient supply of electric power is expected to improve considerably in the course of the next five years. The Brazilian Traction Light and Power is increasing the capacity of its system in the Paraíba valley by interconnexion with the network in the State of Rio de Janeiro, through frequency converters installed at Aparecida. The capacity of the State of Rio de Janeiro, in turn, will be increased by the plant at Forçacava, close to the existing units at Ribeirão das Lages. It has been proposed to increase the capacity of the plant at Cubatão (near Santos), from the present 545,000 kilowatts to 760,000 kilowatts in 1954 and to 1,020,000 in 1956. Although a substantial portion of this increased capacity will be absorbed by industries in São Paulo, it is expected that a surplus will be available for use in the Paraíba valley.

#### D. UTILIZATION OF EUCALYPTUS PLANTATIONS IN THE NORTHERN ZONE

An area was selected, designated by the term "Northern Zone" and comprising twenty-four municipalities, of which those outstanding for their eucalyptus resources are: Ribeirão Preto, Guariba, Jaboticabal, Pitangueiras, Bebedouro and Barretos.<sup>40</sup> Altogether there are 28,220,000 trees which would yield an annual total of 176,000 tons of dry wood. Assuming that 70 per cent of this wood would be used for purposes other than paper manufacture, sufficient material would remain to produce 22,000 tons of chemical

<sup>39</sup> The other municipalities included in the Paraíba river valley zone, are: Jambuí, Santa Branca, Mogi das Cruzes, Santa Izabel, São José dos Campos, Suzano and Santo André.

<sup>40</sup> The other municipalities of the "Northern Zone" are: São José do Rio Preto, Olímpia, Cedral, Ucho, Tabapuã, Cajobi, Jaborandi, Colina, Monte Azul, Paulista, Terra Roxa, Viradouro, Pirangi, Sertãozinho, Jardinópolis, Monte Alto, Taiuva, Ponta and Brodosqui.

pulp for paper, or 40,000 tons of semi-chemical pulp, or 20,000 tons of pulp for rayon or acetate.

Apart from its forest resources, the "Northern Zone" is of great importance because economic activity in the capital of the State of São Paulo is now tending to move towards this sector. At the present time the area is served by the main railways of the Companhia Paulista de Estradas de Ferro, extending to Colombia and Nova Granada, with many branch-lines. A navigable portion of the Mogi-Guaçu river flows through this zone and could be used to transport raw materials, and provide water for the manufacturing processes. In the north, the zone is bounded by a navigable portion of the Rio Grande.

Although little electric power is at present available, this situation will be modified when the hydro-electric project at Maribondo, on the Rio Grande, at the municipality of Icem, is completed, which possibly may provide more than one million kilowatts. Two other generating plants (at present being studied) could be installed on the Rio Tietê (municipalities of Ibitinga and of Avanhandava) not far from this zone, which would together supply more than 200,000 kilowatts.

It should be recalled that the pulpwood capacity from the three areas examined was calculated on the basis of the utilization of a relatively low proportion of existing plantations. At the present time, the State Forestry Service is distributing more than 6 million eucalyptus seedlings annually. It may be assumed that the establishment of mills would be followed by an intensive programme for afforestation to be undertaken by the new companies.

#### E. SUPPLY OF CHEMICAL RAW MATERIALS

The raw materials required for the manufacture of the chemicals used in producing chemical pulp are: limestone, sodium sulphate, salt, water and electricity. It is assumed that only sulphate eucalyptus pulp would be produced, since Brazil possesses only small amounts of the sulphur required for the sulphite process and this process has not proved very successful with eucalyptus. There are abundant quantities of limestone in the western part of the State of São Paulo, particularly in the municipalities of Itararé, Itapeva and Itabera. Salt can be supplied from the Cabo Frio region, in the State of Rio de Janeiro, but the sodium sulphate would have to be imported unless either domestic deposits were found or it could be obtained as a by-product from some other industry. The availability of water and power has already been discussed.

### V. Development possibilities in the Amazon region

Brazil's territory in the Amazon basin comprises approximately 3 million square kilometres of forests, most of which are linked to the sea by an excellent river system comprising the Amazon and its tributaries. This area therefore has an unusual potential of fibrous raw material for the pulp and paper industry, although a number of problems, described below, prevent it from being considered immediately for an industrial development programme.

#### A. GENERAL PROBLEMS

The first obstacle to the short-term promotion of the pulp and paper industry is the lack of knowledge

concerning the resources of the Amazon, which makes it difficult to select optimum zones for industrial development and also to draw any conclusions as to the best utilization of the forests, their preservation and improvement, and the possible yield for different types of products.

The good navigability of the river system (13,000 kilometres of waterways) causes a scarcity of hydraulic resources for the production of electric power. The hydro-electric potential of the States of Amazonas and Pará together is only 585 kilowatts per square kilometre, whereas that of Minas Gerais, the Federal District, Rio de Janeiro, São Paulo and Paraná, grouped together, reaches 7,850 kilowatts. This shortage of hydro electric potential makes it more difficult to find ideal sites for the development of pulp industries, but it does not prevent their installation, either in areas where there are a number of waterfalls such as the lower Xingú and upper Tapajoz or where thermal power can be generated. Although the latter solution might prove satisfactory, it would place the new industry at a disadvantage in relation to those that can use hydro-electric power. Omitting the production of energy and steam by burning forest products for this purpose—a possibility which cannot be discussed unless an investigation is made as to the most suitable methods for utilizing the forests—it is believed that the Amazon basin would most certainly have to import foreign coal, since the Brazilian coal fields in the south are too far away.

Oil could be obtained from Bahía or from Peru, unless it were actually proved, as some believe, that at a future date it may be found in this vast area.

A considerable distance separates the Amazon basin from the main foreign and domestic markets. Consequently there is little incentive for manufacturers who are at present interested in pulp and paper production. The fact that this area is closer to certain foreign countries than to the leading domestic markets tends to make it more suitable for inclusion in a second phase of industrial development, when, after meeting domestic requirements with the natural resources nearer to its domestic markets, Brazil can concentrate its efforts on production for export. The scanty population of the Amazon basin, the unsuitable climate compared with other regions of Brazil and the exaggerated tales which novelists have spread regarding its inhospitability have led manufacturers to select more progressive areas for their projects in regions which are more densely populated and better known.

Forest industries in the Amazon basin are also likely to encounter difficulties in establishing sustained forest yields on the so-called *terra firme*,<sup>41</sup> which makes up most of this area. Generally, the layer of soil is extremely shallow and easily loses its nutritive elements as soon as a substantial proportion of the trees have been felled. Thus, the forests which have been transformed into arable land lose a good deal of their productivity in little more than one year of cultivation,<sup>42</sup> and reforestation does not take place naturally. As a result, industrial planning must be preceded by a much more detailed ecological survey than is usual, in order to provide a firm basis for planning the rational utilization of the forests.

<sup>41</sup> See the definition of *terra firme* in the following section.

<sup>42</sup> This is the reason for the so-called "nomadic agriculture" to which frequent reference is made.

## B. GENERAL CLASSIFICATION OF THE AMAZON TERRITORY<sup>43</sup>

The Amazon territory can be divided into *terra firme*,<sup>44</sup> which is never flooded by the winter flux of the Amazon river; low "inundable territory" (*várzeas baixas*), which are alluvial formations, periodically flooded between the months of November and April,<sup>45</sup> and the high "inundable territories" (*várzeas altas*) situated between the two others and occasionally flooded, but only when the rivers are in full spate.

Throughout nearly the entire Amazon basin the *terra firme* and the *várzeas altas* contain rich sections of extremely heterogeneous forests, principally of slow-growing species producing hard and coloured woods, many of which are of considerable commercial value. On the other hand, in the *várzeas baixas*, there are a number of rapidly growing species, producing soft white woods (*Bombax munguba*, *Ceiba pentandra*, *Cecropia sp.* and *Ficus*). Such areas can easily be afforested by natural means, assisted by the river floods.<sup>46</sup> However, it should be noted that the *várzeas baixas*, located in that part of the Amazon basin extending between the river port of Santarém and the mouth of the Amazon, are, generally speaking, smaller than those in the upper Amazon and the upper Solimões. There are fewer trees, less homogeneous in species and less concentrated in dense stands.

## C. POSSIBLE ALTERNATIVES IN THE UTILIZATION OF RESOURCES

According to the above statements, the Amazon basin offers three types of utilization of its resources for the manufacture of pulp and paper. These are as follows:

(a) The utilization of one, or a few, soft white wood species, from the *várzeas baixas* between Santarém and the upper Solimões, up to the Peruvian and Colombian frontiers;

(b) The use of heterogeneous species of hard or semi-hard woods, from the *terra firme*, near rivers with prospects for substantial electric power development, such as the Tapajoz, the Xingú and the Tocantins; and

(c) The utilization of woods from the *terra firme* sector, wherever there are abundant forests as close as possible to the sea, despite the probability of limitations in electric power development.

## D. UTILIZATION OF THE SPECIES FOUND IN "VÁRZEAS BAIXAS"

The greatest advantage of this alternative is that there are substantial quantities of soft white woods, which at present have no commercial value, but can be obtained close to rivers navigable by ocean-going vessels. It is likely that, by using well-known industrial processes, satisfactory mechanical and chemical pulp can be manufactured. Peruvian experiments, in

<sup>43</sup> Data supplied personally by Dr. Ricardo de Lemos Fróes, from the Instituto Agronômico do Norte, Belém, Pará.

<sup>44</sup> Actually, these are old formations of the valleys and not firm ground.

<sup>45</sup> In some regions the period of flooding is from February to June.

<sup>46</sup> Although the floods destroy some of the forests along the banks of the rivers, the effects of this inundation are counterbalanced by the formation of alluvial soil, on which, some years later, new and dense forests will be found.



fact, have proved successful<sup>47</sup> with *Cecropia* ("imbaúba" in Brazil and "cetico" in Perú) in the manufacture of paper. At present Perú is projecting the establishment of a pilot plant in the neighbourhood of Iquitos, on the banks of the Amazon. *Cecropia* produces woodpulp with a length of fibre similar to that of poplar and chestnut, but with higher yields than those of the broad-leaved trees more commonly used in the industry.

Although there is no apparent difficulty in natural reproduction of the species growing in the *várzeas baixas*, the possibility of reforestation after the large-scale felling required for the manufacture of pulp and paper should be studied. In French West Africa experiments have already been made with a species similar to the "imbaúba", namely the "parasolier" (*Musanga smithii*), which, after intensive felling, disappeared completely and artificial reforestation could not be carried through.<sup>48</sup>

The main disadvantages of this possibility for industrial development are: the distances between the source of the fibrous raw material, the sea (probably about 1,000 kilometres) and the consumer centres; the impossibility of obtaining hydro-electric power; and problems which may arise in the felling and transport of the pulpwood as a result of the seasonal river flooding. Such disadvantages imply high investment and operating costs. These would weigh entirely upon products of low economic value and would prevent them from competing profitably with pulp and paper manufactured by mills located nearer to consumer centres and subject to fewer of the problems encountered in the Amazon basin. As may be seen below, it is believed that the possibility for economic production of pulp products in the Amazon basin depends upon the level of industrial integration which could be achieved.

#### E. UTILIZATION OF THE "TERRA FIRME" FORESTS NEAR SUBSTANTIAL POWER RESOURCES

Probably the most suitable zones, as regards an abundance of electric power and the presence of dense forests, are the upper Tapajoz, the lower Xingú and the Tocantins. It is estimated that potential energy exceeds 400,000, 700,000 and 150,000 kilowatts respectively. These zones are located near, or in, the true mahogany (*Swietenia macrophylla*) belt—the most valuable species of Amazon timber.

No concrete data are available regarding the composition and variety of the forest resources in these zones. It is known that most of the *terra firme* regions of the Amazon valley contain a wide diversity of species. However, there are only a few examples of each variety per hectare. The work carried out by G. A. Black and his associates<sup>49</sup> gave the following

<sup>47</sup> See the chapter on Perú.

<sup>48</sup> In Brazil, it is also said that reforestation with "imbaúba" is difficult. It is stated that the seed has a long period of germination; too long compared with the age at which the trees could be used for the paper industry (three to five years). Since this species cannot stand competition with others, the only seeds which grow into trees are those which are ready to germinate when the forest is cut down. Certain sources suggest that the seed has to be swallowed and later deposited by birds before it is ready for germination.

<sup>49</sup> G. A. Black, Th. Dobzhansky and C. Pavan: "Some attempts to estimate species, diversity and population density of trees in Amazonian forests" (*The Botanical Gazette*, vol. III, No. 4, June 1950). This work and a paper by Arthur de Miranda Bastos, mentioned below, represent the only research of this type carried out in the Amazon valley.

results concerning the different species in the forests, for a sampling of one hectare of *terra firme* in Mucambú, near Belém:

Species found = 87	
Trees counted = 423	
Number of individual trees (with a diameter of more than 10 centimetres)	Number of species
1	33
2	15
3	15
4	3
5	4
6	2
7	3
9	4
12	1
17	2
20	1
25	1
37	2
49	1

Although undoubtedly the number and size of the samples were extremely small, the analysis of the data, with the aid of a frequency chart suggested by Preston,<sup>50</sup> led the authors to the following conclusions:

(a) Probably half, or less than half, of the species of a given forest type in the area studied were included in the samples. The majority of the rarer species and some of the moderately common ones were missing in the plots.

(b) The density of population of half or less than half of the forest species in the Amazon valley is probably less than one tree per hectare. This density is extremely low as compared with that of temperate zones.

The diversity referred to above leads to the conviction that the utilization of the *terra firme* forests for the manufacturer of pulp and paper will have to be based on industrial processes which permit the employment of very heterogeneous mixtures of species, since only in this way can the area of the source of supply be maintained within an economic range. It will also be necessary to integrate other industries together with the manufacture of paper, in order to take advantage of the high commercial value of some of these species (in the form of sawn wood for export, plywood, veneers and other manufactures). Integration and the need to install all the services required for the industry, such as transport, energy, public health facilities, water, etc., would involve large-scale industrial enterprises and substantial investments.

<sup>50</sup> F. W. Preston, in his paper, "The Commonness and Rarity of Species" (*Ecology*, No. 29, pp. 254-283, 1948) says that commonness of species of a group of organisms follows a probability or Gaussian curve. Dividing the species of the Amazon sampling into ranges of frequency in geometrical progression, as Preston suggests, one finds curves broken off at the left extremity, showing that certain rare species of the region were not included in the samples:

Number of individuals of more than 10 centimetres in diameter	Number of species of terra firme
1	16.5
1-2	24
2-4	24
4-8	10.5
8-16	5
16-32	4
32-64	3
64-128	—
128-256	—
Total species = 87	
Total individuals = 423	

Thus far, few attempts have been made to determine the properties of the Amazon woods in relation to their employment as raw material in the manufacture of pulp and paper. The Jacaré paper mill at Bahía do Sol (Pará) at present produces about 30 tons of paper and cardboard monthly, using a mechanical pulp obtained from imbaúba (*Cecropia sp.*), morototó (*Didymopanax morototoni*), parapará (*Jacaranda copaia*), quaruba (*Vochysia*), marupá (*Simaruba amara*) and tamanqueira (*Fagara rhoifolia*). These species have given good results, particularly because their wood is soft and white. Table 28 shows the characteristics of some of the Amazon woods which have been partially studied in relation to their employment in the manufacture of pulp and paper. Although no experiments have yet been made with complex mixtures of Amazon pulpwood for the manufacture of pulp and paper, it is believed that they will be successful if the necessary research is carried out. This statement is based on the results obtained from studies made by the Régie Industrielle de la Cellulose Coloniale (a French Government agency), both in its Paris laboratories and in its pilot plant at Abidjan, French West Africa. Successful experiments were made there with simultaneous cooking of up to twenty-five broad-leaved species, similar to those encountered in the Amazon valley.<sup>51</sup>

The main disadvantages of locating the industry on the *terra firme*, near abundant electric power sources, would be:

(a) The great distance from the main fluvial means of communication with the sea, namely the Amazon river. Although there are some navigable stretches in the river, the number of waterfalls and rapids precludes the possibility of integral river transport. However, it might be possible to overcome certain obstacles to navigation by making use of the highways or rail traffic overland at these points. This has been done, in fact, on the Tocantins river between Tucuruí and Jacundá, where shipments are carried by rail parallel to the unnavigable part of the river.

(b) The isolation of these sites in relation to the main economic centres with which they could share the cost of public and industrial services such as means of transport, urbanization, public health facilities, etc.

#### F. UTILIZATION OF THE "TERRA FIRME" FORESTS NEAR THE SEA

If the heterogeneous *terra firme* forests are to be used, probably the best solution, or at least that which could be carried out within the shortest time, would be found in the Território do Amapá. Situated at the mouth of the Amazon, this territory is undergoing a process of intense economic development, owing largely to the great efforts of the government to move population into the area, to provide it with communications and to make use of its forest resources and its deposits of manganese, iron, gold and tin.

The heterogeneous tropical forests of Amapá are considered to be among the richest in the Amazon valley, but so far remain undeveloped. Specific reference should be made to the Vila-Nova river valley, which was studied to determine the possibilities for

the charcoal production in connexion with projects to develop an iron industry. Reference should also be made to the Araguari river valley with its tributaries, the Falsino and the Amapari, which are not only rich in forest resources but count also with communications, development projects for hydro-electric power, and considerable economic activity due to the mining of manganese.

No detailed studies have yet been made of the forests of this area, but some sampling was carried out by Arthur de Miranda Bastos,<sup>52</sup> in order to determine roughly the density and composition of these resources. The analysis and measurement of ten sample plots, 20 by 50 metres, showed an average volume of 450 cubic metres of wood per hectare, including young trees with a diameter of 15 or more centimetres. The total sampling comprised 891 trees, of which 124 had a diameter of more than 30 centimetres. These latter belong to forty-six different species, the relative importance of which is shown in table 29. Of the species shown in that table, all of which grow on *terra firme*, the following produce soft white woods: abiurana, breu branco, cupiúba, guajará, ipê, louro cumarú, louro vermelho, pracaxi, quaruba, sorveira, sucúba, uxirana, ucuúba and umirirana.

The Araguari river zone has been considered to be of greater immediate importance than the Vila-Nova river area, since the number of public works and projects being carried out at present make its forests accessible to the sea and will provide it with adequate electric power in the future. The government of this territory is building a 20,000-kilowatt hydro-electric plant on the Paredão waterfall of the Araguari river. Within two years' time it is hoped to complete the railway line from Serra do Navio to Macapá, linking the above-mentioned region to the sea. There is already a highway between Macapá and Amapá touching the navigable stretch of the Araguari at Pôrto Grande. After passing close to Paredão, it turns north, running through the valleys of other rivers, which in the future could be considered as sources for fibrous raw materials.

Probably the ideal location for a pulp mill or an integrated forestry industry would be along the banks of the Araguari, near Pôrto Grande. Pulpwood could be transported along that stretch of the river, which is navigable for vessels of up to 62 tons, and also by using the highway to Amapá and the railway to Serra do Navio. The output could be carried down to the Amazon river by the road or the railway which will reach an embarkation point near Macapá (opposite the island of Santana), or making use of the navigable stretch of the Matapi river, which flows out at that port. The embarkation port is being equipped for ore ships of up to 25,000 tons and will be easily accessible to ocean-going vessels, or those from the upper Amazon. Due to the lack of information concerning this region, it is impossible to estimate the potential volume of pulpwood accessible by means of the rivers, railways or highways. However, without exceeding a distance of 100 kilometres beyond existing communications and 15 kilometres on each side of such communications, sufficient raw material could be obtained to feed a pulp mill with an output of 100 to 150 tons daily, even if—with a view to integrating the mill in

<sup>51</sup> See chapter I, for reference to the work carried out by the Régie Industrielle de la Cellulose Coloniale in the pilot plant at Abidjan, French West Africa.

<sup>52</sup> Arthur de Miranda Bastos: "As Matas de Santa Maria de Vila-Nova, Território do Amapá" (*Anuário Brasileiro de Economia Florestal*, No. 1, 1948).



a general forest industry plan—only 25 per cent of the annual constant yield<sup>58</sup> of the forests would be used for pulp production.

According to Dr. Fritz Ackermann, a geologist working in the Production Division of the Territorial

<sup>58</sup> This estimate is based on conservative figures for the usable yield for pulp, amounting to about 100 cubic metres of pulpwood per hectare in thirty-five years, that is to say, 2.85 cubic metres annually per hectare. It has been assumed that one cubic metre of pulpwood will yield 150 kilogrammes of pulp.

Government, limestone exists along the Cajarí river, in the State of Pará, and in the lower Amazon basin. There is no salt, sulphur or coal in the territory. The manufacture of caustic soda would require shipment of salt from Rio Grande do Norte, or any of the other States producing it in the north-eastern sector. However, it is conceivable that caustic soda, and other essential raw materials or fuel, could be imported at moderate prices, by making use of the return loads of vessels which at present carry ore.

TABLE 23  
Brazil: Geographic distribution and installed capacity of the pulp and paper industry<sup>a</sup>  
(Capacity in thousands of metric tons annually)

State	Number of mills					Capacity of the paper industry <sup>a</sup>			Capacity of the chemical pulp industry <sup>b</sup>			Capacity of the mechanical pulp industry <sup>c</sup>		
	Paper exclusively	Paper and chemical pulp	Paper and mechanical pulp	Paper, chemical pulp and mechanical pulp	Mechanical pulp exclusively	Total capacity	No. of mills	Average capacity per mill	Total capacity	No. of mills	Average capacity per mill	Total capacity	No. of mills	Total capacity per mill
Pernambuco.....	1	—	—	—	—	7.2	1	7.2	—	—	—	—	—	—
Bahia.....	1	—	—	—	—	0.7	1	0.7	—	—	—	—	—	—
Minas Gerais.....	5	—	—	—	—	11.7	5	2.3	—	—	—	—	—	—
Rio de Janeiro.....	4	—	—	1	—	31.3	5	6.3	4.5	1	4.5	—	—	—
Federal District.....	5	—	—	—	—	14.3	5	2.9	—	—	—	—	—	—
São Paulo.....	14	1	5	4	2	135.0	24	5.6	24.0	5	4.8	40.0	11	3.6
Paraná.....	—	1	2	3 <sup>d</sup>	7	48.0	6	8.0	30.0	4	7.5	40.0	12	3.3
Santa Catarina.....	—	—	—	2	53	7.8	2	3.9	7.5	2	3.7	41.2	55	0.8
Rio Grande do Sul...	8	3	1	—	4	10.5	12	0.9	7.5	3	2.5	3.7	5	0.7
TOTAL	38	5	8	10	66	266.5	61	4.4	73.5	15	4.9	124.9	83	1.5

Sources: The capacity of the paper mills is based principally on production data for 1950, compiled by the Paper Industry Associations of Rio de Janeiro and São Paulo. The production capacity for chemical and mechanical pulp was estimated on the basis of data compiled during visits to manufacturers and experts. In the particular instance of mechanical pulp, this data was obtained mainly from the Mechanical Pulp Manufacturers Association (Associação Profissional dos Fabricantes de Pasta Mecânica).

<sup>a</sup> Includes paperboard.

<sup>b</sup> Includes a small proportion of the capacity at present used for the manufacture of semi-chemical pulp.

<sup>c</sup> Estimates. Some of the small units also manufacture cardboard, but their capacity in this sector was not determined.

<sup>d</sup> Two of these mills use "lirio do brejo" (*Hedychium coronarium*) as raw material.

TABLE 24  
*Brazil: Estimated future demand for paper, chemical pulp for paper and  
mechanical pulp*  
(Thousands of metric tons annually)

		<i>Per capita demand for paper (kgs.)</i>	<i>Total demand for paper</i>	<i>Total demand for mechanical pulp<sup>c</sup></i>	<i>Total demand for chemical pulp<sup>c</sup></i>
Newsprint:	1950 <sup>a</sup> .....	1.82	92	84	12
	1955 <sup>b</sup> .....	2.26	124	114	16
	1960.....	2.79	169	155	22
	1965.....	3.45	228	210	30
Other paper and paperboard:	1950 <sup>a</sup> .....	4.51	226	52 <sup>d</sup>	145
	1955 <sup>b</sup> .....	5.66	312	28	200
	1960.....	7.11	429	39	275
	1965.....	8.92	591	53	378
TOTAL:	1950 <sup>a</sup> .....	6.33	318	136	157
	1955 <sup>b</sup> .....	7.92	436	142	216
	1960.....	9.90	598	194	297
	1965.....	12.37	819	263	408

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.  
<sup>a</sup> Total and per capita demands for paper in 1950 are obtained from tables 18, 19 and 20 of annex I.

<sup>b</sup> Estimates for demand in 1955, 1960 and 1965 were obtained by correlating world per capita income with per capita consumption of paper and assuming varying rates of annual expansion for Brazil's per capita income. The complete method and its results will be found in annex II. To simplify the description in this part of the report, only the figures for an average rate of per capita income expansion were used, equivalent to an annual rate of 3 per cent.

<sup>c</sup> Calculating total demand for groundwood (excepting that for "other paper and cardboard" in 1950) and woodpulp, the following average conversion factors were used, as approved by FAO during the two International Conferences on Forestry Statistics, held in Washington and Rome, in 1947:

<i>Mechanical pulp</i>	<i>Chemical pulp</i>
Newsprint x 0.92	Newsprint x 0.13
Other paper x 0.09	Other paper x 0.68
Paperboard x 0.07	Paperboard x 0.32

Since the table shows "other paper and paperboard" together, the following averages of the respective factors were used, weighted by Brazilian consumption:

<i>Mechanical pulp:</i>	Other paper and paperboard x 0.09
<i>Chemical pulp:</i>	Other paper and paperboard x 0.64

<sup>d</sup> Demand for groundwood for "other paper and cardboard" in 1950 was estimated on the basis of data supplied by the industry. The conversion factors referred to in footnote c were not used in this calculation, since it was felt that at the present time Brazilian manufacturers employ a higher proportion of groundwood than is usual.

TABLE 25  
*Brazil: Expansion needs of the pulp and paper industry*  
(Thousands of metric tons annually)

	<i>Present demand</i>	<i>Installed capacity</i>	<i>Expansion required now</i>	<i>Expansion needed in the future</i>		
				<i>Total to 1955</i>	<i>Total to 1960</i>	<i>Total to 1965</i>
Newsprint.....	92	36	56	88	133	192
Other paper and paperboard.....	226	230	0 <sup>a</sup>	82	199	361
<b>TOTAL PAPER AND PAPERBOARD</b>	<b>318</b>	<b>266</b>	<b>56</b>	<b>170</b>	<b>332</b>	<b>553</b>
Chemical pulp for paper:						
Consumption of domestic pulp..	74					
To replace imports of pulp as raw material.....	69					
To replace the raw material con- tained in imported paper.....	14					
<b>TOTAL CHEMICAL PULP FOR PAPER</b>	<b>157</b>	<b>74</b>	<b>83</b>	<b>142</b>	<b>233</b>	<b>334</b>
Mechanical pulp:						
Consumption of domestic pulp..	80 <sup>b</sup>					
To replace the raw material con- tained in imported paper.....	56					
<b>TOTAL MECHANICAL PULP</b>	<b>136</b>	<b>125<sup>b</sup></b>	<b>11</b>	<b>17</b>	<b>69</b>	<b>138</b>

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Although in this item the estimate of installed capacity exceeds demand, Brazil still has to import a small amount of paper specialties (equivalent to about 9,000 tons annually), which has not been taken into account in this table, in view of its little importance in relation to the development of the industry.

<sup>b</sup> The difference between estimates of installed capacity and consumption of domestic mechanical pulp arises principally from the closing down of many small southern units, which have found it difficult to place their products on the market. Another important cause for this difference is the fact that cardboard manufactured by certain small mills also producing groundwood is not recorded in the statistics for the production of paper and paperboard.

TABLE 26

Brazil: Apparent consumption of rayon and acetate and its equivalent in filament and dissolving pulp  
(Metric tons annually)

Year	Imports						Exports				Equivalents in dissolving pulp <sup>a</sup>			Total in terms of filament <sup>b</sup>		
	Fila- ment	Fila- ment	Staple- fibre	Yarn	Fabrics	Manu- factures	Fila- ment	Staple- fibre	Fabrics	Manu- factures	Of pro- duction	Of imports	Of exports	Total	Per capita (grammes)	Total
1930..	0,272	..	..	..	..	..	..	..	..	..	283	..	..	..	..	..
1931..	0,500	..	..	..	..	..	..	..	..	..	521	..	..	..	..	..
1932..	0,667	..	..	..	..	..	..	..	..	..	695	..	..	..	..	..
1933..	0,919	137	—	—	1	—	—	—	—	—	957	144	—	1,101	023.7	1,057
1934..	1,198	238	—	—	1	—	—	—	—	—	1,248	249	—	1,497	031.7	1,437
1935..	1,588	426	15	49	4	—	—	—	—	—	1,654	518	—	2,172	045.3	2,085
1936..	2,234	817	3	69	1	—	—	—	—	—	2,327	932	—	3,259	066.6	3,129
1937..	3,290	963	180	10	13	—	2	—	—	—	3,427	1,219	2	4,644	093.8	4,458
1938..	5,273	203	121	4	11	—	—	—	—	—	5,493	356	—	5,849	116.2	5,615
1939..	6,672	108	21	5	1	1	—	—	—	—	6,950	142	—	7,092	138.7	6,808
1940..	7,142	152	12	—	1	1	73	70	—	—	7,440	173	150	7,463	143.7	7,164
1941..	7,742	77	1	2	1	2	1,022	212	10	—	8,065	87	1,300	6,852	130.1	6,578
1942..	8,092	8	3	—	1	3	588	59	47	7	8,429	16	737	7,708	144.2	7,400
1943..	7,366	—	—	—	—	1	67	—	82	75	7,673	1	256	7,418	137.0	7,121
1944..	9,259	1	—	—	1	2	30	—	78	20	9,645	5	145	9,505	173.1	9,125
1945..	9,741	1	91	—	2	4	25	5	182	24	10,147	104	270	9,981	179.1	9,582
1946..	10,922	144	272	—	28	10	103	257	83	43	11,377	481	526	11,332	200.3	10,879
1947..	12,000	434	396	11	83	15	41	58	6	8	12,500	995	121	13,374	232.4	12,839
1948..	12,000	598	500	1	48	5	—	—	9	—	12,500	1,212	10	13,702	234.1	13,154
1949..	14,000	383	441	4	1	3	50	106	1	—	14,584	872	165	15,291	257.1	14,679
1950..	16,490	563	421	—	—	7	—	—	—	—	17,178	1,038	—	18,216	301.0	17,487

Sources: Imports and exports: Serviço de Estatística Econômica e Financeira do Ministerio da Fazenda. Production: Departamento Econômico da Confederação Nacional da Indústria.

<sup>a</sup> To obtain the equivalent in dissolving pulp, the quantities of filament, staple-fibre, yarn, etc., were multiplied by the following factors: filament, 1.04; staple-fibre, 1.05; yarn, 1.10; fabrics, 1.15; manufactures, 1.22.

<sup>b</sup> The total equivalent in pulp was converted into filament by multiplying it by 0.96.

TABLE 27

Brazil: Average yield of Paraná pine, based on São Paulo sampling<sup>a</sup>

Age (years)	Average Height (m.)	Average diameter (m.)	Number of trees per hectare	Percentage of trees with a diameter of:			Existing volume (cu. m. per hectare)	Existing volume plus thinnings (cu. m. per hectare)	Annual yield including thinnings (cu. m. per hectare)
				Less than 10 cm.	10 to 19.5 cm.	More than 20 cm.			
<i>First-class sampling plots<sup>b</sup></i>									
8	8.2	8.8	4,400	81	19	—	99	101	12.6
11	10.2	9.8	3,790	44	56	—	137	147	13.2
14	12.1	11.2	3,150	19	80	1	173	193	13.7
17	13.9	12.8	2,520	7	87	6	208	238	14.0
20	15.3	15.3	1,870	3	79	18	243	279	13.9
23	16.1	19.8	1,160	1	65	34	273	313	13.6
<i>Second-class sampling plots<sup>b</sup></i>									
8	7.2	7.8	5,010	93	7	—	67	67	8.3
11	9.0	8.7	4,480	72	28	—	102	103	9.3
14	10.5	9.7	3,860	53	47	—	132	140	10.0
17	11.8	10.9	3,160	37	63	—	160	177	10.4
20	13.0	12.7	2,410	22	73	5	185	211	10.5
23	13.9	16.0	1,570	8	78	14	208	244	10.6
<i>Third-class sampling plots<sup>b</sup></i>									
(8)	(5.6)	(6.9)	(5,410)	(100)	—	—	(40)	(40)	(5.0)
(11)	(7.7)	(7.6)	(4,910)	(92)	(8)	—	(60)	(66)	(6.0)
14	8.9	8.2	4,390	71	29	—	78	90	6.4
17	9.8	9.3	3,700	55	45	—	95	110	6.4
20	10.4	10.4	2,960	41	59	—	112	129	6.4
23	10.7	12.4	2,130	30	68	2	129	148	6.4

Source: I. Kissin: "Crescimento e Produção do Pinheiro Brasileiro", *Anuário Brasileiro de Economia Florestal*, Instituto Nacional do Pinho, 1950.

<sup>a</sup> Measurements were taken on eighty-three sampling plots of forests which, together, contain a total of 30,000 trees, varying between the ages of 8 and 23 years.

<sup>b</sup> The sampling plots were classified according to the average height of the trees. In a chart of average heights against age, curves were plotted which passed approximately through the highest and lowest points. The space between these curves was divided by other equidistant curves into three belts; the plantation plots were classified by dividing them into first class when they were within or slightly above the highest belt, second class when they fell within the middle belt, and third class when they came within or slightly below the lowest belt.

TABLE 28

## Brazil: Technological characteristics of certain Amazon woods

Common names in Brazil	Scientific names	Colour	Specific weight	Hardness	(L) Length fibre (mm)	(D) Diameter fibre (mm)	Relation of L to D	% cellulose
1. Acapúrana da terra firme	<i>Batesia floribunda</i> , Legum. Mimos		0.80-0.90	..	1.00-1.60	very thin	..	..
2. Acapúrana da várzea	<i>Campsiandra laurifolia</i> , Legum. Caesal	Reddish brown	0.89-1.10	..	1.80-1.46	very thin	..	..
3. Anani	<i>Symphonia flobulifera</i> , Guttiferae	Yellowish white	0.68-0.75	med. hard	1.66	0.022	75	..
4. Andiroba	<i>Carapa guianensis</i> , Meliaceae	Brown	0.40-0.75	..	1.20-1.70	very thin	..	..
5. Angelim	<i>Dinizia excelsa</i> , Legum. Mimos	Reddish brown	1.15	..	1.00-2.00	very thick	..	..
6. Angelim	<i>Hymenolobium excelsum</i> , Legum. Papil	..	..	..	1.00-2.20	thick	..	..
7. Angelim pedra	<i>Hymenolobium petraeum</i> , Legum. Papil	..	..	..	1.30-2.10	thick	..	..
8. Araracanga	<i>Aspidosperma desmanthum</i> , Apocynaceae	Yellowish	0.83-0.93	..	1.76	0.026	68	..
9. Aruano	<i>Camptosperma gummiferum</i> , Anacardiaceae	..	..	..	..	..	..	..
10. Assaçu	<i>Hura crepitans</i> , Euphorbiaceae	..	0.40-0.45	..	1.15-1.80	very thin	..	..
11. Ataná	<i>Dimorphandra macrostachya</i> , Legum.	..	..	..	1.60-2.70	very thin	..	..
12. Breu Branco (B. jauaricica)	<i>Protium heptaphyllum</i> , Burseraceae	Pinkish brown	0.78-0.81	..	..	..	..	35
13. Caimbé	<i>Curatela americana</i> , Dilleniaceae	..	..	..	0.77-2.10	..	..	..
14. Cajurana	..	White	..	medium	0.76	0.023	33	..
15. Carapanauba	<i>Aspidosperma nitidum</i> , Apocynaceae	..	0.88-1.96	..	0.80-1.80	..	..	..
16. Carabeira	<i>Tecoma caraiba</i> , Bignoniaceae	..	..	..	0.84-1.20	thin to thick	..	..
17. Castanha de arara	..	White	..	med. soft	1.43	0.025	57	..
18. Cedrorana	<i>Cedrelinga catenaeformis</i> , Legum. Mimos	..	..	..	1.08-1.56	very thin	..	..
19. Cupiúba	<i>Goupia glabra</i> , Celastraceae	Reddish brown	0.85-0.94	..	2.00-2.50	..	..	..
20. Envira branca	..	White	..	hard	1.20	0.030	40	41.8
21. Envira preta	..	Striped black	..	hard	..	..	..	46
22. Freijó	<i>Cordia goeldiana</i> , Borraginaceae	Yellowish brown	0.40-0.70	..	0.92-2.04	very thin	..	..
23. Imbaúba branca	<i>Cecropia sp.</i> , Aporcápeas	White	0.30-0.45	..	1.45	0.040	36	46
24. Imbaúba da mata	..	White	..	soft	1.28	0.039	33	47
25. Imbaúba preta	..	Dirty white	..	soft	1.11	0.021	53	45
26. Imbaúba róxa da capoeira	..	Reddish	..	soft	1.28	0.039	33	42
27. Jacaréuba	<i>Calophyllum brasiliense</i> , Guttiferae	..	..	..	0.90-1.65	thin	..	..
28. Japacanim	..	..	..	..	1.04	0.020	52	46
29. Louro branco (L. tamanco)	<i>Ajouvea</i> , Lauraceae	Pink	..	medium	1.47	0.022	67	43
30. Maçaranduba	<i>Mimusope huberi</i> , Sapotaceae	..	..	..	0.78-1.97	thick	..	..
31. Mandioqueira	<i>Qualea albiflora</i> , Vochysiaceae	Brown	0.75-0.85	..	1.20	0.026	46	42
32. Mamorana	..	White	..	soft	1.88	0.020	94	36
33. Maparaná	<i>Aspidosperma inundatum</i> , Apocynaceae	..	..	..	1.00-1.80	..	..	..
34. Marupá	<i>Simaruba amara</i> , Simarubaceae	Yellowish white	0.45-0.53	..	1.00-1.30	very thin	..	..
35. Morototó	<i>Didymopanax morototoni</i> , Araliaceae	White	0.50	..	1.62	0.034	48	52.5
36. Mutamba (pojó)	..	..	..	..	1.10	0.023	48	43.8
37. Mututí da t. f.	..	..	..	..	..	..	..	44
38. Parapará (carauba)	<i>Jacaranda copaia</i> , Bignoniaceae	White	0.41-0.46	..	1.00-1.15	very thin	..	42
39. Paricá branco d.v.	<i>Pithecolobium trapezifolium</i> , Legum. Mimos	White	..	soft	0.84	0.035	24	36
40. Paricarana branca d.v.	..	White	..	soft	1.43	0.018	79	36
41. Pau amarelo	<i>Euxylophora paraensis</i> , Rutaceae	..	..	..	0.77-1.84	very thin	..	..
42. Pau de bôto	<i>Lonchocarpus denudatus</i> , Legum. Papil	..	..	..	0.74-1.12	thick	..	..
43. Pau mulato	<i>Qualea dinizii</i>	Yellowish white	0.66-0.70	..	..	..	..	38
44. Pau rosa	<i>Aniba duckei</i> , Lauraceae	..	..	..	0.70-1.40	very thin	..	..
45. Pracachi	<i>Pentaclethra filamentosa</i> , Legum. Mimos	..	..	..	0.60-1.35	very thin	..	..
46. Quaruba	<i>Vochysia</i> , Vochysiaceae	..	..	..	0.75-1.43	very thin	..	..
47. Quaruba branca	..	Pinkish white	..	medium	1.3	0.019	68	43
48. Quaruba vermelha	..	Pink	..	medium	1.13	0.015	75	41

Sources: Arthur de Miranda Bastos, personal information, and Fundação Brasil Central, Belém, Pará.

Common names in other places (B.G., British Guiana; F.G., French Guiana; S., Surinam): 2, apikara (B.G.); 3, matakis (S.); 4, krappa (S.), crabwood (B.G.); 5, parakwa (B.G.); 8, shibadan (B.G.); 10, sabier (F.G.), hurawood (B.G.); 12, haiwa (B.G.), encens rose

(F.G.); 15, paddlewood (B.G.), bois pagaie (F.G.); 19, kabukalli (B.G.), goupí (F.G.); 22, taparai (B.G.); 23, pumpwood (B.G.), bois canon (F.G.); 29, wild currant (B.G.); ajouvé (F.G.); 34, cedro blanco (Venezuela), adoosidero (B.G.); 35, morototo (S.), karo-horo (B.G.); 38, gobaja (S.), futui (B.G.); 43, goejave kwarie (S.), laba-laba (F.G.).

TABLE 29

Brazil: Distribution by species of trees with a diameter of more than 30 centimetres, found in a sample from the forests of Santa Maria de Vila-Nova, in the Territory of Amapá

Common name	Scientific classification	No. of trees per hectare	Volume of wood per hectare (cubic metres)
Abiurana.....	<i>Lucuma</i> Sapotaceae	4	4,839
Acapu <sup>a</sup> .....	<i>Vouacapoua americana</i> Legum. Caesalp.	11	12,915
Axuá <sup>a</sup> .....	<i>Saccoglottis guianensis</i> Humiriaceae	2	1,472
Angelim <sup>a</sup> .....	<i>Hymenolobium</i> Legum. Papil. Dalberg	5	30,033
Angelim amarelo.....	<i>Hymenolobium</i> Legum. Papil. Dalberg	4	18,632
Breu branco.....	<i>Protium Heptaphyllum</i> Burseraceae	3	2,108
Buleteiro.....		1	
Caraipe.....	<i>Licania</i> Rosaceae	10	13,525
Carapaná.....	<i>Aspidosperma</i> Apocynaceae	1	991
Copaiba.....	<i>Copaifera</i> Legum. Caesalp.	1	3,309
Cumarú.....	<i>Coumarouna odorata</i> Legum. Papil. Dalberg	3	6,498
Cumarurana.....		1	991
Cupiúba <sup>a</sup> .....	<i>Goupia Glabra</i> Celastraceae	6	12,404
Guajará.....	<i>Chrysophyllum</i> Sapotaceae	1	1,283
Ingarana.....	<i>Pithecolobium</i> Legum. Mimos.	1	991
Ipê <sup>a</sup> .....	<i>Macrolobium</i> Legum. Caesalp.	2	3,669
Itaúba.....	<i>Silvia</i> Lauraceae	2	7,838
Jarana.....	<i>Chytroma</i> Lecythidaceae	1	736
Jutá.....	<i>Hymenaea courbaril</i> Legum. Caesalp.	1	3,309
Jutá pororóca.....	<i>Hymenaea parvifolia</i> Legum. Caesalp.	1	2,386
Louro amarelo.....	<i>Aniba</i> Lauraceae	5	8,366
Louro cumarú.....		1	1,980
Louro vermelho, <sup>a</sup> .....	<i>Ocotea rubra</i> Lauraceae	3	6,422
Macucu.....	<i>Licania</i> Rosaceae	4	3,199
Mangabarana.....	<i>Sideroxylon</i> Sapotaceae	1	1,283
Macaranduba <sup>a</sup> .....	<i>Mimusops</i> Sapotaceae	1	3,963
Maparajuba.....	<i>Mimusops</i> Sapotaceae	4	4,840
Matamatá.....	<i>Eschweilera</i> Lecythidaceae	9	1,980
Meraúba.....	<i>Mouriria Plasschaerti</i> Melastomaceae	2	2,274
Pajurá.....	<i>Parinarium</i> Rosaceae	1	1,980
Peu doce.....	<i>Chrysophyllum</i> Sapotaceae	1	3,963
Piquiá.....	<i>Caryocar</i> Caryocaraceae	1	1,980
Pracaxi.....	<i>Pentaclethra filamentosa</i> Legum. Mimos.	2	1,727
Quaruba <sup>a</sup> .....	<i>Vochysia</i> Vochysiaceae	2	4,954
Quina.....	<i>Aspidosperma nitidum</i> Apocynaceae	1	1,283
Roseira.....	<i>Aspidosperma</i> Apocynaceae	1	1,283
Sapucaia.....	<i>Lecythis</i> Lecythidaceae	1	2,390
Sorveira.....	<i>Couma</i> Apocynaceae	3	2,718
Sucuúba.....	<i>Plumiera</i> Apocynaceae	1	1,610
Tachi preto.....	<i>Tachigalia myrmecophyla</i> Legum. Caesalp.	5	9,355
Tauari.....	<i>Couratari</i> Lecythidaceae	3	10,378
Tenteiro.....	<i>Ormosia</i> Legum. Papil.	1	3,960
Uxi.....	<i>Saccoglottis uchi</i> Humiriaceae	2	3,260
Uxirana.....	<i>Saccoglottis</i> Humiriaceae	3	4,845
Ucuúba <sup>a</sup> .....	<i>Virola</i> Myristicaceae	2	4,260
Umirirana.....	<i>Humiria</i> Humiriaceae	1	4,260
Unidentified species.....		2	5,943

Source: Arthur de Miranda Bastos: "As Matas de Santa Maria de Vila-Nova, Território do Amapá", — *Anuário Brasileiro de Economia Florestal*, Rio de Janeiro, 1948.

<sup>a</sup>Export species.

## Chapter IV. CENTRAL AMERICA

### I. General considerations

Central America consumes approximately 17,000 tons of paper and paperboard annually, of which some 40 per cent is newsprint. Paper production is extremely low,<sup>1</sup> and the pulp industry is confined to two small mills, one in Costa Rica and the other in Guatemala using, respectively, the by-products of abacá and lemon-oil as raw materials.

As may be seen in annexes I and II to this report, the paper consumption of each of the Central American Republics—both at present as well as that estimated for 1965—is too low to justify the development of paper industries for domestic markets alone. The total estimated consumption of the five countries for 1965 will be approximately 15,000 tons of newsprint annually and 24,000 tons of other paper and paperboard. These figures are still too small to justify the establishment of mills to provide an economic supply of all the diverse paper products required by Central America.

The reduced size of the domestic markets, both individually and as a group, indicates that any plan for a substantial development of the paper industry in Central America would have to be based upon production for export. The success of such a plan would not only depend upon sufficient available foreign markets but on the possibility of competing, in terms of quality and price, with the other world producers.

For these reasons, the promotion of pulp and paper mills in Central America requires an almost ideal combination of the productive factors. This does not imply that in special cases, for purely domestic reasons, such as scarcities of foreign exchange, the establishment of small mills is not advisable to supply the domestic demand, despite certain disadvantages as to cost and quality.

As indicated below, practically all the Central American Republics are endowed with abundant fibrous raw material as well as a varied combination of other productive factors such as transport, power and water, etc. But, owing to the general lack of data, it is practically impossible for this preliminary report to reach definite conclusions concerning the comparative advantages between one area and another. Nevertheless, the opinion is hazarded, subject to rectification, that Guatemala appears to offer the best conditions for the development of a paper industry, at least in regards to its natural coniferous and tropical forest wealth. A general description of the resources follows.

### II. Resources of Costa Rica

In Costa Rica preference should be given to studies of the possibilities of the tropical forests located in the area of the Atlantic seaboard consisting of the Provinces of Limón and part of the Provinces of

<sup>1</sup> There is one small mill in Guatemala for paper and paperboard, and one for paperboard only in Costa Rica.

Heredia and Alajuela. Accurate information on these forests is not available, although they are known to be highly heterogeneous. However, research, which will be considered further below, has disclosed large quantities of guarumo (*Cecropia peltata*), a species characterized by very rapid growth and recognized internationally as of high quality.<sup>2</sup>

A preliminary study to ascertain the pulp and paper potentiality of Costa Rica,<sup>3</sup> proposes utilizing not only the guarumo, but the eucalyptus and poró gigante (*Erythrina peopiggiana*). The latter species not only grows profusely in Costa Rica with extremely rapid growth, but can easily be cultivated in plantations. Experiments conducted with poró gigante in the United States and France have justified its suitability as a raw material for pulp and paper.

This preliminary study also indicates that the Pacific area is more suitable for pulp and paper production, citing the following reasons:

(a) There are excellent transport facilities through the railway in the central region of Limón Province, running as far as Guápiles in the north and to the Estrella river in the south, and having various branch lines. Another important means of transportation is a branch line of the Compañía Bananera, extending from Almirante to the interior.

(b) Ocean transport is available along the entire length of Limón Province. River transport facilities are also fairly extensive, particularly in the areas between the San Juan river, the Barra del Colorado and the San Carlos river.

(c) Various other rivers have waterfalls which could probably be utilized to generate sufficient electrical power for the needs of the industry.

Utilization of the by-products of the manila hemp industry presents another possibility for the development of a pulp industry in Costa Rica. Recently a mill capable of producing 3,000 tons of kraft paper annually was established on the banks of the Pacuare river, on the Atlantic seaboard, using waste material of the manila hemp factories located in the same region. In addition, the mill has established its own plantation of a type of abacá (*abacá bastardo*) whose rate of growth is higher than the abacá used by the manila hemp industry.

In Costa Rica, no deposits of coal or other mineral fuels have been discovered which might be worked on

<sup>2</sup> Extensive research into *Cecropia* has been undertaken, particularly as regards a project for establishing a mill in the Peruvian Amazon area (see chapter XI, Peru). Large stands of guarumo are known to exist in the following Costa Rican areas: Siquirres, Canadá, San Alberto, San Cristóbal, Germania, Línea Vieja, La Cabaña, El Hogar, La Selva, Ramal de la Perla, Finca de Ricardo, Gutiérrez Ross, Guácimo, Parismina, Río Frío, Roxana, Matina.

<sup>3</sup> See *Preliminary Study for Establishing a Pulp and Paper Industry in Costa Rica*, prepared for the Costa Rican Government in 1952 by Messrs. Jorge Lang S., Luis Uribe P., Alejandro Oropeza C., Francisco de P. Gutiérrez R., Edmond Woodbridge M., Raúl Sequeira R., Fernando Fournier A. and Francisco J. Orlich B.

a commercial basis. Sulphur deposits are known to exist, but their size is unknown; it is generally considered that the Poas area predominates in minerals of this nature. The quality of limestone found in Golfito, on the Pacific coast, is considered to be the best in the country, although deposits have also been found in San José, to the south, as well as in the area south-west of Cartago. Sodium chloride could be obtained by using the salt beds of the Pacific coast as well as on the border of the Gulf of Nicoya, and in addition those areas situated between Dominical and Puerto Cortés.

### III. Resources of Guatemala

There are various areas in Guatemala which are considered as suitable for the development of a pulp and paper industry. The Department of Huehuetenango probably contains one of the richest softwood coniferous forests in the whole of Central America. Due to the absence of adequate communications, these resources have been almost completely inaccessible, not only regarding the interior itself but also in its connexion with the important ports and domestic markets. The Pan-American Highway will increase accessibility in regard to the country as a whole, but the construction of a system of secondary roads communicating with these forests will be required, a difficult problem due to the rough terrain.

The Department of Totonicapán, near Huehuetenango, also contains rich coniferous areas, although they are for the most part unexploited. This section is also fortunate in having adequate roads as well as ample hydro-electric potentials<sup>4</sup> and rich deposits of sulphur and lime.

The most important coniferous species of the zone are: white pine, (*Pinus Pseudostrobus*), ocote pine (*Pinus oocarpa*, *Pinus Montezuma*), pinabete (*Abies Guatemalensis*) and cypress (*Cupressus lusitanica*). Inasmuch as the terrain has considerable slopes, soil erosion following the initial wood-extraction operations will be one of the fundamental problems requiring immediate solution, since the land of this area has a relatively thin layer of subsoil.

Regarding the wet tropical forests,<sup>5</sup> the Department of Petén comprises some of the richest stands in Central America, and it is probably the only zone which has been studied to some extent. Although these studies are in no way complete, they include a general reconnaissance, based on the interpretation of aerial photographs taken by the Shell Company of Guatemala.<sup>6</sup>

From the various areas studied in the Petén Department—Usumacinta, San Pedro, Poctún, Dos Lagunas, Fallabón and Río de la Pasión—it would appear that Poctún offers the best short-term possibilities for the development of a pulp industry integrated to the lumbering of the valuable species found in the region. This area is the most accessible one from the Caribbean Sea and from the general communication system

already existing in Central America. Poctún is connected to the Sarstún river by a 70-kilometre road and this river is navigable as far as the Bay of Amatique, where Livingston and Puerto Barrios are situated. This latter is a weekly port of call for United Fruit Company vessels, which normally arrive with considerable available cargo space which could be utilized to import certain raw materials not found in Guatemala, such as sodium sulphate.

According to the studies of this area, Poctún contains more than 250,000 hectares of good quality hardwood forests accessible for lumbering. They could produce 2 million board-feet of mahogany (*Swietenia macrophylla*), during the next forty years, as well as vast quantities of other commercial species, such as cedar (*Cedrela mexicana*), maria (*Calophyllum brasiliense*), kauxán (*Terminalia amazonia*), tamarindo (*Kaillium guianensis*) and San Juan (*Voschysia guatemalensis*). The total volume of wood available for pulp production in this area has not been established, but, based on data from other similar areas in Latin America, it is estimated that Poctún could supply raw material for producing, at least 50,000 tons annually.

The Petén forests are situated on sufficiently level ground to permit cheap road construction, as well as the use of mechanical equipment for wood extraction and transportation. However, cutting operations in the south of the department, where Poctún is situated, would necessarily be limited to the four to six months of the dry season (November to May), since there is considerable rain during the other months of the year. There are possible mill locations near good water supplies, but it is improbable that means of generating electric power or fuels other than wood could be found.

As a future possibility, it should be mentioned that plans are being studied to construct a railway between San Pedro and San Luis. At San Luis, it is planned to establish a junction. One of the lines will continue to Fallabón, and the other route will cross Río de la Pasión and will follow the Usumacinta river, reaching the Mexican border at two places, one on the Usumacinta river and the other near the San Pedro river. This project is intended for lumbering, but also could be used to facilitate the development of the paper industry.

The area of the basin encircling Lake Izabal should be mentioned as an excellent wet tropical area worth further investigation.<sup>7</sup> This valley is covered by hardwood forests not so rich as those of Petén but very well connected with Livingston and Puerto Barrios, by means of Lake Izabal. In addition, pulpwood could be transported directly from Panzos to the sea in 60-ton barges, via the Polochic and Dulce rivers.

The Lake Izabal basin consists of fairly level terrain where wood extraction and transportation could be easily done. Various rivers, connected with the lake, afford access to the forests, covering the 20 to 35 kilometres' distance to the foothills of the mountain ranges. It is estimated that the area comprises 460,000 hectares with a possible total of 46 million trees in heterogeneous mixtures of hard and semi-hard wood species.<sup>8</sup>

Using the same calculations employed for estimating

<sup>7</sup> See Dr. Olindo Secondini's study, *The Forest of Guatemala and the Newsprint Industry*.

<sup>8</sup> Large quantities of corozos also exist there, which are palm trees providing a fruit from which oils may be extracted.

<sup>4</sup> It is generally considered that the capacity of the Quezaltenango hydro-electric plant could be increased to satisfy the entire needs of Central America.

<sup>5</sup> Chapter I of this study deals with the possibility of producing pulps from hard and semi-hard tropical woods.

<sup>6</sup> This work was performed by L. R. Holdridge (ecologist), F. Bruce Lamb (forester) and Mertell Mason, Jr. (aerial photographer) for the report issued by the Instituto Centroamericano de Ciencias Económicas and the Instituto de Fomento de la Producción de Guatemala (*Los Bosques de Guatemala*, Turrialba, Costa Rica, May, 1950).

the capacity of Poctún, it is estimated that the Lake Izabal basin could supply a production of at least 100,000 tons of pulp annually. Studies<sup>9</sup> have also revealed that the mineral deposits near the Lampara river—another tributary of Lake Izabal—could supply this area with lime and probably with mineral fuels such as coal and bituminous schists.

This area is connected to Guatemala City and the Pacific Ocean by the Puerto Barrios—San José Railway, and with branch lines to Champerico and Tapachula. At the same time, construction of the so-called Atlantic Route highway is under way, joining the capital with Puerto Barrios. This could probably be extended to whatever location within the zone was ultimately decided upon for a future mill site.

#### IV. Resources of Honduras

Pine forests are the most important fibrous resources of Honduras. They contain mixtures of various species, the most common of which are the antillano pine (*Pinus caribaea*), in the lowlands; the ocote (*Pinus oocarpa*) in the central ranges, and pinabete (*Pinus pseudostrabus*), in the highest and most humid forests.

A serious problem for pine forests in Honduras is the progressive devastation caused by fire, soil erosion due to over-cutting, and injurious exploitation of the pine resin. From Tegucigalpa to the west, it is not likely that adequate sites will be found for the establishment of a pulp or paper mill, particularly because the pine stands have already been overcut. The Yoro, Olancho and Paraíso Departments, to the east of the capital, are probably suitable for a mill location, but only if the area is definitely assured of adequate forest protection, above all against fire, but also against haphazard and irrational exploitation.

Although of secondary importance, possibilities do exist to work the tropical forests of the Mosquitia zone of Colón Department, particularly as regards the production of pulp as an industry integrated with the extraction of such valuable species as mahogany and cedar, using as fibrous raw material the remaining mixed species which cannot be put to a better use. Although adequate data is lacking to judge the importance of this project, it appears to rank as less attractive than projects for utilizing the pine forests of Honduras itself or the hardwood forests of Guatemala and Nicaragua.

The possibilities of using canes and bamboos are a third choice worthy of closer study. These two resources grow very rapidly in the north of the country, near ports, rivers and means of land communication.

<sup>9</sup> Private data contributed by Dr. Olindo Secondini.

<sup>10</sup> Information given by Dr. Jorge St. Siegens in the form of personal and official comments concerning the project of Sr. Roberto Maas for constructing a bamboo chemical and mechanical pulp mill.

The studies regarding the development of a pulp industry utilizing these sources<sup>10</sup> indicate that in various regions to the north, particularly the Colón Department and the Mosquitia jungle zone, there exist large stands of bamboo. The raw material could be transported with relative ease to the sites considered as suitable for the establishment of mills, utilizing rivers which have a regular flow.

Information regarding the possibilities of developing hydro-electric plants near these areas is not available. However, the Patuca river—near the Portal del Infierno, Olancho Department—has long been considered as a potentially important hydro-electric source. Unfortunately, the electric power to be produced from the Guayabo falls on the Lempa river, in El Salvador,<sup>11</sup> is too far from those areas in Honduras considered as probable sources for fibrous raw materials.

#### V. Resources of Nicaragua

Nicaragua has relatively small pine forests, both near the Caribbean coast, in the northern part of Zelaya, where *Pinus caribaea* predominates, and in the mountain ranges of Jinotega, Madriz, Nueva Segovia and Estelí Departments in the northwest of the country, where *Pinus oocarpa* is most important. All these forests have been ravaged by fire and uncontrolled cutting, as well as by an indiscriminate clearing of vast areas to make way for agricultural activities.

The inclusion of Nicaragua within a future comparative study as a possible source for pulp raw materials may only be considered if the vast tropical forests near the Caribbean coast, particularly in Zelaya Department, are taken into account. This area has navigable rivers and is particularly suitable for pulp industries integrated to the exploitation of such valuable species as: mahogany (*Swietenia macrophylla*), cedro macho (*Carapa nicaraguensis*), cedar (*Cedrela odorata*), aceituno, (*Simaruba glauca*), laurel (*Cordia alliodora*), balsa (*Ochroma lagopus*) and Santa Maria (*Callophyllum brasiliense*).

No data are available concerning water-power potentials or other factors of production which might be available in the hardwood forests of Zelaya.

It is probable that an area near the Escondido river could be used as an industrial site, particularly since this river is navigable starting from Rama. The neighbourhood of Bluefields, an important centre on the Caribbean, and the connexion with Managua and the Pacific coast by means of an unsurfaced road are important factors favouring this area. Also worthy of study is the area near Río Grande de Matagalpa since it not only has a number of waterfalls near its headwaters, but is also navigable from La Cruz to La Barra, the Atlantic Ocean outlet.

<sup>11</sup> Installed capacity of 30,000 kilowatts will be ready by July 1953, later to be increased to 75,000 kilowatts.



TABLE 30

*Central America: Estimated future demand for paper, chemical pulp and mechanical pulp used for paper*

(Thousands of metric tons annually)

		<i>Per capita demand for paper (kgs.)</i>	<i>Total demand for paper</i>	<i>Total demand for mechanical pulp<sup>c</sup></i>	<i>Total demand for chemical pulp<sup>c</sup></i>
Newsprint.....	1950 <sup>a</sup>	0.85	6.8	6.2	0.9
	1955 <sup>b</sup>	0.92	8.1	7.5	1.1
	1960	1.12	10.9	10.0	1.4
	1965	1.40	14.7	13.5	1.9
Other paper and paperboard.....	1950 <sup>a</sup>	1.23	9.9	0.9	5.9
	1955 <sup>b</sup>	1.46	12.9	1.2	7.7
	1960	1.82	17.7	1.6	10.6
	1965	2.31	24.4	2.2	14.6
TOTAL.....	1950 <sup>a</sup>	2.08	16.7	7.1	6.8
	1955 <sup>b</sup>	2.38	21.0	8.7	8.8
	1960	2.94	28.6	11.6	12.0
	1965	3.71	39.1	15.7	16.5

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.<sup>a</sup> Statistical data contained in annex I.<sup>b</sup> Estimates of the 1955, 1960 and 1965 demands were calculated by correlating the world per capita demand for paper and per capita income. The procedure used and the results obtained can be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate, of per capita income of 3 per cent per year.<sup>c</sup> In calculating the total demands for mechanical and chemical pulp, the following conversion factors were used; these were approved for use by FAO at two international conferences on forest statistics held in Washington and Rome in 1947:

<i>Mechanical pulp:</i> Newsprint	x 0.92	<i>Chemical pulp:</i> Newsprint	x 0.13
Other papers	x 0.09	Other papers	x 0.68
Paperboard	x 0.07	Paperboard	x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Central-American consumption.

<i>Mechanical pulp:</i> Other papers and paperboard	x 0.09
<i>Chemical pulp:</i> Other papers and paperboard	x 0.60

## Chapter V. CHILE

### I. Summary and conclusions

In Chile, in contrast to most other Latin-American countries, it has been possible to determine with considerable accuracy the potential natural resources of the raw materials for the paper industry. One reason for this is that precise forest surveys have already been made, at least in the areas of greatest interest as far as the future of the industry is concerned. These include the area which in this study has been called "the Valdivia region", composed of the province of the same name, as well as "the Concepción region", formed by a group of seven provinces lying between Maule, Linares and Malleco. Although the general survey of forest resources made by the Haig Mission<sup>1</sup> in 1944 might have served as an excellent basis for estimating the potential productive capacity of raw materials in the main regions, it was possible to use more recent data, i.e., the survey carried out at the end of 1952 by the Corporación de Fomento de la Producción in the Province of Valdivia, as well as some of the results from the survey which is being undertaken by the same organization in the Concepción region. Owing to the preliminary nature of this report, it has not been possible to examine the degree and extent of the economic factors which might limit the expansion of the industry in the future. For this reason, in speaking of export capacity, only that which is offered by the potential use of the natural resources for raw materials has been considered.

At present, Chile produces approximately 46 per cent of the 24,000 tons of newsprint consumed annually, and about 96 per cent of the 46,000 tons constituting the demand for other types of paper and paperboard. The more pressing need for expansion is in the chemical pulp industry, where production satisfies less than 20 per cent of the 26,000 tons consumed annually. The manufacture of mechanical pulp is fully sufficient to meet the present demand of the paper mills.

Full satisfaction of future requirements of the country would require the installation of a paper-producing capacity of 20,000 tons by 1955, and a further expansion to 50,000 tons by 1960 and 92,000 by 1965.<sup>2</sup> These expansions would have to be supplemented by the following amounts: 33,000, 48,000 and 67,000 tons of capacity for chemical pulp, and 11,000, 24,000 and 38,000 tons of capacity for mechanical pulp. As will be seen below, the forest resources considered in this report could furnish sufficient raw material to supply a market ten times larger than the domestic demand.

<sup>1</sup> In 1944 the Haig Mission, from the United States Forest Service, in co-operation with the Corporación de Fomento de la Producción, concluded a valuable survey which included the general reconnaissance of the total forest resources of the country. *Forest Resources of Chile as a Basis for Industrial Expansion*, Forest Service, United States Department of Agriculture, 1946.

<sup>2</sup> All measurements of production capacity used in this report expressed merely in tons should be considered as tons produced annually.

The most important resource for the development of the paper industry is the Insignis pine (*Pinus radiata*), which is grown in plantations throughout a number of provinces, but mainly in the Concepción region. The production capacity of the 250,000 hectares planted in this zone is sufficient to meet the needs of all industrial expansions necessary to satisfy the domestic paper market, leaving a surplus for export. By 1965 such an industry could produce an average of 750,000 tons of chemical pulp, or 1,240,000 tons of newsprint per year. These quantities would be equivalent to 50 per cent of the total estimated pulp consumption for Latin America in 1965, or the whole of newsprint consumption. Calculated in terms of 1950 prices, they would represent annual foreign exchange earnings of approximately 113 or 167 million dollars respectively, which are not far below those estimated for copper.

The expansion of the paper industry to meet domestic requirements and to create exportable surpluses, would require investments of approximately 250 to 300 million dollars, of which about 90 per cent would have to be made in foreign currency. In addition, substantial amounts of such other productive factors, as electric power and chemicals, all of which are plentiful in Chile, would also be required.

The other region which has been considered as a possible source of raw material—the natural forests of the province of Valdivia—could produce an annual yield of approximately 1 million cubic metres of wood suitable for the paper industry, even assuming that this figure represents only 75 per cent of the unmillable wood in areas which can be easily, or moderately easily, exploited. This quantity of wood would enable a further 250,000 tons of chemical pulp or 420,000 tons of semi-chemical pulp to be produced annually.

Although the results obtained with broad-leaved trees in French West Africa indicate that the heterogeneous mixture of Chilean woods could become a rich source of pulp for paper, it would be necessary to begin systematic experiments with blends of woods from natural forests as a preliminary step to any project for using the Valdivia region as a source of pulping raw material.

To summarize, it may be stated that the Insignis pine plantations constitute the best source of pulp, not only in Chile, but probably in the whole of Latin America. The accessibility of the plantations, the rapid rate of growth and their facility for natural regeneration, provide a series of factors difficult to equal in any other Latin-American country. The large stands already accumulated show the urgent need to organize a new use for these resources, apart from their present use as sawn timber. Their application in the pulp and paper industry would help to diversify the economy of the country and might create an important new source of foreign exchange.

A second source of raw material available for the

expansion of the industry would consist of the natural forests. They are less well-known today than those of Insignis pine, and their economic utilization would require integration with other forest industries whose economic possibilities depend upon the expansion of the existing markets for lumber as such. However, it must be borne in mind that the integration of the pulp and paper industry with other forest industries is essential since it forms possibly the only means for preventing the continued destruction of the natural forests and for conserving and increasing their value by means of rational methods of exploitation.

## II. Productive capacity and consumption

### A. PRODUCTIVE CAPACITY AND CONSUMPTION OF PAPER

Chile consumes about 70,000 tons of paper and paperboard annually, of which 24,000 tons is made up of newsprint. In 1951, the year to which these figures refer,<sup>3</sup> domestic industry produced approximately 46 per cent of the newsprint required and satisfied 96 per cent of the demand for other types of paper and paperboard.

The industry comprises four paper mills, of which only one, situated at Puente Alto, Santiago, is of any importance. There are also twenty-two small paperboard mills whose average capacity is less than 1,000 tons annually (see table 31). Practically all these enterprises are located in or around Santiago—the largest consuming centre—and at a considerable distance from the main sources of raw material. Generally speaking, with the exception of the Valdivia plant, which commenced operations in 1951, paper production is a long-established industry.

Table 8 of annex II shows the various estimates of paper consumption for the years 1955, 1960 and 1965. In order to simplify this part of the report, only the figures corresponding to an average growth in per capita income of 3 per cent annually have been taken (see table 32).

The Economic Commission for Latin America's study on economic development in Chile<sup>4</sup> estimates the annual rates of growth of per capita income at 2.4 per cent for an assumed conservative rate of economic development and 5.1 per cent for an accelerated development.

A comparison of the estimated future requirements for paper with the figures for installed capacity (see table 33) indicates that, in order to meet the domestic demand for paper, there would have to be expansions in the capacity for producing newsprint of approximately 20,000 tons per year by 1955, 31,000 tons by 1960 and 45,000 tons by 1965. As regards paperboard and other types of paper (excluding newsprint), the installed capacity is sufficient to meet demand until 1955, except for small amounts of special types of paper which would still have to be imported. By 1960, capacity would have to be increased by 19,000 tons and in 1965 this figure would amount to 47,000 tons.

The largest Chilean enterprise is planning to install two more units for the production of 44,000 tons of newsprint, 6,000 tons of kraft paper and 4,500 tons of box paperboard per year. These mills will be located

<sup>3</sup> For previous years see statistics for production, imports and apparent consumption given in tables 23 to 31 of annex I.

<sup>4</sup> See *Study on the Technique of Programming for Economic Development*, Economic Commission for Latin America, E/CN.12/292.

in the south of the country, near Concepción, and will be partly financed with funds from the International Bank for Reconstruction and Development. The raw material for these projects will be the Insignis pine (*Pinus radiata*), a species originating in the western United States which has given excellent results in Chile and New Zealand.

### B. PRODUCTIVE CAPACITY AND CONSUMPTION OF CHEMICAL PULP FOR PAPER

Although Chilean industry consumes about 26,000 tons of chemical pulp annually,<sup>5</sup> only 5,000 tons is produced, this being carried out in a factory subsidiary to the principal paper mill and using straw treated by the Pomilio process. If the pulp contained in the imported paper be taken into consideration, total consumption amounts to 29,000 tons per year. The present capacity for manufacturing straw pulp is 6,000 tons, a figure which is hardly likely to increase in the future owing to difficulties in the supply of raw materials.

To enable the paper industry to expand sufficiently to meet domestic requirements, the following approximate quantities would have to be added to the present capacity to produce chemical pulp: 33,000 tons up to 1955, 48,000 tons up to 1960 and 67,000 tons up to 1965. The projected paper mills mentioned above include an installation for producing 50,000 tons of sulphate pulp annually. As will be seen below, the natural resources of the country greatly exceed both present requirements and those of development projects now being considered.

### C. PRODUCTIVE CAPACITY AND CONSUMPTION OF MECHANICAL PULP

There are only two mills producing and consuming mechanical pulp at the present: these are located in the provinces of Santiago and Valdivia. The remaining mills all use waste, and their production for any given year depends on the availability of this type of raw material. At present they have been compelled to limit their capacity by 40 to 50 per cent, owing to the fact that municipal authorities have introduced a system of burning rubbish which has considerably reduced the supplies of waste paper utilized previously. The mills producing mechanical pulp use an abnormally low proportion of waste and consequently excessively high quantities of pulp. The industry consumes approximately 16,000 tons of mechanical pulp, which, together with the quantities represented by the paper imported, constitutes a total demand of 28,000 tons per year.

In order to achieve the rate of expansion which the paper industry would require in order to meet the domestic demand, the producing capacity for mechanical pulp would need to be increased to the extent of 11,000 tons by 1955, 24,000 tons by 1960 and 38,000 by 1965. The projected paper mills mentioned previously also include an installed capacity for making over 40,000 tons annually of this raw material.

### D. PRODUCTIVE CAPACITY AND CONSUMPTION OF DISSOLVING PULP

There is no production of dissolving pulp in Chile. The two existing rayon factories consume about 4,000

<sup>5</sup> Chilean consumption of chemical pulp is made up approximately as follows:

	Tons per year	Percentage
Domestic straw pulp . . . . .	5,000	19
Imported bleached pulp . . . . .	5,000	19
Imported unbleached pulp . . . . .	16,000	62
<b>TOTAL</b>	<b>26,000</b>	<b>100</b>

tons of imported chemical pulp per year. It is proposed to manufacture 6,000 tons per year from Insignis pine in a subsidiary plant which is to be added to one of the paper mills projected.

Assuming that the consumption of rayon will continue to grow at approximately the same rate as in previous years, the estimated capacity for producing dissolving pulp will easily exceed the requirements of Chilean industry, at least until 1960.

### III. Development possibilities based on Insignis pine

In order to achieve the expansions mentioned in the previous paragraphs and to enable the paper, chemical and mechanical pulp industries to satisfy the whole of the future requirements of the country, the following quantities of pine pulpwood would be needed: 268,000 cubic metres per year by 1955, 382,000 cubic metres by 1960 and 520,000 cubic metres by 1965 (see table 34). As will be seen below, these timber requirements are extremely small compared with the potential resources of the Insignis pine plantations.

The Insignis or Monterey pine (*Pinus radiata*) is an exotic species whose growth in Chile has exceeded that of its place of origin, i.e., the western United States. The planting of this conifer began about 1916, and at present the plantations cover an area which is probably in excess of 300,000 hectares. Although the plantations are distributed throughout the country, from the Province of Coquimbo in the north to Valdivia in the south, the most important are located between the Provinces of Linares and Malleco, centring round the Province of Concepción where the city of the same name and the port of Talcahuano are situated. The Corporación de Fomento de la Producción is about to conclude a survey of the forest resources in these provinces, and by the beginning of 1953 had succeeded in making an inventory of 211,000 hectares of plantations, distributed as follows:

Province	Hectares
Linares.....	4,400
Maule.....	34,700
Ñuble.....	25,800
Concepción.....	82,900
Bío-Bío.....	30,000
Arauco.....	17,900
Malleco.....	15,700
<b>TOTAL</b>	<b>211,400</b>

The experts in charge of the survey estimate that the total area of the plantations in these seven provinces is about 250,000 hectares. In order to calculate the future yield of the plantations, and in the absence of over-all figures which have not yet been ascertained by the survey mentioned above, it has been assumed that the distribution by ages or dates of planting of the 250,000 hectares calculated has followed a logistic curve, whose co-ordinates are as follows:

Year of planting	Hectares planted
1916-31.....	3,000
1932-34.....	9,000
1935-37.....	17,000
1938-40.....	28,000
1941-43.....	38,000
1944-46.....	47,000
1947-49.....	53,000
1950-52.....	55,000

Taking the above figures as a basis and assuming two kinds of forest exploitation designed to give maximum and minimum yields of pulpwood respectively, the probable programmes of production shown in tables 35 and 36 were determined. The first programme is designed to obtain the maximum amount of wood for conversion into sawn timber and other uses different from paper. It was calculated on the assumption that: (a) the plantations are thinned after fourteen years, the entire production of which (40 cubic metres per hectare) is absorbed by the paper industry, and (b) that the final cutting takes place after twenty years, 40 per cent of the total production (400 cubic metres per hectare) going to the paper industry and the remainder to other forest industries. The second programme considers (a) two thinnings (at eight and fourteen years), producing 20 and 75 cubic metres per hectare respectively for the paper industry, and (b) a final cutting after twenty-three years, producing 410 cubic metres per hectare, of which 90 per cent would go to the paper industry and the remainder<sup>6</sup> to the lumber and other forest industries.

In practice, the proportions absorbed by the paper and lumber industries respectively will depend mainly on market conditions for each product. In order to simplify the present explanation, the final estimates of the potential productive capacity have been based on a single series of figures representing the average for the two programmes mentioned above.

Table 37 shows the balance between the available resources and future requirements of Insignis pine, bearing in mind the following: (a) the total quantities yielded by the thinning and cutting programmes outlined above; (b) the requirements of the paper industry in order to supply domestic demand (table 34); (c) the future requirements of pine lumber, calculated on the supposition that the present level of consumption will grow at the rate of 7 per cent annually,<sup>7</sup> and (d) the maximum and minimum quantities of lumber set aside for export purposes.

The comparison shows that after satisfying all domestic requirements and setting aside a large part of the wood for its utilization for building purposes, etc., there would still remain a surplus of wood suitable for pulp and paper manufacture, amounting to an average of 1,500,000 cubic metres per year by 1955, 2,310,000 by 1960 and 3,920,000 by 1965. These quantities would be sufficient to meet the demand of an export industry for pulp products whose extent, expressed in quantities of chemical pulp, would vary from 286,000 tons annually by 1955 to 750,000 tons by 1965. If it is assumed that the whole of this surplus would be devoted to the manufacture of newsprint, the exportable quantities of this commodity would amount to 476,000 tons per year by 1955, 734,000 tons by 1960 and 1,240,000 tons by 1965. In order to give a better illustration of the magnitude of these potential resources, it will be enough to point out that by 1965 the output would be sufficient to satisfy half the Latin-American demand for pulp or the whole of the newsprint requirements of this region.

As has already been explained, these figures are the average of maximum and minimum estimates of the wood resources available for the manufacture of pulp.

<sup>6</sup> Specially selected trees over 25 centimetres in diameter.

<sup>7</sup> This is the rate given in the report of the Joint Mission of the International Bank for Reconstruction and Development and the Food and Agriculture Organization, *The Agricultural Economy of Chile*, December 1952.

If future lumber exports were to be severely restricted and only small quantities of carefully selected lumber were sold (e.g., 10 per cent of the final fellings), Chile's export capacity for pulp products derived from Insignis pine would, by 1965, amount to 975,000 tons of pulp or 1,620,000 tons of newsprint per year.

These tremendous resources, together with the accessibility of the pine plantations and their exceptional capacity for natural regeneration, make Chile probably the most important country in Latin America as regards immediate prospects for large-scale developments in the paper and pulp industries.

The export capacity for pulp products, based on 1950 prices,<sup>8</sup> and using the intermediate figures of table 37, would vary from 43 million dollars by 1955 to 113 million dollars by 1965, if the wood surplus were devoted only to pulp manufacture, or from 64 million dollars in 1955 to 167 million dollars in 1965 if this surplus were exported entirely in the form of newsprint. These figures indicate that, if Chile were able to expand its productive capacity to the extent allowed by its pine resources, the foreign exchange earnings from this new item of export would reach an extremely high degree of importance, little inferior to that of the greatest present source, i.e., copper.<sup>9</sup>

Any future decision to concentrate efforts on the production of pulp or newsprint should not be taken without careful examination of the various factors involved. The world demand for these products and the alternative uses to which the necessary productive factors might be devoted are of primary importance in this connexion. Viewed only in terms of the yield in foreign exchange which a given investment in foreign currency can produce, it might be said that, in the future, rather than develop pulp manufacture alone, it would be preferable to develop it in conjunction with newsprint, since the relationship between yield in dollars and investments in the same type of currency is considerably greater for newsprint than for pulp.<sup>10</sup>

In order to achieve a development programme which would serve not only to satisfy the entire domestic demand for paper and pulp, but also to utilize the surplus potential resources in the production of pulp for export, investments of approximately 300 million dollars, from now until 1965, would be required. By the latter year it would also be necessary to be able to depend upon about 70,000 kilowatts of installed electric power capacity and on the availability of adequate sources for supplying 98,000 tons of coal, 87,000 tons of sodium chloride, 49,000 tons of sodium sulphate and 65,000 tons of lime per year. If the potential surplus resources were devoted entirely to the manufacture of newsprint for export, the investments required up to 1965 would be approximately 250 million dollars, while the necessary generating capacity would amount to 365,000 kilowatts. The consumption of fuels

<sup>8</sup> Average c.i.f. prices for 1950: pulp, 150 dollars (U.S.); newsprint, 135 dollars.

<sup>9</sup> In accordance with the estimated rate of Chilean economic development as calculated by the Economic Commission for Latin America (see E/CN.12/292, already quoted), copper and nitrate exports will increase as follows (in millions of U.S. dollars):

	1950	1955	1960	1962
Copper.....	152.0	172.8	196.5	206.8
Nitrate.....	65.8	68.5	71.2	72.4

<sup>10</sup> The approximate relationship between the price of pulp and the investments required in dollars per ton of installed capacity is 0.43, whereas for newsprint, if the necessary capacity for producing the chemical pulp which enters into its manufacture is also included, the corresponding figure is 0.80.

and other raw materials, however, would fall to 28,000 tons of coal, 25,000 tons of sodium chloride, 14,000 tons of sodium sulphate and 18,000 tons of lime per year.

In the south of Chile, especially in or around the seven provinces constituting the main pine-producing areas, there is an abundance of hydro-electric potentials which will be developed in the future. For the present, power from the Abanico plant of the Empresa Nacional de Electricidad, located on the Laja river, in the Province of Bío-Bío, could be depended upon. Coal is found within the area under consideration at Lota and Coronel. The salt required for electrolysis could be obtained from natural deposits in the Province of Tarapacá. The same source of lime could be utilized as that used by the Compañía de Acero del Pacífico, which contains 99.6 per cent of Ca CO<sub>3</sub>, and comes from Guarello Island. The sodium sulphate could be brought from natural deposits in the Province of Antofagasta. Water is abundant in many parts of the region and could be found in places suitable for the establishment of the plants near Concepción.

As regards communications, there is a railway and road system linking not only the area of Concepción and the port of Talcahuano within the region, but the port of Valparaíso and Santiago as well. For forest exploitation itself, a network of secondary roads and tracks would gradually have to be constructed, although this should not constitute a great problem since the pine plantations, generally speaking, are relatively accessible.

#### IV. Development possibilities based on pulpwood from natural forests

Although it is considered that the Insignis pine plantations are more than sufficient for any future development in the paper and pulp industry, it has seemed desirable in this report to examine the possibilities offered by natural forest areas as sources of raw material. One of the principal reasons for this is the conviction that the exploitation of these natural forests urgently requires the integration of heavy industries with the light industries operating at present and which are constituted by large numbers of saw-mills, most of which move from place to place. This system leads to the forest resources being exhausted without being replaced. The establishment of heavy industries would in some measure guarantee the preservation of the forest areas which are now being destroyed, since the need for a permanent supply of raw material within the immediate proximity would ensure that these enterprises would concern themselves with forest management, rational exploitation, and natural or artificial reforestation.

Another important consideration which has been taken into account in including the natural forests in this report is the possibility that paper and pulp mills could utilize large amounts of the waste at present left unused in the forest. It is no exaggeration to say that in many parts of the natural forests, only 5 per cent of the total standing volume of wood is utilized, the remaining 95 per cent being destroyed by fire. Even with good forestry legislation, it is extremely difficult to compel operators to take measures for conserving or increasing the resources of the forests which they are exploiting, since their object is to extract only certain particularly valuable types of timber, moving on when this has been exhausted. As they are dealing with slow-

growing species, they are not interested, as they themselves declare, "in planting or taking care of trees for somebody else's benefit in a hundred years' time." On the other hand, the pulp and paper industries would have their own interests at stake in preserving sources of raw materials near at hand.

Chile's natural forests extend from the Province of Coquimbo, in the north, to Magallanes in the south, comprising an area of 5 million hectares. Only the Province of Valdivia has been considered in this preliminary report, both because it offers the greatest concentration of natural forests (approximately 19 per cent by volume of wood and 11 per cent by area of all the forest areas in the country) and because a detailed survey of the forest resources of the region has just been completed by the Corporación de Fomento de la Producción.

A summary of the results of the Valdivia survey is given in tables 38 and 39. On the basis of the data contained therein, the probable yield of raw material for pulp manufacture has been estimated, with the help of the following factors:

(a) It has been assumed that by means of recently-developed processes for the utilization of deciduous species in the pulp manufacture, most of the indigenous species could be used in a mixture whose composition would be more or less the same as is found under conditions of natural growth.<sup>11</sup>

(b) Only the tops of the trees and 50 per cent of the waste wood resulting from sawing operations are considered as a source of raw material for pulp. On this assumption, the quantity of wood contained in the forest areas, with the exception of small trees, would be distributed as follows:

	Percentage for pulp	Percentage for other uses
Sawn timber.....	—	36.8
Waste wood.....	6.9	6.9
Sawdust.....	—	12.5
Tops.....	36.9	—
<b>TOTAL</b>	<b>43.8</b>	<b>56.2</b>

(c) Only the production of those sectors of the forest whose exploitation has been characterized in the Corporación de Fomento survey as "easy" and "moderately easy" (see table 39) has been considered, i.e., the areas which could be exploited by means of mechanical equipment.

(d) An average rotation of 100 years has been assumed.

(e) Owing to the fact that not all the pulpwood available for the paper industry would be recovered, and that probably not all the species would be suitable for the manufacture of pulp, it has been assumed that only 75 per cent of the available quantities would actually be converted into pulp products.

(f) At least five cubic metres of wood per ton of chemical pulp and 3 cubic metres per ton of semi-chemical pulp would be required for manufacturing purposes.

<sup>11</sup> Although pulping tests of mixtures of Chilean woods have not as yet been undertaken, they would no doubt be successful, providing the necessary investigations were first made. This statement is based mainly on the results obtained by the Régie Industrielle de la Cellulose Coloniale of the French Government, in Paris laboratories and in a pilot plant at Abidjan, French West Africa, where experiments have been successfully conducted in the cooking of up to twenty-five deciduous species simultaneously. Further details of the work undertaken by the above-mentioned institution are given in chapter I of this report.

The calculated potential productive capacity of the Province of Valdivia, based on the assumptions and data given above, is as follows:

Volume of wood per hectare in "easy" or "moderately easy" sectors, 677 cubic metres;  
 Area of above sectors, 455,000 hectares;  
 Total quantity of wood, 308 million cubic metres;  
 Period of rotation, 100 years;  
 Total annual yield, 3,080,000 cubic metres;  
 Annual yield suitable for pulp manufacture (43.8 per cent), 1,350,000 cubic metres;  
 Quantity of wood which could be collected and used in the manufacture of pulp (75 per cent of 1,350,000 cubic metres), 1,000,000 cubic metres;  
 Equivalent in chemical pulp (4 cubic metres of wood per ton of pulp), 250,000 tons per year;  
 Equivalent in semi-chemical pulp (2.4 cubic metres per ton of pulp), 420,000 tons per year.

The potential productive capacity for the Valdivia region, as expressed by the figures of 250,000 tons of chemical pulp, or 420,000 tons of semi-chemical pulp per year, may be considered as a minimum since it is based only on the utilization of wood which would otherwise be wasted during the total exploitation of the forest areas for purposes other than that of paper and pulp production. The future market for the timber from the various species comprising the natural forests would be the main factor determining their actual capacity for supplying pulp raw material. The coigüe (*Nothofagus dombeyi*) and the tepa (*Laurelia serrata*), which together form over 55 per cent of the standing value, are species which at present have no great commercial value for saw-milling. If they become difficult to dispose of in the form of sawn timber, it is likely that most of their recoverable volume could be devoted to pulp manufacture. This would mean a considerable increase in the capacity indicated for previous items and would simplify the chemical process involved, since large quantities of the available material could be treated as a homogeneous type of raw material.

Research has been undertaken in the Madison Forest Products Laboratory into the pulping properties of the ulmo (*Eucryphia cordifolia*),<sup>12</sup> which, next to the coigüe and the tepa, is the most plentiful species. The suitability of all three species as a raw material for dissolving pulp has also been determined.<sup>13</sup> The main necessity in the way of research, before any project for utilizing these resources is begun, is the determination of the conditions under which they should be employed for making paper, viz., (a) blends of a limited number of common species, mainly coigüe, tepa and ulmo, and (b) heterogeneous mixtures of similar composition to those encountered under natural conditions.

No detailed research has yet been made concerning other productive factors which might help towards determining the possibilities of an economic use of the

<sup>12</sup> J. S. Martín and E. L. Keller (in co-operation with the Corporación de Fomento de la Producción), *Production of Paper-Grade Unbleached Sulphate and Sulphite Pulps from Chilean Ulmo*, 1946.

<sup>13</sup> F. A. Simmons and R. M. Kingsbury (in co-operation with the Corporación de Fomento de la Producción), *Viscose-Rayon Pulps from Chilean Hardwoods Coigüe, Tepa and Ulmo*. Report submitted at the fifth session of the Technical Committee for Timber Chemistry, Food and Agriculture Organization, Appleton, Wisconsin, September 1951.

natural forest lands of the Valdivia region in the manufacture of pulp products. It may be stated that, as regards electric power, coal and other raw materials, approximately the same conditions prevail as in the Concepción region. As far as electric power is concerned, the existing Pilmaiquén plant in the Province of Osorno (24,000 kilowatts), which in the near future will be interconnected with that under construction at Pullinque in the Province of Valdivia (73,600 kilowatts), could be utilized.<sup>14</sup> No information regarding other potential hydro-electric resources in the region

<sup>14</sup> The Pullinque plant will begin with an installed capacity of 32,000 kilowatts, to be later increased to 48,000.

is available, but it is known that these are sufficient to supply requirements of large industrial developments in the future.

The existence, in the same natural forest areas, of lakes, such as Calafquén, Panguipulli and Riñihue, and of rivers, such as the San Pedro and the Calle-Calle, which may be conditioned for the rafting of wood, indicates good facilities for the transport of the raw material. The region possesses a port at Corral suitable for ocean-going vessels and is connected to Santiago and the rest of the country by road and railway. In order to penetrate the forests, it would be necessary to construct surfaced roads which could be used during the long and unusually heavy rainy season.

TABLE 31  
Chile: Geographic distribution and installed capacity of the pulp and paper industry in 1952  
(Thousands of metric tons annually)

Province	Number of mills					Capacity of the industry for:											
						Paper			Paperboard *			Chemical pulp			Mechanical pulp		
	Paper only	Paper and mechanical pulp	Paper and paperboard	Paper, chemical and mechanical pulp	Paperboard only	Total capacity	Number of mills	Average capacity per mill	Total capacity	Number of mills	Average capacity per mill	Total capacity	Number of mills	Average capacity per mill	Total capacity	Number of mills	Average capacity per mill
Antofagasta.....	—	—	—	—	1	—	—	—	0.4	1	0.4	—	—	—	—	—	—
Coquimbo.....	—	—	—	—	1	—	—	—	0.3	1	0.3	—	—	—	—	—	—
Valparaíso.....	—	—	1	—	—	0.9	1	0.9	0.9	1	0.9	—	—	—	—	—	—
Santiago.....	—	—	—	1	20	43.0	1	43.0	16.0	20	0.8	6.0 <sup>b</sup>	1	6.0	20.0	1	20.0
Talca.....	1	—	—	—	—	1.0	1	1.0	—	—	—	—	—	—	—	—	—
Concepción.....	—	—	—	—	2	—	—	—	0.4	2	0.2	—	—	—	—	—	—
Valdivia.....	—	1	—	—	—	5.0	1	5.0	—	—	—	—	—	—	3.0	1	3.0
TOTALS	1	1	1	1	22	49.9	4	12.5	18.0	25	0.7	6.0	1	6.0	23.0	2	11.5

Source: Economic Commission for Latin America and Food and Agriculture Organization.

\* Estimates.

<sup>b</sup> Straw pulp.

TABLE 32

## Chile: Estimated future demand for paper, chemical pulp for paper and mechanical pulp

(Thousands of metric tons annually)

		Per capita demand for paper (kgs.)	Total demand for paper	Total demand for mechanical pulp <sup>a</sup>	Total demand for chemical pulp <sup>a</sup>
Newsprint.....	1950 <sup>a</sup>	5.17	30	28	4
	1951 <sup>b</sup>	4.06	24	22	3
	1955 <sup>c</sup>	5.08	32	29	4
	1960	6.27	43	40	6
	1965	7.76	57	52	7
Other paper and paperboard.....	1950 <sup>a</sup>	6.30	37	3 <sup>d</sup>	24
	1951 <sup>b</sup>	7.80	46	6 <sup>e</sup>	26 <sup>f</sup>
	1955 <sup>c</sup>	8.81	55	5	35
	1960	11.07	75	7	48
	1965	13.89	103	9	66
TOTAL.....	1950 <sup>a</sup>	11.47	67	31	28
	1951 <sup>b</sup>	11.86	70	28 <sup>g</sup>	29 <sup>f</sup>
	1955 <sup>c</sup>	13.89	87	34	39
	1960	17.34	118	47	54
	1965	21.65	160	61	73

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total and per capita demands for paper, in 1950, were taken from annex I.

<sup>b</sup> Apparent consumption based on 1951.

<sup>c</sup> The estimates of demand for 1955, 1960 and 1965 were made by correlating the world per capita consumption of paper to per capita income, and by assuming various rates of annual increase of income per capita in Chile. The complete procedure and the results may be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate of increase of per capita income of 3 per cent per year.

<sup>d</sup> In calculating the total demand for mechanical and chemical pulp the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947.

Mechanical pulp: Newsprint	x 0.92	Chemical pulp: Newsprint	x 0.13
Other papers	x 0.09	Other papers	x 0.68
Paperboard	x 0.07	Paperboard	x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Chilean consumption.

Mechanical pulp: Other papers and paperboard	x 0.09
Chemical pulp: Other papers and paperboard	x 0.64

<sup>e</sup> Figure somewhat higher than normal, due to the paper mills using relatively little waste-paper, and high quantities of mechanical pulp.

<sup>f</sup> Figure somewhat lower than normal, due to the paperboard mills using only waste-paper and no chemical pulp.



TABLE 33  
Chile: Expansion needs of the pulp and paper industry  
(Thousands of metric tons annually)

	Present demand <sup>a</sup>	Installed capacity <sup>a</sup>	Expansion required now	Expansion needed in the future		
				Total up to 1955	Total up to 1960	Total up to 1965
<b>Newsprint:</b>						
Domestic.....	11					
Imported.....	13					
TOTAL NEWSPRINT	<u>24</u>	<u>12</u>	<u>12</u>	<u>20</u>	<u>31</u>	<u>45</u>
<b>Other papers and paperboard:</b>						
Domestic papers.....	33	38				
Domestic paperboard.....	11	18				
Imported papers.....	2					
TOTAL OTHER PAPER AND PAPERBOARD	<u>46</u>	<u>56</u>	—	—	<u>19</u>	<u>47</u>
TOTAL PAPER AND PAPERBOARD	<u>70</u>	<u>68</u>	<u>12<sup>b</sup></u>	<u>20</u>	<u>50</u>	<u>92</u>
<b>Chemical pulp:</b>						
Consumption of domestic pulp..	5					
To replace imports of pulp as raw material.....	21					
To replace the raw material contained in imported paper.....	3					
TOTAL CHEMICAL PULP FOR PAPER	<u>29</u>	<u>6</u>	<u>23</u>	<u>33</u>	<u>48</u>	<u>67</u>
<b>Mechanical pulp:</b>						
Consumption of domestic pulp..	16					
To replace the raw material contained in imported paper.....	12					
TOTAL MECHANICAL PULP	<u>28</u>	<u>23</u>	<u>5</u>	<u>11</u>	<u>24</u>	<u>38</u>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Data for 1951.

<sup>b</sup> Corresponds only to newsprint. The surplus capacity to produce "other papers and paperboard" is due to one of the paper mills not having operated normally in 1951, while the paperboard mills, for the same year, operated at only 60 per cent of their theoretical maximum output.

TABLE 34  
Chile: Amount of pine wood required annually to satisfy the demand of the pulp and paper industry<sup>a</sup>  
(Thousands of cubic metres annually)

	1951	1955	1960	1965
<b>For the existing industry:</b>				
For mechanical pulp.....	45	64	64	64
<b>For the increase in capacity required to satisfy the domestic market:</b>				
For chemical pulp <sup>b</sup> .....	125	173	251	350
For mechanical pulp.....	33	31	67	106
TOTAL	<u>203</u>	<u>268</u>	<u>382</u>	<u>520</u>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup>This table is based on the data for consumption and capacity that appear in tables 32 and 33. The quantities of wood were calculated on the basis of their being exclusively Insignis pine, at 5.23 cubic metres per ton of chemical pulp, and 2.8 cubic metres per ton of mechanical pulp.

<sup>b</sup>It was assumed that the present mill for straw pulp will continue to operate at the nominal capacity of 6,000 tons per year.

TABLE 35

Chile: Probable yield of *Insignis* pine planted in the Provinces of Linares, Maule, Ñuble, Concepción, Bío-Bío, Arauco and Malleco, assuming minimum availabilities of wood for pulp and paper

Planting date	Thousands of hectares planted	Yield in millions of cubic metres of wood													
		1952-1954		1955-1957		1958-1960		1961-1963		1964-1966					
		Thinning	Cutting	Thinning	Cutting	Thinning	Cutting	Thinning	Cutting	Thinning	Cutting				
1916-31.....	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1932-34.....	9	—	3.60	—	—	—	—	—	—	—	—	—	—	—	—
1935-37.....	17	—	—	—	6.80	—	—	—	—	—	—	—	—	—	—
1938-40.....	28	1.12	—	—	—	—	11.20	—	—	—	—	—	—	—	—
1941-43.....	38	—	—	1.52	—	—	—	—	—	15.20	—	—	—	—	—
1944-46.....	47	—	—	—	—	1.88	—	—	—	—	—	—	—	—	18.80
1947-49.....	53	—	—	—	—	—	—	—	2.12	—	—	—	—	—	—
1950-52.....	55	—	—	—	—	—	—	—	—	—	—	—	2.20	—	—
TOTAL	250	1.12	3.60	1.52	6.80	1.88	11.20	2.12	15.20	2.20	18.80				
Annual average.....		0.37	1.20	0.51	2.26	0.63	3.73	0.71	5.06	0.73	6.27				
Annual availability for chemical and mechanical pulp:															
100% of thinnings.....		0.37		0.51		0.63		0.71		0.73					
40% of final cuttings.....		0.48		0.90		1.49		2.06		2.51					
Total quantity of wood available for the paper industry.....		0.85		1.41		2.12		2.77		3.24					

Source: Economic Commission for Latin America and Food and Agriculture Organization.

Note: The calculations for the total yield were made on the basis of thinnings being made at fourteen years, with a production of 40 cubic metres per hectare, and a final cutting at twenty years, with a production of 400 cubic metres per hectare.

TABLE 36

Chile: Probable yield of *Insignis* pine planted in the Provinces of Linares, Maule, Ñuble, Concepción, Bío-Bío, Arauco and Malleco, assuming maximum availabilities of wood for pulp and paper

Planting date	Thousands of hectares planted	Yield in millions of cubic metres of wood														
		1952-1954			1955-1957			1958-1960			1961-1963			1964-1966		
		Thinning I	Thinning II	Cutting	Thinning I	Thinning II	Cutting	Thinning I	Thinning II	Cutting	Thinning I	Thinning II	Cutting	Thinning I	Thinning II	Cutting
1916-31.....	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1932-34.....	9	—	—	—	—	—	3.69	—	—	—	—	—	—	—	0.18	—
1935-37.....	17	—	—	—	—	—	—	—	—	6.97	—	—	—	—	—	—
1938-40.....	28	—	2.10	—	—	—	—	—	—	—	—	—	11.47	—	—	—
1941-43.....	38	—	—	—	—	2.85	—	—	—	—	—	—	—	—	—	15.60
1944-46.....	47	0.94	—	—	—	—	—	—	3.52	—	—	—	—	—	—	—
1947-49.....	53	—	—	—	1.06	—	—	—	—	—	—	3.98	—	—	—	—
1950-52.....	55	—	—	—	—	—	—	1.10	—	—	—	—	—	—	4.13	—
TOTAL	250	0.94	2.10	—	1.06	2.85	3.69	1.10	3.52	6.97	—	3.98	11.47	0.18	4.13	15.60
Annual average.....		0.31	0.70	—	0.35	0.95	1.23	0.37	1.17	2.32	—	1.33	3.82	0.06	1.38	5.24
Total quantity from thinnings and cuttings.....			1.01			2.53			3.86			5.15			6.68	
Wood for domestic consumption, excluding paper production.....			0.24			0.28			0.35			0.43			0.53	
High-quality wood for exports, selected from trees more than 25 cm. in diameter (10% of the final cuttings).....			—			0.12			0.23			0.38			0.52	
Quantity of pine wood available for the paper industry.....			0.80			2.13			3.28			4.34			5.63	

Source: Economic Commission for Latin America and Food and Agriculture Organization.

Note: The calculations for the total yield were made on the basis of two thinnings, at eight years and fourteen years, and a final cutting at twenty-three years. The thinnings and cuttings were then assumed to produce 20.75 and 410 cubic metres of wood per hectare, respectively. The domestic consumption of pine was estimated by applying a rate of increase of 7 per cent per year to the present consumption.

TABLE 37  
Chile: Balance of the availabilities and future requirements of Insignis pine wood  
(Millions of cubic metres annually)

	Minimum availability of wood for paper and pulp			Average availability of wood for paper and pulp			Maximum availability of wood for paper and pulp		
	1955	1960	1965	1955	1960	1965	1955	1960	1965
Total quantity of available wood per year <sup>a</sup> . . . . .	2.77	4.36	7.00	2.65	4.10	6.84	2.53	3.86	6.68
Available for saw-mills and other uses than paper:									
For domestic consumption <sup>b</sup> . . . . .	0.28	0.35	0.53	0.28	0.35	0.53	0.28	0.35	0.53
For export . . . . .	1.08	1.89	3.23	0.60	1.06	1.87	0.12	0.23	0.52
Available for paper and pulp . . . . .	1.41	2.12	3.24	1.77	2.69	4.44	2.13	3.28	2.63
Requirements of the paper industry to satisfy domestic demand . . . . .	0.27	0.38	0.52	0.27	0.38	0.52	0.27	0.38	0.52
Wood surplus utilizable for pulp or paper production for export . . . . .	1.14	1.74	2.72	1.50	2.31	3.92	1.86	2.90	5.11
Export capacity of pulp products in terms of thousands of metric tons of newsprint per year (if the wood surplus is only dedicated to this item) <sup>c</sup> . . . . .	362	552	864	476	734	1,240	590	920	1,620
Export capacity of pulp products in terms of thousands of metric tons of chemical pulp (if the wood surplus is only dedicated to this item) <sup>d</sup> . . . . .	218	332	519	286	442	750	355	554	975

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> See tables 35 and 36.

<sup>b</sup> The domestic consumption of pine is estimated by applying the rate of growth of 7 per cent annually to present consumption.

<sup>c</sup> Calculated on the basis of 3.15 cubic metres of wood per ton of newsprint.

<sup>d</sup> Calculated on the basis of 5.23 cubic metres of wood per ton of chemical pulp.

TABLE 38  
Chile: Volume and composition of the natural forests in the Province of Valdivia, by species

Species		Lumber that can be obtained from the natural forest			Total volume of the forest in millions of cubic feet			
Common name	Scientific name	Percentage	Millions of board-feet	Percentage	Portion usable for lumber	Tree tops	Small trees	Total
Coigüe . . . . .	<i>Nothofagus dombeyi</i> (Fagaceae)	45.3	23,540	43.2	3,158	1,963	12	5,133
Tepa . . . . .	<i>Laurelia serrata</i> (Monimiaceae)	13.2	6,878	12.4	1,036	410	25	1,471
Ulmo . . . . .	<i>Eucryphia cordifolia</i> (Eucryphiaceae)	8.3	4,295	8.8	609	434	2	1,045
Tineo . . . . .	<i>Weinmannia trichosperma</i> (Cunoniaceae)	7.9	4,091	7.7	544	364	4	912
Mañío . . . . .	<i>Saxegotha conspicua</i> (Coniferae)	4.3	2,221	6.8	417	361	26	804
Raulí . . . . .	<i>Nothofagus procera</i> (Fagaceae)	6.5	3,386	6.2	513	221	2	736
Olivillo . . . . .	<i>Aextoxicum punctatum</i> (Aextoxicaceae)	4.0	2,099	3.9	322	128	11	461
Lenga . . . . .	<i>Nothofagus pumilio</i> (Fagaceae)	3.2	1,975	3.9	226	217	17	460
Roble . . . . .	<i>Nothofagus obliqua</i> (Fagaceae)	3.0	1,536	2.7	233	92	1	326
Trevo . . . . .	<i>Floutovia Diacathoides</i>	2.1	1,097	2.1	176	74	4	254
Canelo . . . . .	<i>Drymis winteri</i> (Magnoliaceae)	0.4	213	0.5	38	16	9	63
Laurel . . . . .	<i>Laurelia aromatica</i> (Monimiaceae)	0.4	206	0.4	33	12	—	45
Alerce . . . . .	<i>Fitzroya cupressoides</i> (Coniferae)	0.3	155	0.3	27	11	1	39
Luma . . . . .	<i>Myrtus luma</i> (Mirtaceae)	0.2	94	0.3	17	17	4	38
Araucaria . . . . .	<i>Araucaria araucana</i> (Coniferae)	0.5	244	0.3	34	3	—	37
Lingue . . . . .	<i>Persea lingue</i> (Lauraceae)	0.2	126	0.2	20	6	—	26
Avellano . . . . .	<i>Guerina avellana</i> (Protaceae)	—	26	0.1	5	2	3	10
Ciprés . . . . .	<i>Libocedrus chilensis</i> (Coniferae)	—	—	—	—	—	1	1
Others . . . . .		0.1	47	0.1	10	4	3	17
	TOTAL	100.0	51,932	100.0	7,418	4,335	125	11,878
Total volumes, in thousands of cubic metres . . . . .		—		100.0	210,080	122,700	3,540	336,390

Source: Final forestry measurements for the Province of Valdivia, completed by the Corporación de Fomento de la Producción in 1952.

TABLE 39  
Chile: Distribution of areas and standing volumes of natural usable forests in the Province of Valdivia, according to the facilities for exploitation

Grade	Areas		Total quantity		Utilizable quantity	
	Thousands of hectares	%	Millions of cubic feet	%	Millions of board-feet	%
1. Easy . . . . .	258	49.8	6,640	55.8	29,701	57.2
2. Moderately easy . . . . .	197	38.0	4,157	35.1	17,623	33.9
3. Difficult . . . . .	53	10.2	947	8.0	4,092	7.9
4. Non commercial . . . . .	10	2.0	134	1.1	516	1.0
TOTAL	518	100.0	11,878	100.0	51,932	100.0

Source: Final forestry measurements for the Province of Valdivia, completed by the Corporación de Fomento de la Producción in 1952.

## Chapter VI. COLOMBIA

### I. Productive capacity and consumption

Colombia consumes a little more than 60,000 tons annually of paper and paperboard, of which approximately a third consists of newsprint. There is a modern mill at Cali with an annual capacity of 12,000 tons of paper and a similar tonnage of paperboard. No newsprint, chemical pulp or mechanical pulp are produced in the country.

Table 40 indicates the estimated average future consumption for paper, mechanical and chemical pulp, based on a normal rate of increase in demand. A comparison of these figures with those for installed capacity indicates that for Colombia to satisfy the aggregate domestic demand for paper it would be necessary to reach an approximate capacity of 40,000 tons by 1955 rising to 65,000 tons in 1960 and 100,000 in 1965. Of these total capacity figures, 19,000, 27,000 and 37,000 tons per year respectively would represent newsprint.

Inasmuch as expansion plans in capacity have already been planned for the mill at Cali to produce paper and paperboard other than newsprint within the near future,<sup>1</sup> the only important development problem confronting the industry at present is the production of newsprint, as well as the chemical and mechanical pulp to be used as raw materials for the present mill and its projected expansion.

### II. Principal resources for pulp and paper production in Colombia

There are five zones in Colombia with potentially important fibrous resources for the development of a paper industry: (1) Chocó-Urabá, in the extreme north-east of the country; (2) the Pacific zone, situated between the western Cordillera and the coastal mangrove swamps, including the Departments of Cauca, Valle, Caldas and Antioquia; (3) the Magdalena river valley, including the end of the Cauca valley; (4) the sugar belt of the Cauca valley; (5) the Colombian Amazon region to the east of the eastern ranges of the Andes.

The Chocó-Urabá zone, for the purposes of this study, can be considered as bounded by an irregular line running from the mouth of the Baudó river, on the Pacific Ocean, following a north by north-east direction to Quibdó, capital of Chocó Department, passing through the Abibe mountains, following the San Juan river and finally ending at the Atlantic coast; the boundaries being the frontier with Panama and the Pacific coast.

This zone is rich in white softwoods, with long fibres and of rapid growth, which in all probability could be used for the production of mechanical pulp. Among the most important are tamboro (*Schizolobium parahybum*), balsos (*Ochroma*), guarumos (*Cecropia*), sueldo (*Leguminosa*), damaguo (*Antiaris saccidora*), güino, black rubber (*Castilloa elastica*), ficus, macondo (*Cava-*

<sup>1</sup> It is planned to increase the total capacity to 36,000 tons annually, principally for kraft paper.

*nillesia platanifolia*), cativo or amansamujer (*Prioria copaifera*). The pulp industry could be integrated to the extraction of such valuable woods as cedar (*Cedrela*), ceiba de Tolú (*Bombacopsis quinatum*), river oak (*Tabebuia pentaphylla*), güino and purple cañaguate (*Tabebuia chrysantha*).

The advantages of the Chocó-Urabá zone lie in the sea transport facilities as well as the possibility of pulpwood transportation on the Atrato, San Juan and Baudó rivers. However, there are no roads and the area is not generally developed sufficiently for the establishment of an industry. There is a scarcity of man-power and there are few possibilities for developing electric power resources. Such raw materials as salt and sulphur are lacking.

The Pacific zone is bounded on the north by the Chocó area, to the east by the watershed of the western Cordillera extending from Antioquia to Nariño, and to the west by the mangrove swamps of the Pacific coast. This zone is much more highly developed than Chocó-Urabá, having an important port (Buenaventura) which is connected to Cali and other cities of the interior by railway. This area has the additional benefit of another railway from Tumaco to El Diviso. It probably has sufficient hydro-electric resources,<sup>2</sup> in addition to vast deposits of sulphur in Popayán and coal in Valle Department. The area probably has more or less the same tree species, in regard to fibrous raw materials, as were indicated for Chocó-Urabá.

The forests of the Magdalena river valley are densest between the neighbourhood of Puerto Salgar, to the south, and the confluence of the Cauca and Magdalena rivers, to the north. The principal species of the zone are mahogany (*Swietenia macrophylla*), cedar (*Cedrela*), albarco (*Cariniana*), Tolú (*Bombacopsis*), caracolí (*Anacardium excelsum*), carreto (*Aspidosperma*), ceiba amarilla (*Hura crepitans*), coco de mono (*Lecythis*) and guáimara (*Brosimum*). The species which appear to be most suitable for pulp and paper production<sup>3</sup> are: ceiba bruja (*Ceiba pentandra*), caracolí (*Rhinocarpus excelsa*), jobo (*Spondias mombin*), gambombo (*Schizolobium*), cabeza de mono (*Jacaranda*), resbalamono (*Brusera simaruba*) and guarumo (*Cecropia*). There are also abundant stands of palms as well as bamboo (*Guadua*).

The Magdalena river valley appears to be a very suitable site for paper industries, not only because of the almost unlimited supply of fibrous raw materials, but also due to the high level of economic development. River transport and railways provide ready accessibility between the forests and appropriate industrial sites, as well as connexions with the principal

<sup>2</sup> At present the Anchicayá hydro-electric plant is being built near Cali.

<sup>3</sup> The paper-making properties of ceiba bruja, jobo, gambombo and caracolí were determined by the Forestry Products Laboratory of the United States Department of Agriculture at Madison, Wisconsin. These results, separately and collectively, revealed good sulphate-pulp potentialities, well suited for wrapping paper and newsprint.

markets and the ports whence exports could be dispatched. Examples are the river traffic between Barranquilla, the principal Colombian port on the northern seaboard, and Puerto Salgar; the railway between Bogotá and Puerto Salgar on the Magdalena river, and the railway planned to follow the Magdalena upstream from Puerto Salgar to Gamorra where, even during the dry season, the river remains navigable.

There are many appropriate sites along this valley which might be used for establishing pulp and paper mills.<sup>4</sup> There is an adequate water supply, although it would require purification, and there are no pollution problems. In addition, low-priced fuels are available in abundance through the oil pipe lines from the various petroleum concessions granted by the government in this same area. The salt required to produce soda and chlorine can be obtained from the extensive salt

<sup>4</sup> In the study being prepared at the moment by the FAO mission, regarding the possibilities for a paper industry, the Magdalena valley is specifically recommended as the most appropriate area for the establishment of mills.

beds of Galera Zamba on the Atlantic coast.

The Cauca valley, the fourth zone indicated above, has certain advantages for a future paper industry since the sugar-cane bagasse derived from the sugar mills in the area could be used as a raw material for pulp. A major portion of the sugar industry is located near Cali, which in itself constitutes an important market due to the increase of industrial activity there. All the bagasse produced by the sugar refineries is sufficient to provide an equivalent of 70,000 tons of pulp annually. At present, it is used as fuel in the sugar industry, although the possibility exists that it might be replaced by oil, at least in so far as the larger installations are concerned, bearing in mind that Colombia is an important oil-producing country.

Although the Colombian Amazon region has almost unlimited resources of fibrous raw materials, it is for the moment an unsuitable area in which to develop a paper industry, primarily owing to the complete absence of communications, which render it generally inaccessible.

TABLE 40  
*Colombia: Estimated future demand for paper; chemical pulp for paper and mechanical pulp*

(Thousands of metric tons annually)

		Per capita demand for paper (kgs.)	Total demand for paper	Total demand for mechanical pulp <sup>c</sup>	Total demand for chemical pulp <sup>c</sup>
Newsprint.....	1950 <sup>a</sup>	1.77	20	18	3
	1955 <sup>b</sup>	1.54	19	17	2
	1960	1.91	27	25	4
	1965	2.36	37	34	5
Other paper and paperboard.....	1950 <sup>a</sup>	3.71	42	4	25
	1955 <sup>b</sup>	3.51	44	4	26
	1960	4.41	62	6	37
	1965	5.53	86	8	52
TOTAL.....	1950 <sup>a</sup>	5.48	62	22	28
	1955 <sup>b</sup>	5.05	63	21	28
	1960	6.32	89	31	41
	1965	7.89	123	42	57

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total per capita demand for paper for 1950 was based on tables 32, 33 and 34 of annex I.

<sup>b</sup> The estimates of demand for 1955, 1960 and 1965 were made by correlating the world per capita consumption of paper to per capita income and by assuming various rates of annual increase of per capita income in Colombia. The complete procedure and the results may be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demand for mechanical and chemical pulp, the following conversion factors were used; these were approved, for use by FAO, at two international conferences on forestry statistics held in Washington and Rome in 1947:

*Mechanical pulp:* Newsprint x 0.92      *Chemical pulp:* Newsprint x 0.13  
Other papers x 0.09                              Other papers x 0.68  
Paperboard x 0.07                                 Paperboard x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Colombian consumption:

*Mechanical pulp:* Other papers and paperboard x 0.09  
*Chemical pulp:* Other papers and paperboard x 0.60

## Chapter VII. CUBA

### I. Productive capacity and consumption

#### A. PRODUCTIVE CAPACITY AND CONSUMPTION OF PAPER

The newsprint consumption of Cuba amounts to approximately 38,000 tons, all of which is imported, while consumption of other paper and paperboard totals 99,000 tons, of which 34,000 tons are domestically produced.

The industry consists of two mills,<sup>1</sup> having a combined production capacity of 45,000 tons annually, and which produce almost every grade of paper and paperboard except newsprint. For the most part, they utilize imported raw materials, with the exception of a certain amount of waste paper from domestic sources.

Estimates of the average Cuban consumption of paper, mechanical and chemical pulp for 1955, 1960 and 1965 are presented in table 41.<sup>2</sup>

A comparison of the estimates of future demand for paper with the actual installed capacity (see table 42) shows that, to cover the domestic demand for paper fully, Cuba would have to develop a newsprint productive capacity of 30,000 tons by 1955, 40,000 by 1960 and 53,000 by 1965. Regarding the production of other papers and paperboard, capacity will have to be increased to 64,000 tons by 1955, 102,000 by 1960 and 152,000 tons annually by 1965.

#### B. PRODUCTIVE CAPACITY AND CONSUMPTION OF CHEMICAL PULP FOR PAPER

The Cuban paper industry consumes approximately 20,000 tons of chemical pulp annually, all of which is imported, but, allowing for the chemical pulp contained in all paper imports, total consumption would reach 64,000 tons.

In order to complete an industrial development programme capable of satisfying domestic needs, it would be necessary to increase chemical pulp productive capacity to 69,000 tons by 1955, 92,000 by 1960 and 125,000 tons by 1965. Studies are at present being conducted as to the possibilities of producing chemical pulp from sugar-cane bagasse to be used for newsprint production, but so far no actual mill has been planned.<sup>3</sup>

In Cuba the only available fibrous raw material for chemical pulp is bagasse, but, for reasons of a technical nature, the market could absorb only 40 per cent of bagasse pulp in relation to total chemical pulp required. Therefore, despite a high production potential of this type of pulp, Cuba would be obliged to go on importing the remaining 60 per cent of the total demand—which by 1965 is estimated to reach 71,000 tons.

<sup>1</sup> Papelera Cubana and Papelera Moderna, both situated in Havana.

<sup>2</sup> See the complete figures in table 11 of annex II.

<sup>3</sup> In addition to the interest shown by the Junta Nacional de Economía, the Banco de Fomento Agrícola e Industrial de Cuba is at present carrying out research into this project.

#### C. PRODUCTIVE CAPACITY AND CONSUMPTION OF MECHANICAL PULP

Theoretically, the Cuban paper industry requires some 3,000 tons of mechanical pulp annually. In fact, much smaller quantities are consumed—all of which are imported—owing to a greater supply than usual of waste paper and paperboard.

In order to satisfy future needs, an expanded Cuban paper industry would have to increase mechanical pulp production capacity to 38,000 tons by 1955, 45,000 by 1960 and 67,000 tons by 1965, which in practical terms is virtually impossible since Cuba lacks the necessary raw materials. Where other paper and paperboard, excluding newsprint, are concerned, the supply is fairly well assured since the relatively small amount of pulp required can be supplied by replacing mechanical pulp by semi-chemical bagasse pulp or by waste paper. The greatest problem would be to make newsprint because groundwood (80 per cent of the product) could probably not be replaced economically by semi-chemical bagasse pulp. At the present time, the use of 100 per cent bagasse in the production of newsprint is being studied, but whether or not this process will prove to be economically practical remains to be seen.

#### D. PRODUCTIVE CAPACITY AND CONSUMPTION OF DISSOLVING PULP

The Cuban demand for dissolving pulp to manufacture rayon is approximately 8,000 tons annually, all of which is imported. But, allowing for the equivalent pulp contained in imported rayon and acetate goods, total Cuban consumption would actually amount to 17,000 tons annually. Up to the present, there is no serious project for producing dissolving pulp.<sup>4</sup> Provided the rate of increase for former years is maintained in the demand for dissolving pulp, Cuba will have to establish a production of some 18,000 tons by 1955, 25,000 by 1960 and 33,000 tons by 1965, if the domestic demand is to be satisfied.

### II. Development possibilities based on sugar-cane bagasse

Cuba produces more sugar than any other country in the world, and consequently could have the greatest amount of bagasse for use in a paper industry. The total bagasse produced by the 161 sugar mills (see table 43) could theoretically be converted into 1,500,000 tons of pulp if fuel could be found to replace

<sup>4</sup> La Compañía Rayonera Cubana S.A., the only mill producing rayon, is considering the possibility of using cane bagasse to produce purified cellulose. In 1927, a mill manufacturing alfa cellulose was established, using the de la Roza process. In 1938, owing to the difficulties experienced in financing the costly equipment required to recuperate the chemical products, the project was abandoned. The discoverer of this system maintains that purified cellulose from bagasse shows definite advantages over that from pulpwood. (J. de la Roza, *Purified Cellulose from Bagasse*. Proceedings of the International Society of Sugar Cane Technologists, Brisbane, Australia, 1951.)

the bagasse, which at present is burned in the boilers of the mills. If pulp were made only with the excess bagasse, after deducting the amount required for generating power and steam under the highest possible thermal efficiency, there would still remain enough raw material to manufacture 300,000 tons of pulp annually.

However, these theoretical figures do not take into consideration some of the more fundamental problems, such as the possibilities of counting with an uninterrupted supply of petroleum and coal as substitutes for bagasse fuel, and the technical problems of adaptation to new fuels resulting within each sugar mill.<sup>5</sup> A further obstacle would be the smaller sugar mills which, as a unit, produce insufficient amounts of bagasse to satisfy pulp mill requirements and the subsequent need for their incorporation into a large collective organization. This, in turn, would immediately create a difficult problem of collecting bagasse economically among the various components.

For the purpose of this study, three zones were selected as the principal bagasse-supply centres most likely to be used in the future development of the Cuban paper industry. Two of these—Camagüey and Oriente—have eight and six large mills respectively, situated within what was considered to be an economically practical radius for bagasse collection. In calculating the total available bagasse, only the excess bagasse that could be obtained after achieving improved thermal efficiency was taken into account. In addition, the advantages of the excellent transport system existing within these two zones were considered as regards both the collection of bagasse and the distribution of the finished pulp products throughout the principal consumer centres. However, it should be noted that neither Camagüey nor Oriente have electric power potentials, and that sufficient water to supply the substantial quantities required by the pulp and paper industry would have to be obtained from subterranean streams in the area. In addition, a great deal of attention would have to be devoted to the selection of the site in order to avoid problems in the disposal of waste liquors.

The third zone selected was Cienfuegos, in the Province of Las Villas, with sixteen small sugar re-

<sup>5</sup> Although there is no immediate supply problem for petroleum—Cuba being situated sufficiently near three large petroleum-exporting countries—possible changes in supply would have to be carried out. Further, despite recent studies demonstrating that the proposed substitute fuels would actually be cheaper than the value of bagasse considered as a raw material for pulp, serious resistance to changing fuels would have to be faced, particularly in the older sugar mills. The main reasons would be the additional investment required to transform the sugar mills so as to utilize, store and transport the substitute fuel, together with the problem of handling the bagasse within the sugar mills.

fineries, which, owing to their small size, would probably be unable to supply sufficient excess bagasse to satisfy a pulp mill, unless the use of bagasse as fuel was completely discontinued.<sup>6</sup> On the whole, this is an ideal zone, considering its proximity to Havana, the principal paper market, and the excellent future electric power potentialities. However, the difficulties involved in organizing the replacement or improvement of the systems for generating or consuming steam in all the mills are so great that the possibilities of developing a pulp industry are slight compared with those of Camagüey or Oriente.

The eight sugar refineries considered in Camagüey Province (Adelaida, Algodones, Cunagua, Joroní, Morón, Punta Alegre, Stewart and Violeta) could together give sufficient raw materials to produce 40,000 tons of chemical pulp annually (see table 44). This is dependent upon the improvement in thermal efficiency of the boilers and other steam-using equipment in order to secure a greater volume of excess bagasse, which would be devoted exclusively to pulp production.

In the zone of Oriente, the six sugar mills, Boston, Chaparra, Delicias, Manatí, Preston and San Germán (see table 45), could supply raw material to produce 37,000 tons of pulp annually, assuming that 20 per cent of the total bagasse would be available, as in the case of Camagüey.

In Cienfuegos, the entire bagasse of the sixteen plants would have to be utilized in order to produce 147,000 tons of pulp a year, assuming complete substitution of bagasse as fuel (see table 46).

If the establishment of pulp mills in Camagüey and Oriente were reached, the total productive capacity of 77,000 tons would greatly exceed the requirements of the paper and paperboard industry—excluding newsprint production. In the event that it was possible to produce newsprint exclusively from bagasse, including sugar-cane pith,<sup>7</sup> the total productive capacity of the two zones would almost satisfy the demand for newsprint in addition to 40 per cent of the remainder of the paper and paperboard industry.<sup>8</sup>

<sup>6</sup> In the study, "Una Estrategia de Fomento de Largo Alcance", by Angel Ramón Ruiz, *Revista de la Sociedad Cubana de Ingenieros*, No. 2, 1952, the author also selected the Cienfuegos zone.

<sup>7</sup> Although the majority of the modern processes for producing chemical pulp have been based on the principle of eliminating a high percentage of cane pith, the only recent techniques evolved to date for the successful production of newsprint entirely from bagasse, have, on the contrary, universally specified its inclusion; *Study on Newsprint Expansion*, United States Department of Commerce, Washington, 1952.

<sup>8</sup> Total dry excess bagasse that could be available in the two zones of Oriente and Camagüey, or 238,000 tons annually, could be theoretically allocated to the industry by a distribution of 145,000 tons for the production of paper and paperboard, and 93,000 for newsprint. The production of newsprint derived from this quota would amount to 46,000 tons, equivalent to 87 per cent of the aggregate 53,000 tons estimated to be consumed by the country in 1965.

TABLE 41

*Cuba: Estimated future demand for paper, chemical pulp for paper and mechanical pulp*

(Thousands of metric tons)

		<i>Per capita demand for paper (kgs.)</i>	<i>Total demand for paper</i>	<i>Total demand for mechanical pulp<sup>c</sup></i>	<i>Total demand for chemical pulp<sup>c</sup></i>
Newsprint.....	1950 <sup>a</sup>	7.12	38	35	5
	1955 <sup>b</sup>	5.33	30	28	4
	1960	6.60	40	37	5
	1965	8.16	53	49	7
Other paper and paperboard.....	1950 <sup>a</sup>	18.84	99	9	59
	1955 <sup>b</sup>	19.38	109	10	65
	1960	24.34	147	13	88
	1965	30.54	197	18	118
TOTAL.....	1950 <sup>a</sup>	25.96	137	44	64
	1955 <sup>b</sup>	24.71	139	38	69
	1960	30.94	187	50	93
	1965	38.70	250	67	125

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total and per capita demands for paper for 1950 were based on tables 46, 47 and 48 of annex I. Inasmuch as imports are abnormally high, the apparent consumption for that year is higher than the estimates for the demand for 1955.

<sup>b</sup> Estimates of the 1955, 1960 and 1965 demands were calculated by correlating the world per capita demand for paper and the per capita income. The procedure used and the results obtained can be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demands for mechanical and chemical pulp, the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947:

<i>Mechanical pulp:</i> Newsprint	x 0.92	<i>Chemical pulp:</i> Newsprint	x 0.13
Other papers	x 0.09	Other papers	x 0.68
Paperboard	x 0.07	Paperboard	x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Cuban consumption:

<i>Mechanical pulp:</i> Other papers and paperboard	x 0.09
<i>Chemical pulp:</i> Other papers and paperboard	x 0.60



**TABLE 42**  
*Cuba: Expansion needs of the pulp and paper industry*  
(Thousands of metric tons annually)

	Present demand <sup>a</sup>	Installed capacity <sup>b</sup>	Expansion required now	Expansion needed in the future		
				Total 1955	Total 1960	Total 1965
<b>Newsprint:</b>						
Domestic.....	—					
Imported.....	38					
<b>TOTAL NEWSPRINT</b>	<b>38<sup>b</sup></b>	<b>—</b>	<b>38<sup>b</sup></b>	<b>30</b>	<b>40</b>	<b>53</b>
<b>Other paper and paperboard:</b>						
Domestic.....	34					
Imported.....	65					
<b>TOTAL OTHER PAPER AND PAPERBOARD</b>	<b>99</b>	<b>45</b>	<b>54</b>	<b>64</b>	<b>102</b>	<b>152</b>
<b>TOTAL PAPER AND PAPERBOARD</b>	<b>137</b>	<b>45</b>	<b>92</b>	<b>94</b>	<b>137</b>	<b>205</b>
<b>Chemical pulp:</b>						
Consumption of domestic pulp..	—					
Consumption of pulp imported as raw material.....	20					
To replace raw material contained in imported paper.....	44					
<b>TOTAL CHEMICAL PULP FOR PAPER</b>	<b>64</b>	<b>—</b>	<b>64</b>	<b>69</b>	<b>93</b>	<b>125</b>
<b>Mechanical pulp:</b>						
Consumption of domestic pulp..	3 <sup>c</sup>					
Consumption of pulp imported as raw material.....	—					
To replace raw material contained in imported paper.....	41					
<b>TOTAL MECHANICAL PULP</b>	<b>44</b>	<b>—</b>	<b>44</b>	<b>38</b>	<b>50</b>	<b>67</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures based on statistical data for 1950.

<sup>b</sup> Since figures were based on apparent consumption of 1950, which was abnormally high, and capacity increases required by 1955, 1960 and 1965, on the other hand, were based on what was considered normal consumption for 1950, the figures for the expansion needs for 1955, 1960 and 1965 are less than those for 1950.

<sup>c</sup> Figure was calculated on the basis of data of the domestic paper production. Since Cuba does not produce mechanical pulp and imports relatively small amounts, the paper industry uses equivalent amounts of waste paper and paperboard.

**TABLE 43**  
*Cuba: Calculated potential of sugar-cane bagasse as a source of raw material for chemical pulp, 1950*  
(Thousands of metric tons annually)

Province	No. of sugar mills <sup>a</sup>	Wet bagasse <sup>a</sup> (a)	Humidity <sup>a</sup> (b)	Percentage		Total fibre (e = a x d) 100	Usable fibre (f = 0.65e) <sup>b</sup>	Chemical pulp	
				Saccharose in bagasse <sup>a</sup> (c)	Fibre in bagasse (d = 100 - b - c)			If an alternative fuel is used for the boilers (g = 0.50f)	If only the surplus bagasse is used for chemical pulp (h = 0.20g)
Pinar del Río.....	9	420	47.1	3.0	49.9	210	136	68	14
Havana.....	13	832	48.5	3.7	47.8	400	260	130	26
Matanzas.....	24	1,159	48.7	3.5	47.8	555	361	180	36
Las Villas.....	50	2,374	48.1	3.5	48.4	1,150	748	374	75
Camagüey.....	24	2,751	48.2	3.1	48.7	1,340	871	436	87
Oriente.....	41	2,859	48.5	3.5	48.0	1,375	894	447	89
<b>TOTAL</b>	<b>161</b>	<b>10,395</b>	<b>48.2</b>	<b>3.4</b>	<b>48.4</b>	<b>5,030</b>	<b>3,270</b>	<b>1,635</b>	<b>327</b>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The number of mills, the quantity of wet bagasse and the percentages of humidity were taken from the *Sugar Report, 1947-1950*, Ministry of Agriculture, Republic of Cuba, 1951.

<sup>b</sup> It was estimated that the dry bagasse contains 65 per cent fibre, 25 per cent pith and 10 per cent foreign solid matter and solubles.

TABLE 44

Cuba: Calculated potential of sugar-cane bagasse from large mills selected in the Province of Camagüey

(Thousands of metric tons annually)

Mills	Wet bagasse <sup>a</sup> (a)	Humidity <sup>a</sup> (b)	Percentage		Total fibre (e = a x d) 100	Usable fibre (f = 0.65e) <sup>b</sup>	Chemical pulp	
			Saccharose in bagasse <sup>a</sup> (c)	Fibre in bagasse (d = 100-b-c)			If an alternative fuel is used for the boilers (g = 0.50f)	If only the surplus bagasse is used for chemical pulp (h = 0.20g)
Adelaida .....	109	49.5	1.8	48.7	53	34	17	3
Algodones .....	89	48.1	3.2	48.7	43	28	14	3
Cunagua .....	129	48.7	3.1	48.2	62	40	20	4
Jaronú .....	231	48.5	2.9	49.6	114	74	37	7
Morón .....	270	48.5	3.4	48.1	130	85	43	9
Punta Alegre .....	100	48.8	3.4	47.8	48	31	15	3
Stewart .....	197	49.6	3.7	46.7	92	60	30	6
Violeta .....	144	48.5	3.1	48.4	70	46	23	5
TOTAL	1,269	48.6	3.1	48.3	612	398	199	40

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The quantities of wet bagasse and the percentages of water and saccharose in the bagasse were taken from *Sugar Report, 1947-1950*, Ministry of Agriculture, Republic of Cuba, 1951.<sup>b</sup> It was estimated that the bagasse contains 65 per cent fibre, 25 per cent pith and 10 per cent foreign solid matter and solubles.

TABLE 45

Cuba: Calculated potential of sugar-cane bagasse from large mills selected in the Province of Oriente

(Thousands of metric tons annually)

Mills	Wet bagasse <sup>a</sup> (a)	Humidity <sup>a</sup> (b)	Percentage		Total fibre (e = a x d) 100	Usable fibre (f = 0.65e) <sup>b</sup>	Chemical pulp	
			Saccharose in bagasse <sup>a</sup> (c)	Fibre in bagasse (d = 100-b-c)			If an alternative fuel is used for the boilers (g = 0.50f)	If only the surplus bagasse is used for chemical pulp (h = 0.20g)
Boston .....	140	50.2	2.4	47.4	66	43	21	4
Chaparra .....	220	47.5	2.7 <sup>c</sup>	49.8	110	71	36	7
Delicias .....	282	48.5	2.7 <sup>c</sup>	48.8	138	90	45	9
Manatí .....	230	49.0	3.3	47.7	110	71	36	7
Preston .....	165	49.8	2.4	46.9	77	50	25	5
San Germán .....	165	49.8	2.6	47.6	79	52	26	5
TOTAL	1,202	49.1	2.7	48.2	580	377	189	37

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The quantities of wet bagasse and the percentages of water and saccharose in the bagasse were taken from *Sugar Report, 1947-1950*, Ministry of Agriculture, Republic of Cuba, 1951.<sup>b</sup> It was estimated that the bagasse contains 65 per cent fibre, 25 per cent pith and 10 per cent foreign solid matter and solubles.<sup>c</sup> Estimated.

TABLE 46  
Cuba: Calculated potential of sugar-cane bagasse in the Cienfuegos zone  
(Thousands of metric tons annually)

Mills	Wet bagasse <sup>a</sup> (a)	Percentage			Total fibre (e = a x d) 100	Usable fibre (f = 0.65e) <sup>b</sup>	Chemical pulp If all fuel for the boilers is substituted (g = 0.50f)
		Humidity <sup>a</sup> (b)	Saccharose in bagasse <sup>a</sup> (c)	Fibre in bagasse (d = 100 - b - c)			
Andresta.....	58	47.6	2.8	49.6	29	19	9
Angelita.....	39	48.7	3.0	48.3	19	12	6
Caracas.....	89	49.1	3.2	47.7	42	27	14
Constancia "A".....	100	47.5	3.0	49.5	50	33	17
Covadonga.....	52	49.8	3.0	48.2	25	16	8
Hormiguero.....	76	50.4	2.9	46.7	35	23	12
Manuelita.....	58	47.9	2.6	49.5	29	19	9
Pastora.....	37	48.9	4.1	47.0	17	11	5
Perseverancia.....	77	47.7	3.0	49.3	38	25	13
Portugalete.....	34	49.2	3.5	47.3	16	10	5
San Agustín "L".....	75	47.5	2.7	49.8	37	24	12
San Francisco.....	28	49.3	3.0	47.7	13	9	5
Santa Catalina.....	48	48.3	3.0	48.7	23	15	8
Santa María.....	60	48.6	3.7	47.7	29	19	9
Santa Rosa.....	40	46.4	3.1	50.3	20	13	6
Soledad.....	56	47.7	2.0	50.3	28	18	9
TOTAL	927	48.5	3.0	48.5	450	293	147

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The quantities of wet bagasse and the percentages of humidity and saccharose in the bagasse were taken from *Sugar Report, 1947-50*, Ministry of Agriculture, 1951.

<sup>b</sup> It was estimated that the dry bagasse contains 65 per cent fibre, 25 per cent pith and 10 per cent foreign solid matter and solubles.

## Chapter VIII. ECUADOR

### I. Estimates of future consumption of pulp and paper

Ecuador consumes some 8,000 tons of paper and paperboard annually, approximately half of which is newsprint. The present industry consists of one small paperboard mill, operating entirely with waste paper and producing 400 tons a year. Another mill is being built in Latacunga, 65 kilometres from Quito, which will have a capacity of some 3,000 tons annually, producing principally wrapping paper. The chemical pulp required will be manufactured by the "modified sulphate process", although it has not yet been decided what raw material will be used.

According to the estimates in table 47, consumption of newsprint in 1965 will be a little more than 10,000 tons annually, while approximately 13,000 tons annually of paper and paperboard will be required. This paper consumption as well as the consumption of the pulp that would be required as raw material are extremely low compared to the production that might be expected from mills of economic size. For this reason, it is considered that the objectives for a future development programme for paper and pulp in Ecuador should include a far greater capacity than that required by the domestic market alone; a large percentage of output should be devoted to export.

Consequently, it is important to study in detail the possibilities for pulp and paper exports, before trying to carry out any development programme.

### II. Principal resources for pulp and paper production in Ecuador<sup>1</sup>

The main Ecuadorean forest types are: the rain tropical forest, the temperate evergreen forest of broad-leaved species, the tropical forests of deciduous species, and the mangrove forests found in small swampy areas along the coast.

The rain tropical forests are the most important of the four, both in terms of area and of the amount of pulpwood available per unit of area. Such forests are found in the north-eastern lowlands, between sea level and the forests of the highlands, as well as in the vast and little explored region east of the Andes. They include a great variety of tree species: cedar (*Cedrela*), amarilla de Guayaquil (*Centra lobium*), tangare (*Carapa*), pechiche (*Miquartia*), laurel (*Cordia*), María (*Calphyllum*) and balsa (*Ochroma*).<sup>2</sup> Other secondary species, potentially important for pulp and paper, are: guarumo (*Cecropia*), Fernán Sánchez (*Triplaris*), sandé (*Brosimum*) and nigüito (*Muntingia*). Various types

<sup>1</sup> This section includes the observations of members of the FAO mission which conducted an extensive study of the possibilities for producing pulp and paper in Ecuador. The official report is at present being prepared and will include the final conclusions and recommendations for both short- and long-term plans.

<sup>2</sup> Balsa wood has always been exported in great quantities, particularly during the Second World War when Ecuador supplied 90 per cent of the Allies' requirements.

of palms are to be found in this type of forest, as well as bamboo (*Guadua*), which can often be found in pure stands along river banks.

The temperate broad-leaved evergreen forests first appear in the foothills, at 1,500–1,800 metres, and continue to the timber line, between 3,000 and 3,700 metres, thereafter gradually thinning out. The species typical of this type of forest are: *Cordia*, *Weinmannia*, *Nectandra*, *Eugenia*, *Heironyma*, *Billia*, *Alnus* and *Podocarpus*, but, owing to their relative inaccessibility as well as the rough terrain, they are not considered of great economic importance.

In the areas near Guayaquil the forests are of the tropical deciduous type. Except for the forest giants, *Enterolobium* and *Ceiba*, the majority of the trees are low and slender, growing in thin stands. Of these trees, the most important are: *Tabebuia*, *Bursera*, *Prosopis*, *Geoffraea Guacima*, *Schinus* and *Caesalpinia*. These forests are of little importance as sources for raw materials, since a large part of them have already been cut in order to open land for agriculture and livestock raising.

Most of the area between the western and eastern Andes mountain ranges is devoid of trees, being principally agricultural land. It is possible that forests did once exist, but must have been cut before the arrival of the Spaniards, when the population density of the highlands was greater than today.

Between the timber line (3,000 and 3,700 metres) and the snow line (4,500 metres) there are vast treeless areas, bare and cold, known as *páramos*, where the principal vegetation consists of a thick grass with a highly dispersed root-system. Adjoining this area, and on the frontier with Colombia, plants named *frailejones* (*Espeletia hartwegiana*) flourish, which have erroneously been suggested as a possible source for pulp inasmuch as the leaves are covered by thin hairs not unlike velvet.

The FAO mission studying the development possibilities for a paper industry in Ecuador is agreed that by far the best location for a paper mill based on pulpwood is at Esmeraldas, a port at the mouth of the river of the same name, or in any of the immediate surroundings. Here, the forests are most all virgin and are within a short distance of the town. In addition, the area has an abundant supply of the water so necessary for paper production and there is no problem of polluting the water sources. Since there is no possibility of installing a hydro-electric plant, owing to the level nature of the ground, the additional power necessary to supplement that produced by the alkali-recovery system would have to be generated by thermo-electric plants.

The paper produced in this area for domestic consumption could be transported by sea to Guayaquil and from there by railway to Quito. When the Esmeraldas-Quinindé sector of the Quito-Esmeraldas highway is completed, the output could be transported overland directly to Quito. Paper for export could be

embarked directly in Esmeraldas, utilizing the banana ships which call there frequently.

It is estimated that there are sufficient forests situated upstream within a radius of 80 kilometres of Esmeralda to supply indefinitely a production of 200 tons of paper daily. If necessary, additional raw materials could be brought by sea from the various forests bordering the Santiago river and its tributaries.

Within the immediate area of Esmeraldas, large quantities of guarumo (*Cecropia spp.*), known as cético in Peru, are found; this tree has proved to be suitable for the manufacture of chemical and mechanical pulps. There are also other abundant species which could be used to produce mechanical pulp, as well as semi-chemical pulp using the cold-caustic-soda process, or the "chemigroundwood" process.<sup>3</sup> The more important of these species are: Fernán Sánchez (*Triplaris*), ceiba (*Ceiba pentandra*) and sandé (*Brosimum sp.*). The heavier types of balsa (*Ochroma*), offer another source of raw material. In contrast with the lighter export type, these species are left untouched in the forest.<sup>4</sup> Research into all these trees should be made, both to produce mechanical pulp as well as the semi-chemical—cold caustic soda—pulp. It may be added that the pulpwood supply appropriate for chemical pulp is practically unlimited.

A further area that might be considered as a possible site for the industry is that of Guayaquil and its vicinity, which can be supplied with pulpwood using the Guayas river and tributaries. Although this area has considerable advantages over Esmeraldas in terms of labour supply, communications, accessibility, transport to Quito, etc., the raw material would have to be brought over longer distances since there are no extensive forests within 50 to 80 kilometres of Guayaquil. The species available are the same for this area as were indicated for Esmeraldas, and the situation in terms of water supply and waste elimination are similar. Special electric power plants would have to be installed for the paper mills, unless the hydro-electric plant on the Chimbo river near Guayaquil, now under consideration, could be utilized.

The relative advantages for a paper mill in Esmeraldas or Guayaquil are listed as follows:

	Esmeraldas	Guayaquil
Cost of equipment.....	Same	Same
Freight charges.....	Same	Same
Raw material:		
Wood.....	Cheaper	More expensive
Chemicals.....	Same	Same

<sup>3</sup> The completion of the highway to Quito will increase accessibility with regards the Quito market to a level as high or higher than that of Guayaquil.

<sup>4</sup> There are no data available for calculating the percentage of waste.

	Esmeraldas	Guayaquil
Fuel (petroleum or coal)	Same	Same
Electric power (to be developed).....	Same	Same
Water.....	Abundant	Abundant
Water pollution.....	No problems	Possible problems
Labour supply.....	Less plentiful	More plentiful
Housing facilities.....	To be constructed	No problems
Sanitary conditions....	Average	Average
Accessibility to market:		
Domestic.....	Less <sup>5</sup>	More
Export.....	Same	Same
General accessibility:		
Banks, etc.....	Less	More
Government agencies	Less	More
Communications....	Less	More

The possibility should be investigated in both areas, but particularly in Esmeraldas, for integrating the production of pulp and paper with other forest industries such as plywood or sawmills; an integration would reduce the general cost of supervision, power and public services, etc. It is well known that Esmeraldas has an abundant supply of certain species appropriate for plywood, as well as for lumber in general. Practically all the products from an integrated industry would be for export, although a proportion would undoubtedly be absorbed by the domestic market. Panama and the oil fields of Talara in northern Peru would be ready markets for lumber products.

There are also certain possibilities of utilizing sugarcane bagasse for the pulp industry. The largest sugar mills—San Carlos and Compañía Valdez—are situated near Milagro, in the Province of Guayas. Other mills of lesser importance—Isabel María, San Pablo and Inés María—are relatively nearby. A portion of the bagasse derived from these mills is used as fuel and the rest is considered as waste.<sup>6</sup> The total amount of bagasse could be used to produce approximately 40,000 tons of pulp, but in this case the mills would have to use some other fuel.

If the substitution of bagasse as a fuel were economically practical, Milagro could probably offer excellent conditions for the location of a pulp industry. There is abundant water supply, no problems relating to water pollution, and the present railway system could be used for transport not only to the immediate local markets but to Guayaquil, the most suitable port for export. It would be necessary to find an export market to absorb a large proportion of the output, since the production of paper from bagasse of this mill would be far higher than domestic consumption.

<sup>5</sup> See a description of these processes in chapter I.

<sup>6</sup> The heaviest types of balsam wood weigh 240 to 320 kilogrammes per cubic metre, whereas the type exported weighs 96 to 190.

TABLE 47

*Ecuador: Estimated future demand for paper, chemical pulp for paper and mechanical pulp*

(Thousands of metric tons annually)

		<i>Per capita demand for paper (kg.)</i>	<i>Total demand for paper</i>	<i>Total demand for mechanical pulp<sup>c</sup></i>	<i>Total demand for chemical pulp<sup>c</sup></i>
Newsprint.....	1950 <sup>a</sup>	1.77	6	6	1
	1955 <sup>b</sup>	1.34	5	5	1
	1960	1.66	7	6	1
	1965	2.05	10	9	1
Other paper and paperboard.....	1950 <sup>a</sup>	1.79	6	1	4
	1955 <sup>b</sup>	1.61	6	1	4
	1960	2.02	9	1	5
	1965	2.54	12	1	7
TOTAL.....	1950 <sup>a</sup>	3.56	12	7	5
	1955 <sup>b</sup>	2.95	11	6	55
	1960	3.68	16	7	6
	1965	4.59	22	10	8

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total per capita demands for paper for 1950 can be found in annex I. As will be noted, statistical data for 1950 are abnormally high so that the figures have not been used as a basis for estimating the later years.

<sup>b</sup> The estimates of demand for 1955, 1960 and 1965 were made by correlating the world per capita consumption of paper to per capita income, and by assuming various rates of annual increase of per capita income in Ecuador. The complete procedure and the results may be found in annex II. To simplify, this part of the report only shows the figures corresponding to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demand for mechanical and chemical pulp, the following conversion factors were used; these were approved, for use by FAO, at two international conferences on forestry statistics held in Washington and Rome in 1947.

<i>Mechanical pulp:</i> Newsprint	x 0.92	<i>Chemical pulp:</i> Newsprint	x 0.13
Other papers	x 0.09	Other papers	x 0.68
Paperboard	x 0.07	Paperboard	x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Latin-American consumption:

<i>Mechanical pulp:</i> Other papers and paperboard	x 0.09
<i>Chemical pulp:</i> Other papers and paperboard	x 0.60

## Chapter IX. MEXICO

### I. Summary and conclusions

At present, Mexico consumes about 267,000 tons of paper annually, of which only 27 per cent are supplied by imports, consisting of the 77,000 tons of newsprint used in the country and approximately 10,000 tons of specialty papers.<sup>1</sup> The industry is entirely self-sufficient in the production of mechanical pulp, though it still has to import about half of the 100,000 tons of chemical pulp needed as a raw material for its paper production.

Although there are substantial forest resources, as shown below, one of the industry's immediate problems is the inadequacy of the supply of fibrous raw material, mainly since the leading mills are located in the neighbourhood of the capital of the Republic where the sources of supply, formerly available, have gradually been exhausted. It is believed that a solution of this problem within the near future can be found largely through the tapping of the forests in the State of Guerrero, although it might also be possible to increase extraction in the State of Mexico, as may be seen from the results of a recent forest inventory carried out by modern methods. Over a longer period, supplies could be forthcoming from reforested areas of the State of Mexico, together with additional sources which could be located by means of careful study of other forest areas in the vicinity of the latter state. The sugar-cane bagasse in the State of Morelos might also be used by the central mills. However, rational management of the forests is essential in order to ensure an immediate supply of raw material for existing mills and later provide a basis for new industrial developments.

The degree of expansion necessary, if the industry is to meet domestic demand, including all raw materials and imported paper, would require a total of about 293,000 cubic metres of pulpwood, calculated on the basis of conifers. Future expansions will require 395,000 cubic metres by 1955, 737,000 by 1960 and 1,227,000 by 1965.<sup>2</sup> Either of the two main types of Mexican forests, that is, conifers or tropical forests, would be more than sufficient to meet this demand and even allow for exportable surpluses. Accounting for only the coniferous forests which have been studied and selected for five important projects in the States of Chihuahua, Durango, Michoacán and Guerrero, there would still be sufficient resources to meet any expansion of the industry up to 1965, provided they were used almost exclusively for the manufacture of

pulp and paper. However, as it is necessary to use a substantial part of the annual wood yield for other forest industries, thus reducing the aggregate operating costs, it is probable that by 1960 other forests would have to be used which have not yet been studied. There would be no difficulty in finding other supply areas within the States of Chihuahua, Durango, Michoacán and Guerrero, since their forest potential is at least three times greater than that of the aggregate areas of the five projects mentioned above. Although Michoacán could supply the raw materials required for a large industry, such as that considered in the project, this State does not offer very bright prospects for future expansion owing to the limited forest area which could be used.

To obtain some idea of the magnitude of Mexican forest resources, it is sufficient to indicate that the theoretical productive capacity of all Mexico's coniferous forests, in their present condition, is estimated at 16.5 million cubic metres annually. If only 33 per cent of this yield were used for the production of pulp and paper, leaving the remainder to other industries, there would still be sufficient pulpwood to meet, hypothetically, about 80 per cent of Latin America's paper consumption. Moreover, the existing coniferous forests contain a mixture of virgin sectors, areas which have been intensively exploited, and regions with normal yields. If the forests can be protected from excessive cutting, fire and pests, and if adequate forest management is applied, in forty or fifty years' time their total yield could be increased to 36 million cubic metres annually. Even assuming that only 33 per cent of this amount is used for the production of pulp and paper, the theoretical pulp volume which could be produced would still be equal to more than two-thirds of that of Sweden.

However, the utilization of conifers must be limited to much lower figures than the theoretical potential, owing to certain disadvantages in the regions where these species are located. First, nearly all the forests are located on very mountainous country, limiting their accessibility, so that a number of areas, which still contain virgin forest, cannot be easily or cheaply reached for transport. The roughness of the country would also account for higher wood extraction costs since highly mechanized equipment cannot be used in felling or transport. The forest areas tributary to adequate mill sites would therefore be limited in extension, implying a serious restriction as to the maximum capacity of the mills. Secondly, with the probable exception of Michoacán and Guerrero, little water is available for manufacturing processes or for the generation of hydro-electric power, thus reducing the number of locations which would be suitable for mills.

Broadly speaking, it may be said that the distances between the forest stands, the ports and the leading markets are very great, exercising a decisive influence upon the cost of certain products, such as newsprint

<sup>1</sup> The figures contained in this paragraph refer to estimates for 1952.

<sup>2</sup> See table 50 for estimates of the increases required in the capacity to produce paper, chemical pulp and mechanical pulp, and table 51 for details concerning pulpwood requirements. To simplify the calculation, all estimates of future consumption or expansions of future capacity correspond to average figures, assuming an average rate of increase of 3 per cent per capita income. Annex II shows estimates of higher or lower future consumption according to other rates of expansion of per capita income.

or paper pulp, which must be sold at a low price in order to compete with large mills abroad, located in sites ideally located in regard to all the factors of production.

Comparing conditions in these four regions, namely Chihuahua, Durango, Michoacán and Guerrero, it becomes apparent that Michoacán is the most suitable for pulp production since it has forests which grow fairly rapidly, abundant water supplies, excellent hydro-electric potentials, and sites which are suitable for establishing mills. Moreover, these sites are quite close to the most important domestic market, namely the Federal District, and they are well served by road and railway communications. However, the size of the forests and the existing growing stock would prevent large-scale mills, such as those required for the cheapest manufacture of newsprint. Nevertheless, it is believed that the present resources are adequate to supply a mill of sufficient size to eliminate the present pulp imports. In future, it might be possible to add a mill producing the types of paper requiring a high proportion of chemical pulp, but very little mechanical pulp. Given sound management, the growing stock could undoubtedly be increased at least twofold in the next forty years.

Durango is probably the best region in Mexico for the development of a newsprint industry, since its extensive forests contain suitable raw materials for mechanical pulp, located at a reasonable distance from Mexico City. Its forests grow more slowly than those of Michoacán, but there are still large virgin areas. Electric power and water availabilities are fewer than in Michoacán, but there are several suitable sites for mills which could adequately be supplied with these two factors of production. As noted earlier, conditions for pulpwood transport to the probable mill sites and the distance between these sites and the market in Mexico City are less attractive than in the case of Michoacán.

Chihuahua has greater forest resources than Durango, but the yield per unit of surface is lower for the same type of forest. On the other hand, the quality of its wood is better than in other coniferous areas, the physical characteristics being more suitable for other forest industries which would be integrated with the production of pulp and paper. The forest stands are at a considerable distance from the centre of the Mexican market; thus, it is not probable that products with a low economic value per unit of weight, such as newsprint, could be marketed profitably. However, the United States, an importer of newsprint, is adjacent and could be reached by any of the three railways linking the forest region of Chihuahua with the frontier.

Conditions described above suggest that Chihuahua should produce commodities of a high economic value—such as chemical pulp for rayon or for high-quality papers—destined for the Mexican market, or newsprint for the United States market.

There is no doubt that Guerrero contains the richest and most compact forest area, made up principally of virgin forests with a high yield. There is likewise an ample supply of good water. However, the region is handicapped by the lack of adequate communications and the topographical obstacles which hamper their construction. It is hoped that the building of the projected railway from Mexico City to Acapulco will greatly improve this situation. Owing to its relative close proximity to the capital, it would certainly merit

early attention for the preparation of a sound forest inventory as a basis for planning forestry and industrial development.

Although considerable attention has been given to the development of pulp industries on the basis of conifers, since this is the classic raw material for world production of pulp and paper, it is believed that the tropical forests of Mexico may be of greater importance than those of the temperate conifers in connexion with future projects for the development of a pulp and paper industry. The Yucatán peninsula, in which there is an abundance of broad-leaved species, offers some advantages not encountered among the pine forests. These include the facility for extracting wood by highly mechanized methods, since there are extensive areas of fairly flat land. Moreover, the forests are close to the sea, offering easy access not only to Mexican ports but to the southeastern ports of the United States, and the whole of the Caribbean area, including Central America, Colombia and Venezuela. There are species of considerable commercial value such as mahogany and Spanish cedar, which, in an integrated industrial system, would greatly increase the profitability of the business venture as a whole. There are almost unlimited raw material resources, and modern lumbering enterprises have not only built roads but have introduced highly mechanized equipment. They have also solved many social problems related to health and labour welfare, which always arise when any attempt is made to develop a tropical forest.

The company working at Colonia, Yucatán,<sup>3</sup> has begun pulping tests with the species remaining in the forest after removing the more valuable timber. The results have been satisfactory, like those obtained by the Régie Industrielle de la Cellulose Coloniale in the pulping of mixed tropical African woods. It may therefore be assumed that there will be no serious technical problems in producing suitable pulps for paper in Yucatán.

The area worked by the Colonia company alone could supply sufficient raw materials to produce 100,000 to 150,000 tons of pulp annually, and the 5 million hectares of tropical forests in the Yucatán peninsula theoretically could provide a larger volume of pulp than is consumed by Latin America as a whole. The restriction on this hypothetical possibility arises not only from the fact that the area of raw material supply cannot be extended beyond certain economic range, but also because, as far as current knowledge permits, it is believed that pulp from tropical woods cannot be as widely used as that of conifers.

As in many countries, in Mexico there are other possibilities for obtaining raw materials for the paper industry. Among these reference should be made to sugar-cane bagasse, for which a small mill is now being built, and the use of bamboo and caña de Castilla. Excluding developments aimed at supplying raw materials to mills located far from the rich forest areas, it is considered that Mexico should primarily focus its attention on its forest resources. This is not only because the forests are plentiful and can supply the cheapest form of fibrous raw material, but also because the pulp and paper industry, as an integrating element for other wood industries, could benefit from wealth which is now being wasted and would lead to increased productivity and improvement of virgin forest

<sup>3</sup> Maderera del Trópico, S.A.



areas which at present do not contribute anything to the national or regional economy.

In selecting some forest regions in preference to others for the development of Mexico's paper industry, it is necessary not only to take into account the factors determining the short-term profitability of the enterprises, but to recall that the establishment of large pulp and paper mills is one of the most effective means of ensuring the preservation, management and enrichment of the forest. The lack of mobility of large mills and the consequent need to guarantee pulpwood supplies within reasonable distances compel the companies to rationalize the development of their resources and to establish services which will prevent forest fires, pests and over-cutting. This reason would be sufficient to justify, within the scope of national industrial policies, the granting of priorities for the establishment of mills in the coniferous regions—which have suffered most and are still frequently subjected to pests, forest fires and excessive cutting.

## II. Productive capacity and consumption

### A. PRODUCTIVE CAPACITY AND CONSUMPTION OF PAPER

At present, Mexico consumes about 77,000 tons of imported newsprint and 190,000 tons<sup>4</sup> of other paper and cardboard, produced almost entirely by domestic industries.<sup>5</sup> Until 1934, one of the more important newsprint mills produced sufficient quantities to supply the Mexican market, but, owing to the withdrawal of the tariff protection it had formerly been granted, it suspended production of this commodity, employing its productive capacity for the manufacture of other types of paper.

The industry comprises twenty-five mills which, for the most part, are small. Only seven of them produce mechanical pulp and only four have any output of chemical pulp.<sup>6</sup> With the exception of one of the mills, the whole Mexican paper industry is at present located near the main markets and at a considerable distance from the large potential sources of raw materials. Consequently, the mills preparing their own chemical or mechanical pulp are often affected by a chronic scarcity of pulpwood which, in turn, prevents the full use of their capacity. It is estimated that the mills located near the capital of the Republic could increase their paper production by 15,000 tons annually (20 per cent) without any need for new equipment, providing they were able to obtain sufficient raw materials to operate at full capacity.

Table 49 shows estimates of paper, mechanical and chemical pulp consumption for 1955, 1960 and 1965.<sup>7</sup> Based on these estimates and on the data for total existing installed capacity, it may be assumed that the newsprint industry will have to expand its production to a level of 91,000 tons annually by 1955, 127,000 tons by 1960 and 177,000 tons by 1965 (see table 50).

If existing capacity were fully employed in the manufacture of paperboard and types of paper other

<sup>4</sup> These figures are estimates for 1952. Production, import, export and apparent consumption series are shown in tables 87 to 93 of annex I.

<sup>5</sup> About 10,000 tons of wrapping, writing and printing paper are imported annually.

<sup>6</sup> See table 48 for the geographical distribution and structure of the industry.

<sup>7</sup> See complete estimates in annex II.

than newsprint, no new installations would be required until 1955–60, when it would become necessary to add 56,000 tons of productive capacity. However, by 1965 it would again have to be increased so as to reach a total of 178,000 tons. If the total installed capacity were not fully employed, an increase of about 30,000 tons would be required by 1955, and by 1960 and 1965, totals of 116,000 and 238,000 tons per year, respectively, would have to be attained, exclusively for the production of paperboard and paper other than newsprint.

Various studies have been made with a view to the establishment of newsprint mills, but thus far no project has yet been carried out. Definite programmes for the development of productive capacity for paperboard and other paper generally refer to small expansions of existing mills.

### B. PRODUCTIVE CAPACITY AND CONSUMPTION OF CHEMICAL PULP FOR PAPER

Mexico at present consumes about 100,000 tons of chemical pulp for paper annually, of which about 70 per cent is unbleached.<sup>8</sup> If the pulp contained in imported paper is also computed, total consumption would reach a figure of 116,000 tons annually. It is estimated that domestic chemical pulp production is only 50,000 tons, although installed nominal capacity is 93,000 tons annually. This low degree of the utilization of existing equipment is mainly due to the shortage of pulpwood in the largest mills located in the Federal District or its neighbourhood.

It is not believed advisable to increase the capacity of these mills, but it is considered necessary that a study should be carried out regarding the extension or better integration of the Atenquique mill, in the State of Jalisco. Its capacity, which at present is fully employed, could probably be increased by extending its extraction operations to include the forests in the municipalities of Atoyac and Tapalpa, in that same State. The extension of Atenquique's exploitable area would make it possible to consider an integrated industry and thus avoid the waste involved in converting high grade logs into pulp in a region where economic development will demand greater supplies of sawn timber.

Based on figures for future demand for chemical pulp, as shown in table 49, and taking into account existing installed capacity, it is estimated that the capacity of the industries producing chemical pulp for paper must be increased by 37,000 tons before 1955, 89,000 tons before 1960 and 164,000 tons by 1965 (see table 50). If, for any reason, existing capacity cannot be fully employed, the preceding figures would have to be raised to 80,000 tons, 132,000 tons and 207,000 tons, respectively.

At present, there are at least five projects for building large mills for the manufacture of pulp for paper, using the conifers of Chihuahua, Durango, Michoacán and Guerrero. One of the Chihuahua projects is at an advanced stage of execution and machinery has already arrived at the site. Although the mill was originally planned only for dissolving pulp, it will

<sup>8</sup> The composition of pulp consumption is approximately as follows:

Unbleached sulphate.....	56%
Unbleached sulphite.....	17%
Bleached sulphite.....	14%
Semi-chemical pulp.....	8%
Others.....	5%

produce 20,000 tons of rayon pulp and 26,000 tons of pulp for paper.

Because it is located in the Federal District, one paper mill has difficulties in obtaining its raw materials and has therefore acquired equipment to produce 9,000 tons of pulp at Ayotla, in the State of Mexico, using bagasse from the sugar mills in the State of Morelos. The same raw material will be used by another mill under construction at Texcoco. Another large mill, which at present produces 6,000 tons of sulphate wood-pulp annually, is considering expanding its capacity to 18,000 tons if it can solve the problem of fibrous raw material supplies. Preliminary studies have also been made to use tropical woods from the forests of Yucatán. In addition, a pilot plant was established at the Xicoténcatl sugar mill, in the State of Tamaulipas, to study the utilization of sugar-cane bagasse as an initial stage in the project for a pulp and paper mill producing 15,000 tons annually.

#### C. PRODUCTIVE CAPACITY AND CONSUMPTION OF MECHANICAL PULP

The Mexican paper industry at present consumes about 15,000 tons of mechanical pulp yearly, produced entirely by mills integrated with the paper industry. Including the mechanical pulp also contained in imported paper, mainly in newsprint, Mexico's total mechanical pulp consumption is equivalent to 86,000 tons annually. Total capacity to produce this raw material is estimated at 63,000 tons, which figure is well above actual production levels. Even assuming that these estimates were made with a wide margin of error, since full data are not available particularly as regards production, it is obvious that existing capacity is not fully employed, largely due to the shortage of pulpwood in the mills located in or near the Federal District.<sup>9</sup> Occasions have been known where these mills have had to obtain pulpwood from points as much as 1,000 kilometres away. The seven mills producing mechanical pulp are integrated with paper mills and none of them is near the main forest regions.

Since it is very probable that any future increase in the capacity to produce mechanical pulp will depend on new mills located at considerable distances from the larger consumer centres but near to the sources of abundant fibrous raw materials, future development needs (see table 50) were calculated regardless of existing capacity, accounting only for the demand created by newsprint production, the principal consumer of mechanical pulp. According to these estimates, future requirements would call for a capacity of 84,000 tons annually by 1955, 117,000 tons by 1960 and 163,000 tons by 1965.

At present there is a project to produce mechanical pulp for newsprint by utilizing the forest resources of Durango. However, construction has not yet started.

#### D. PRODUCTIVE CAPACITY AND CONSUMPTION OF DISSOLVING PULP

Mexico consumes about 20,000 tons of rayon and acetate, which is approximately equivalent to 21,000 tons of the dissolving pulp required for the manufacture of these products. No mill producing this type of pulp has yet been established, but considerable progress has been made on one project to utilize the *ponderosa* pine of Chihuahua for an annual production

<sup>9</sup> One of these mills is further hampered by a shortage of electric power for its grinders.

of 20,000 tons, which would be sufficient to meet domestic demand.

### III. Development possibilities based on conifers

#### A. COMPARISON OF FUTURE PULPWOOD REQUIREMENTS WITH THE PROBABLE VOLUME AVAILABLE

Mexican conifers are concentrated principally on the Western Sierra Madre and on the Sierra Volcánica Transversal, between altitudes of 1,200 and 3,300 metres. The largest stands are found between altitudes of 1,600 and 3,000 metres above sea level. Broadly speaking, they may be said to be in a long narrow strip running from the United States border to the vicinity of Oaxaca, remaining well within the western half of the country.

The greater part of the existing chemical and mechanical pulp industry has obtained its raw material supplies from forests located in the neighbourhood of Mexico City, while only one mill (the most modern of all) is established fairly far from the Federal District, which is the largest consumer. This mill is, however, near the forest stands of the Western Sierra Madre.

Pulpwood requirements for the existing industry and the expansion of capacity which will be necessary if Mexico is to supply its own domestic market, are shown in table 51. This table is based on the conversion of capacity tonnages to annual volumes of pulpwood supply on the assumption that only conifers will be used, and that 5 cubic metres per ton of chemical pulp and 2.5 cubic metres per ton of mechanical pulp would be employed.

As will be shown below, there is no problem in supplying the necessary increases in the country's capacity, if future mills are located in the rich forest areas far from Mexico City. One important problem at present is the continuity of supplies for the main mills located in the Federal District and its neighbourhood, since the pulpwood must be brought from a considerable distance. Although the forest resources available to these mills have decreased, it is believed that careful study of availabilities might provide a solution to ensure future supplies for these mills. In certain regions of the States bordering on the Federal District, the forests have a remarkable rate of growth (yields of 5 to 10 cubic metres per hectare annually). Although no data are available at present regarding total prospects, it is believed that there will be adequate resources to supply chemical and mechanical pulp mills located in the Federal District and in the State of Mexico. However, it is not considered advisable to allow their capacity to increase in the future, without previously making a careful study of wood extraction possibilities.

With a view to comparing future pulpwood requirements with the potentialities of the sources of fibrous raw material, only the areas in Chihuahua, Durango, Michoacán and Guerrero were chosen, since they contain the most extensive and richest pine forests in the country. This does not mean that the possibilities of tropical woods (discussed below) or the forests of Puebla, Veracruz and Mexico should be ignored. The latter might also contribute to solving the problem of pulpwood shortages for the mills located in the Federal District or its vicinity.

Since complete forest inventories have not yet been made, a very conservative comparison of potentiality

was used in the first instance, with figures obtained from preliminary studies for the five specific projects prepared by private enterprises for establishing pulp and paper mills. If the volume of wood required annually to meet the demand of the paper industry (table 51) is compared with the volume of wood which it is hoped to obtain from the Durango, Chihuahua, Michoacán and Guerrero projects (table 52), it will be seen that the aggregate annual yield (3,100,000 cubic metres) is more than sufficient to supply the expansion which will be necessary in the industry by 1965 (1,227,000 cubic metres). In fact, it is even greater than the total volume of wood required by the existing industry and its needed expansions by 1965 (1,775,000 cubic metres annually). However, it would be incorrect to consider that Mexico could exclusively use this forest yield for pulp and paper production, since these products require extremely cheap raw materials which can only be obtained as waste in the manufacture of other forest products of greater economic value, such as sawn wood and timber for construction and railway sleepers. Therefore, lower figures were shown in table 52 for the volume of pulpwood to be used for chemical and mechanical pulp. With this degree of integration, the volume of pulpwood which could be used to produce chemical and mechanical pulp (1,210,000 cubic metres annually) is slightly lower than that required for the increases of capacity necessary by 1960 (1,227,000 cubic metres annually). This indicates that, although the quantity shown in the specific studies of Chihuahua, Durango, Michoacán and Guerrero is sufficient for all the short-term potential developments, it is absolutely essential, even in the above-mentioned States, to undertake new studies to establish further raw-material possibilities after 1965.

The need for these studies is fully justified by the total potential resources of the three regions mentioned. According to the data in table 53, which are considered as conservative, total potential forest resources in Chihuahua, Durango, Michoacán and Guerrero should provide sufficient raw materials for all the developments in the industry designed to supply the domestic market by 1965. In addition there should be an exportable surplus of products equivalent to 250,000 tons of chemical pulp annually even allowing for the fact that only a small percentage of the forest yield would be used for the manufacture of mechanical and chemical pulp. Although these figures should merely be taken as indicative of orders of magnitude, they show that, in these four States alone, there are abundant supplies of raw materials which will become effective resources as soon as they are studied and measured, and highways are built to make them accessible.

Table 54 indicates total potential resources of the pine forest in Mexico, both in their present state (which consists of a mixture of exhausted, normal and virgin forests) and under the ideal conditions attainable if protective measures and forest management were able to renew those sectors which have been overcut and if normal production could be obtained from the virgin forests. In their present state, the pine forests would have an annual theoretical yield of 16,500,000 cubic metres of which, in an estimate of integrated industries, a total of 5,500,000 cubic metres could be used for chemical and mechanical pulp production. This amount, incidentally, would be equivalent to all the pulpwood necessary to produce the

entire paper consumed in Latin America. If all the pine stands could be duly regenerated, within some forty to fifty years there would be a total potential of 36 million cubic metres, of which theoretically 12 million cubic metres annually could be used for the production of chemical and mechanical pulp, within a system of integrated industries. This amount could theoretically be used to manufacture more than two thirds of the pulp produced in Sweden.

## B. UTILIZATION OF THE CONIFEROUS FORESTS OF MICHOACÁN

The Michoacán region appears to have the greatest annual average yield of wood per hectare among areas which at present are fully accessible. It is also suitable from the standpoint of water, electric power and transport facilities, as well as its proximity to the most important domestic market, namely Mexico City. However, in contrast with other areas, its total potential as a source of raw materials is limited since the forest stands which can be used are rather small (see table 53). Nevertheless, at least one pulp mill of economic size could be supplied with fibrous raw materials from this area. Owing to limitations for expansion, it would be better not to plan for newsprint production but to aim preferably at producing the volume of chemical pulp which is at present in short supply.

### *Species*

Among the predominant *pinus* species in Michoacán, the following are the most common: *oocarpa*, *pseudostrobus*, *hudsii*, *tenuifolia*, *michoacana*, *hartwegii*, *montezumae*, *pringley*, *teocote*, *leiophylla*, *ayacahuite* and *lawsoni*. There is also a relatively small amount of spruce (*Abies religiosa*) which is particularly appropriate for mechanical pulp. No complete studies have as yet been made concerning the adaptability of all of the pine species for pulp production, but, based on the results obtained in various places with different pines, it is believed that there will be no problems, at least in so far as sulphate pulp production is concerned. The areas which are accessible in the neighbourhood of Uruapan, particularly from the railways and highways connecting that city with the capital of the Republic, could produce at least 50,000 tons of woodpulp annually.

It is believed that the normal yield of the forest would be 4 cubic metres per hectare annually, which compares favourably with the average annual yield of the Swedish forest.<sup>10</sup> Natural reforestation can be carried out without any difficulty.

### *Water*

If the site selected for the mill were close to Uruapan, very pure water could be obtained from the rivers and springs which would probably require no treatment whatsoever before utilization in the mill. This is a considerable advantage as compared with possible sites in other States where the purification of river water or the pumping of water from wells involves a substantial increase in production costs.

### *Transport*

Some of the existing highways can be used to extract the pulpwood. The network is well distributed but

<sup>10</sup> According to Th. Streyffert, in his book *The Forests of Sweden*, the annual growth of the forests in northern Sweden is 1.58 cubic metres per hectare, whereas in the central and southern part of that country it is 2.82 cubic metres per hectare.

needs to be completed and improved. The ground is not so rough as in the States of Durango and Chihuahua and therefore the stands can be reached with less difficulty. As regards the supply of other raw materials, fuel and transport of the finished product, it should be recalled that the region has excellent railway and highway communications with Mexico City, 500 kilometres away, and with other rail and road systems of the country. The nearest port is Manzanillo, some 750 kilometres away, but it has been planned to complete the railway which is to link Caltzontzin (near Uruapan) with the port of Zihuatanejo, thereby providing the area with an outlet to the Pacific, approximately 350 kilometres distant.

#### *Electric power and fuel*

Generally speaking, the region has greater future possibilities for electric power utilization than the other States studied since Michoacán will probably become the main centre for generating electric power in Mexico. The Zumpimito plant should soon supply a small amount of electric power to the Uruapan area. The main electric power supply in the region will probably come from El Cóbano, which should enter operation in the southern part of the area, in December 1953, producing 52,000 kilowatts immediately and about 300,000 kilowatts in five or six years' time. There is also a future possibility of obtaining coal from the neighbourhood of the Sayula lagoon in the State of Jalisco, little more than 500 kilometres from the forest area under consideration. Fuel oil can be obtained from Salamanca, in the State of Guanajuato, 273 kilometres from Uruapan.

#### *Lime*

It will be necessary to conduct research into the possibility of using lime produced in the region itself, although the high quality lime produced at Apasco (State of Hidalgo), which is 600 kilometres away by rail, could be used. The resources of Huescalapa, in the neighbouring State of Jalisco, might also be utilized.

#### *Salt and sodium sulphate*

The salt would have to be brought from Texcoco, near Mexico City, unless the railway planned from Uruapan to Zihuatanejo could offer cheaper transport from the salt marshes of the Pacific Coast. Sodium sulphate could be obtained from the Viesca lagoon, in the State of Coahuila.

#### *Sulphur*

If for any reason it was decided to use the sulphite rather than the sulphate process, there are several domestic sulphur deposits which could be used. Among the leading sources, reference should be made to those at Cerritos, San Luis Potosí; the by-products of roasting the ores, in Coahuila; the by-products of gas at Poza Rica, in the State of Vera Cruz; and the salt deposits in the Isthmus of Tehuantepec.

### C. UTILIZATION OF THE CONIFEROUS FORESTS OF DURANGO

As noted earlier in contrast with Michoacán, Durango has substantial forest resources which could supply large-scale pulp and paper industries integrated with saw-mills and other forest industries. On the other hand, Durango has fewer economic advantages, particularly as regards proximity to the capital of the

Republic where almost 80 per cent of the domestic market for pulp products is concentrated.

If both Durango and Chihuahua were to be used in developing a pulp and paper industry solely for the purpose of supplying the Mexican market, it might be logically assumed that Durango would be better suited to produce newsprint or other products which cannot stand heavy freight charges, while Chihuahua would be more appropriate for the manufacture of products with a higher economic value.

#### *Species*

The main species in the Durango forests are the *montezumae*, *arizonica*, *avacahuite* and *ponderosa* pines. Natural regeneration appears to offer no problem and it may be assumed that these species can be used to produce mechanical pulp, although no experiments have yet been made. However, these species have been used successfully in the production of sulphate pulp. The average forest yield is about 3 cubic metres per hectare annually, and the location of a mill so as to make the best use of rich virgin zones with an extremely high immediate yield would amply compensate the costs of building and maintaining roads across the uneven terrain.

#### *Water*

Some research has been conducted into locating the mills at specific points, with indications that sufficient water for the large pulp and paper mills could be found in the vicinity. It is probable that supplies would have to be obtained from wells.

#### *Transport*

Generally, the pulpwood extraction and transportation will be more difficult than in the case of Michoacán since the ground is very uneven. Investigations show that raw materials would have to be carried over 60 to 80 kilometres to suitable mill sites chosen for their proximity to road and rail communication and water supply as well as other essential factors of production. It is believed that the pulpwood will have to be transported by road only, since the terrain is too rough for railways.

As regards the transport of other raw materials and of the finished products, this area has good railway connexions with the capital (about 1,100 kilometres) and is adequately connected with the whole railway system. The city of Durango is linked by a paved road with the highway network of the country. Work on the railway from Durango to Mazatlán has been held up for a good many years on the stretch between Aserraderos and Mazatlán—a distance of 273 kilometres. However, when it is completed the forest area of Durango will have access to the sea at a distance of little more than 400 kilometres.

#### *Electric power and fuel*

The possibilities of using hydro-electric power are considerably less than for Michoacán, but nevertheless they are better than in Chihuahua. Up to the present, no complete study has been made regarding utilization of the falls near the sites which are suitable for mill locations. It is known, however, that the Federal Electricity Commission proposes to build a 50,000-kilowatt hydro-electric plant on the Río Verde near the city of Durango. If the industry were located in the northern part of the State, it would also be possible to use power from the Palmito Dam, which, at the outset, will generate 30,000 kilowatts. Fuel oil

could be transported from Salamanca, Guanajuato, which is 746 kilometres from Durango. In the future, there will be a closer supply source at Lagos, Jalisco, when the petroleum distribution centre is completed there. Coal could be supplied from Sabinas, Coahuila (800 kilometres approximately) or from the Sayula area, Jalisco (1,150 kilometres approximately), if the deposits there prove suitable.

#### *Salt, sodium sulphate and sulphur*

Salt could be obtained from the Viesca lagoon, in Coahuila (350 kilometres approximately), or on the coast at Colima when the railway from Durango to Mazatlán is finished. Sodium sulphate could also be brought from the Viesca lagoon. The nearest sulphur source would probably be that of Cerritos, in San Luis Potosí.

#### D. UTILIZATION OF THE CONIFEROUS FORESTS OF CHIHUAHUA

Chihuahua has excellent forests producing stands of higher quality than any others in Mexico. The trees are high and clean, growing where there are practically no weeds or broad-leaved species. However, their growth, and consequently the yield per unit of area, is less than in the States of Durango and Michoacán. As a result of the quality of the forests, the regions which are most accessible from the railways have been intensively cut, but even in such areas sufficient raw material for the manufacture of mechanical and chemical pulp can be obtained, since the saw-mills have limited their felling to trees of more than 50 centimetres in diameter at breast height. However, for reasons already noted earlier, the utilization of these forests for the production of pulp and paper must be limited to the richer zones where trees of a large diameter could be used in industries integrated with the paper mills so as to lower over-all production costs.

At least three studies have been carried out on the utilization of the forests of Chihuahua for the pulp and paper industries. One of these reports selected a site in the north-western part of the State and the other two chose areas nearer, but to the west, of the city of Chihuahua. One of these studies consists of a project for a sulphite pulp mill for rayon, where building will soon begin.

Broadly speaking, Chihuahua's forest resources are as abundant as those of Durango and wood extraction is easier since the ground is less uneven. On the other hand, the greater distance between this area and the market of the Federal District (more than one and a half times as far as Durango and more than three times as far away as Michoacán) will probably limit its production to speciality papers or to high-grade pulps of appreciable value per unit of weight, since current products such as newsprint, owing to their low economic value, could not be carried cheaply over such long distance. However, if a market could be found to the north, Chihuahua would be ideally located for the manufacture of newsprint which the United States imports in large quantities.

#### *Species*

The *ponderosa* pine is the predominant species in Chihuahua. It appears to have less resin than other Mexican pines, but is harder and requires more energy per ton of mechanical pulp. Satisfactory experiments have been made with it in the manufacture of sulphate

and mechanical pulps. It is believed that natural regeneration presents no difficulties.

#### *Water*

In various sites selected as probable mill locations, pure, clean river water has been found, or, alternatively, the possibility of obtaining water supplies from artesian wells has been confirmed. However, generally speaking, prospects of obtaining this factor of production are less attractive in Chihuahua than in Durango and Michoacán.

#### *Transport*

The forest region in the north-east of Chihuahua is served by the North-Eastern Railway, which runs for 759 kilometres from the city of Chihuahua to Ciudad Juárez, a junction for the lines linking Mexico to the United States. Chihuahua is also served by the Mexican State Railways linking that city to the capital of the Republic (1,612 kilometres), with Ciudad Juárez (364 kilometres) and with the rest of the Mexican railway system. Chihuahua is also connected to Ojinaga, on the frontier with the United States, by a 270-kilometre branch line of the Kansas City, Mexico and Oriente Railway. The Pan-American Highway connects Chihuahua with Ciudad Juárez, Mexico City and the rest of the Mexican highway network.

Chihuahua has no port facilities, but, if the remaining stretch of the Kansas City, Mexico and Oriente Railway is built (230 kilometres), it will have access to the port of Topolobampo, 500 to 600 kilometres distant.

Roads and trails will have to be built to bring the pulpwood to the railways, but it may be a much less difficult task than in the case of the forest of Durango.

#### *Electric power and fuel*

Chihuahua has few hydro-electric resources for generating power. Its energy problem is more serious, since it has no other natural fuels which can be easily utilized. It would prove expensive to generate thermo-electric power by using petroleum from Tampico (1,374 kilometres) or Salamanca, or through imports from abroad. A more economic solution might lie in the utilization of coal from Sabinas, Coahuila, which is 780 kilometres away from the capital of Chihuahua.

#### *Salt, sodium sulphate and sulphur*

Salt could be obtained from any of the numerous salt lakes in the State of Chihuahua. It is fairly probable that sodium sulphate might also be found there, but, if not, it could be transported from Viesca (549 kilometres from Chihuahua). Domestic sulphur may possibly be available at Nueva Rosita, Coahuila (804 kilometres from Chihuahua) or at Cerritos, San Luis Potosí.

#### E. UTILIZATION OF THE CONIFEROUS FORESTS OF GUERRERO

The State of Guerrero appears to have the richest compact areas of coniferous forest, being largely virgin and capable of a high yield per hectare. A good percentage of the trees are tall, clean and cylindrical and contain a high percentage of material suitable for plywood and good-grade lumber. They appear to be relatively free of pests and diseases but are much ravaged by annual fires. The predominant species are *Pinus strobus* var. *chiapensis*, *Pinus tenuifolia* and *Pinus pringlei*.

Annual fires and abuses inflict a heavy drain on these forests, so it is imperative that they be opened soon to organized rational exploitation, which should provide considerable revenue for the development of the State. One area of 200,000 hectares is already proposed for pulpwood extraction, and an industrial unit<sup>11</sup> (Patria, S.A.) has been created with 18,000 hectares.

#### *Transport*

The country is distinctly rough and, at the moment, practically devoid of communications, although there is no reason to suppose that an efficient and economic system of access roads and extraction routes cannot be planned. At present, access roads would lead to the Mexico City-Acapulco road at an average distance of about 300 kilometres from Mexico City. However, the Mexico City-Acapulco Railway (constructed as far as Balsas) is a firm project that will considerably increase the accessibility of the forests. It would be advisable to survey the whole forests area by air in order to have a basis for a complete inventory and to provide maps suitable for planning communications. But before plans are made, the ultimate course of the railway should be ascertained to decide whether the main highway or the railway should be favoured.

#### *Water, electric power, salt and lime*

Available water is pure and clean and so abundant that, despite the roughness of the country, there should be little difficulty in selecting mill sites. No electric power is available at the moment and studies would have to be made in order to determine the possibility of hydro-electric generation in the neighbourhood of probable factory sites. Lime is burnt at present in the area and the source for salt would seem to be the salt marshes of the Pacific coast.

#### **IV. Development possibilities based on tropical woods**

Mexican tropical forests cover an area of about 10 million hectares and are principally located in the States of Veracruz, Tabasco, Chiapas and the Yucatán peninsula. Consideration of these forests was left to the end, not because they are believed to be less important than conifers, but simply to give priority to the type of resources which have thus far been the classic raw material supplies for the world's pulp and paper industry.

That part of Mexico which probably shows the best prospects for the pulp and paper industry integrated with other forest industries is the Yucatán peninsula. Its principal advantages in contrast to the disadvantages of the coniferous regions are: (1) the facilities for wood extraction and transportation with highly mechanized methods, since there are large tracts of fairly level ground; (2) proximity to the sea, so that the mills may be located on the edge of the forests and near to seaports; (3) the existence of species of a high commercial value such as cedar (*Cedrela mexicana*) and mahogany (*Swietenia macrophylla*) which, within an integrated industrial system, would increase the over-all profitability of the enterprises) and (4)

<sup>11</sup> By law, some forests belonging to different owners are grouped together in one unit, in order to facilitate their rational exploitation through adequate forest management.

an almost unlimited supply of raw materials.

Specific reference should be made to Colonia, where a modern lumber and saw mill for valuable species already exists.<sup>12</sup> This undertaking has already built about 400 kilometres of access roads, and it could have available as raw material for pulp all the trees left in a forest after felling a number of valuable species. This enterprise is working 1.2 million hectares of forests with a yield which, conservatively estimated, could supply sufficient raw materials to produce from 100,000 to 150,000 tons of pulp annually. (See table 55.) There is sufficient water at Colonia and the area is connected with the port of El Cuyo by means of a narrow-gauge railway 40 kilometres long. Salt is found at a distance of 40 to 50 kilometres, but electric power would have to be produced from wood waste or with fuel brought by ship from Minatitlán, Veracruz. There are some prospects of obtaining petroleum in the State of Yucatán, where wells are at present being drilled.

The market in Mexico City would be only about 1,000 kilometres away by ship and an additional 424 kilometres by railway. Since ocean freight costs one-fifth of railway freight, mixed transport from Yucatán to Mexico would represent little more than the equivalent of 600 kilometres by rail, comparing favourably with the corresponding changes from Durango (more than 1,000 kilometres) and Chihuahua (more than 1,600 kilometres). In addition, Yucatán has far better facilities for exports abroad, since a pulp mill would be located near the south-eastern United States, as well as the Caribbean area, Central America, Colombia and Venezuela.

Although the development of tropical forests has always been considered difficult, in the case of Colonia most of the problems such as housing and social welfare for the labour force have already been solved as well as transport and health services. The establishment of a supplementary mill, alongside the existing lumber industry, would therefore be a relatively simple undertaking.

As regards the abundance of raw materials resources for pulp, the Colonia firm, with the assistance of the laboratories of the United States Forestry Service, at Madison, Wisconsin, arrived at satisfactory results from pulping tests of the most abundant species, both individually and in mixed cookings. Moreover, the results obtained by the Régie Industrielle de la Cellulose Coloniale, in French West Africa, where successful experiments have been made with simultaneous cooking of mixtures containing up to twenty-five broad-leaved species, implies that satisfactory results may also be obtained by pulp production from the species found in Yucatán.<sup>13</sup>

In later studies regarding the utilization of resources in Yucatán, attention should also be given to the production of pulp by some of the modern semi-chemical processes, from which good results have been obtained with species resembling those found in this area.<sup>14</sup>

<sup>12</sup> Maderera del Trópico, S.A.

<sup>13</sup> See section III of chapter I for references concerning the work carried out by Régie Industrielle de la Cellulose Coloniale in the pilot plant at Abidjan, French West Africa.

<sup>14</sup> See section III of chapter I.

TABLE 48

## Mexico: Geographic distribution and installed capacity of the pulp and paper industry in 1952

(Capacity in thousands of metric tons annually)

State	Number of mills				Capacity of paper industry		Capacity of chemical pulp industry		Capacity of mechanical and chemical pulp industry				
	Paper only	Paper chemical pulp	Paper mechanical pulp	Paper chemical and mechanical pulp	Total capacity	No. of mills	Total capacity	No. of mills	Total capacity	No. of mills			
Federal District.....	6	1	5	—	12	12	8	15 <sup>b</sup>	1	15	25	5	5
Mexico.....	5	—	—	1	6	6	12	13 <sup>c</sup>	1	13	17	1	17
Nuevo León.....	2	1	1	—	4	4	9	29 <sup>d</sup>	1	29	21	1	21
Jalisco.....	—	1	—	—	1	1	34	36 <sup>e</sup>	1	36	—	—	—
Chihuahua.....	1	—	—	—	1	1	2	—	—	—	—	—	—
Puebla.....	1	—	—	—	1	1	2	—	—	—	—	—	—
TOTAL	15	3	6	1	25	25	10	93	4	23	63	7	9

Source: Economic Commission for Latin America and Food and Agriculture Organization: data for capacity was obtained principally from questionnaires completed by the mills, and from various other sources.

<sup>a</sup> Includes paperboard.

<sup>b</sup> Unbleached sulphate pulp.

<sup>c</sup> Approximately 7,000 tons of unbleached sulphate pulp, and 6,000 tons of unbleached sulphite pulp. This mill also has a capacity for producing 6,000 tons of semi-chemical pulp.

<sup>d</sup> Approximately 24,000 tons of unbleached sulphate pulp and 5,000 tons of soda pulp.

<sup>e</sup> Unbleached sulphate pulp.

TABLE 49

## Mexico: Estimated future demand for paper, chemical pulp for paper and mechanical pulp

(Thousands of metric tons annually)

	Per capita demand for paper (kg.)	Total demand for paper	Total demand for mechanical pulp <sup>a</sup>	Total demand for chemical pulp <sup>a</sup>
Newsprint.....	1950 <sup>a</sup>	1.57	40	37
	1952 <sup>b</sup>	2.10	77	71
	1955 <sup>c</sup>	3.24	91	84
	1960	4.01	127	117
	1965	4.96	177	163
Other paper and paperboard.....	1950 <sup>a</sup>	5.35	135	11
	1952 <sup>b</sup>	7.26	190	15
	1955 <sup>c</sup>	7.45	210	17
	1960	9.35	296	24
	1965	11.74	418	33
TOTAL.....	1950 <sup>a</sup>	6.92	175	48
	1952 <sup>b</sup>	9.36	267	86
	1955 <sup>c</sup>	10.69	301	101
	1960	13.36	423	141
	1965	16.70	595	196

Source: Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total and per capita demands for paper in 1950 were taken from annex I.

<sup>b</sup> Estimates based on market conditions at the beginning of 1952.

<sup>c</sup> The estimates of demand for 1955, 1960 and 1965 were made by correlating the world per capita consumption of paper to per capita income, and by assuming various rates of annual increase of per capita income in Mexico. The complete procedure, and the results, may be found in annex II. To simplify this part of the report, the figures correspond only to an average rate of increase of per capita income of 3 per cent per year.

<sup>d</sup> In calculating the total demand for mechanical and chemical pulp, the following conversion factors were used; these were approved, for use by FAO, at two international conferences on forestry statistics held in Washington and Rome in 1947.

Mechanical pulp: Newsprint x 0.92      Chemical pulp: Newsprint x 0.13  
 Other papers x 0.09                      Other papers x 0.68  
 Paperboard x 0.07                        Paperboard x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Mexican consumption:

Mechanical pulp: Other papers and paperboard x 0.08  
 Chemical pulp: Other papers and paperboard x 0.56



TABLE 50  
*Mexico: Expansion needs of the pulp and paper industry*  
 (Thousands of metric tons annually)

	Present demand <sup>a</sup>	Installed capacity <sup>b</sup>	Expansion required now	Expansion needed in the future		
				Total up to 1955	Total up to 1960	Total up to 1965
<b>Newsprint:</b>						
Domestic.....	—					
Imported.....	77					
TOTAL NEWSPRINT	77	—	77	91	127	177
<b>Other papers and paperboard:</b>						
Domestic.....	180					
Imported.....	10					
TOTAL OTHER PAPER AND PAPERBOARD	190	240	10 <sup>b</sup>	10 <sup>b</sup>	56	178
TOTAL PAPER AND PAPERBOARD	267	240	87	101	183	355
<b>Chemical pulp:</b>						
Consumption of domestic chemical pulp.....	50					
Consumption of chemical pulp imported as raw material.....	50					
To replace raw material contained in imported paper.....	16					
TOTAL CHEMICAL PULP FOR PAPER	116	93	20	37	89	164
<b>Mechanical pulp:</b>						
Consumption of domestic mechanical pulp.....	15					
To replace raw material contained in imported paper.....	71					
TOTAL MECHANICAL PULP	86	63	71 <sup>c</sup>	84 <sup>c</sup>	117 <sup>c</sup>	163 <sup>c</sup>

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Estimates for 1952.

<sup>b</sup> Represents the demand for special papers which probably cannot be produced at the existing mills.

<sup>c</sup> Since it is probable that the production of newsprint will be at entirely different sites from those at present used by the industry, additional production capacity for mechanical pulp will be necessary despite the total present capacity not being utilized. Therefore, to express the requirements for developing the mechanical pulp industry, figures for the demand to be established by newsprint production have been used.

TABLE 51  
*Mexico: Quantity of wood required annually to satisfy the demands of the pulp and paper industry<sup>a</sup>*  
 (Thousands of cubic metres)

	1952	1955	1960	1965
<i>For the existing industry:</i>				
For chemical pulp.....	465	465	465	465
For mechanical pulp <sup>a</sup> .....	38	43	60	83
TOTAL	503	508	525	548
<i>For the increase of capacity required to satisfy the domestic market:</i>				
For chemical pulp.....	115	185	445	820
For mechanical pulp <sup>a</sup> .....	178	210	292	407
TOTAL	293	395	737	1,227
GRAND TOTAL	796	903	1,262	1,775

Source: This table is based on data for consumption of paper, chemical and mechanical pulp that appear in tables 49 and 50. The quantities of wood were calculated, on the basis of their being coniferous, at 5 cubic metres per ton of chemical pulp and 2.5 cubic metres per ton of mechanical pulp.

<sup>a</sup> It has been assumed that the production of newsprint will be at entirely different sites from those used at present by the paper industry, and that the present surplus production capacity of mechanical pulp will only be used to satisfy the future demand for production of paper and paperboard, as distinct from newsprint. Therefore, the amount of wood necessary to increase the capacity of mechanical pulp depends entirely on the demand made by the development of the newsprint industry, and the volume of wood required by the present mechanical pulp industry does not correspond to the installed capacity, but rather to the demand for "other papers and paperboard".



TABLE 52

Mexico: Probable yield of wood from conifers in the zones already studied in relation to specific projects<sup>a</sup>

	Chihuahua project No. 1	Chihuahua project No. 2	Durango project	Michoacán project	Guerrero project	Combined projects
Forest area chosen (in thousands of hectares).....	563	200	818	250	200	2,031
Area for use at present (in thousands of hectares) ..	250	200 <sup>b</sup>	300	100	200	1,050
Percentage utilization of area .....	36	100	36	40	100	52
Average yield per hectare annually (cubic metres) ..	1.50	1.25	3.30	3.00	6.00	3.00
Total annual yield (in thousands of cubic metres) ..	350	250	1,000	300	1,200	3,100
Quantity for use by industries other than pulp and paper (in thousands of cubic metres per year) . . .	180	125	750	60	800	1,915
Quantity for pulp and paper, in an integrated indus- trial system (in thousands of cubic metres per year).....	195	125	250	240	400	1,210

Source: FAO Forestry Mission to Mexico.

<sup>a</sup> There can be no adherence to a formula for distributing the yield between pulp and other industries. The forests are all in very different conditions and the market possibilities will finally determine the structure of the integrated industry. In the absence of a consumption and market trends study—which is planned for early 1954—it could be said that, if the five projects under consideration get going, there might be a saturation of the market for lumber, with the result that a higher than theoretical percentage of the raw material will have to be diverted to pulping.

<sup>b</sup> Fifty per cent virgin forest, with a yield of 2 m<sup>3</sup>/ha. Fifty per cent second-growth forest, with low yield.

TABLE 53

Mexico: Probable yield of wood from conifers in the forest regions of Chihuahua, Durango, Michoacán and Guerrero<sup>a</sup>

	Chihuahua	Durango	Michoacán	Guerrero	Combined regions
Total forest area (in thousands of hectares).....	3,500	2,700	800	600	7,600
Area for use at present (in thousands of hectares).....	1,100	1,100	300	600	3,100
Percentage utilization of area .....	31	41	37	100	40
Percentage of virgin forests on the area for use.....	55	55	33	100	60
Average yield per hectare per year (cubic metres).....	1.55	2.60	4.00	6.00	3.00
Total annual yield (in thousands of cubic metres).....	1,700	2,850	1,200	3,600	9,350
Quantity for use by industries other than pulp and paper (in thousands of cubic metres per year).....	1,250	2,100	600	2,400	6,350
Quantity for pulp and paper, in an inte- grated industrial system (in thou- sands of cubic metres per year).....	450	750	600	1,200	3,000

Source: FAO Forestry Mission to Mexico.

<sup>a</sup> These estimates are based on the following data, which, in the absence of inventories and other statistics, should be considered only as intelligent guesses:

	Exhausted forests (no yield) 1,000 has.	Normal forests		Virgin forests	
		1,000 has.	m <sup>3</sup> /ha/yr.	1,000 has.	m <sup>3</sup> /ha/yr.
Chihuahua.....	2,400	500	1.0	600	2.0
Durango.....	1,600	500	1.5	600	3.5
Michoacán.....	500	200	3.0	100	6.0
Guerrero.....	—	—	—	600	6.0

TABLE 54

*Mexico: Probable yield of wood from conifers in all forest regions<sup>a</sup>*

	Area (in thousands of hectares)	Yield per hectare per year (m <sup>3</sup> )	Total annual yield (in thousands of cubic metres)
<i>(a) Present capacity:</i>			
Impoverished forests.....	5,000	0.5	2,500
Normal forests.....	2,000	3.0	6,000
Virgin forests.....	2,000	4.0	8,000
TOTAL	9,000	1.8	16,500
Theoretical quantity of wood to be used for pulps in an integrated industrial system (33%).....			
			5,500
<i>(b) Future capacity, provided there is rational management.....</i>			
	9,000	4.0	36,000
Theoretical quantity of wood for use for pulps in an integrated industrial system (33%).....			
			12,000

Source: Forestry Mission of the FAO in Mexico.

<sup>a</sup> In the absence of inventories and other statistics, these estimates should be considered only as intelligent guesses.

TABLE 55

*Mexico: Probable yield of pulpwood in the tropical forests of Colonia, Yucatán*

Area for use (in thousands of hectares).....	1,000
Average yield per hectare annually (cubic metres).....	2
Total annual yield (in thousands of cubic metres).....	2,000
Quantity for pulp and paper, in an integrated industrial system (in thousands of cubic metres annually).....	500

Source: Forestry Mission of the FAO in Mexico.

## Chapter X. PARAGUAY

The domestic paper market in Paraguay is too small to justify the establishment of paper mills of economical size. (See table 56). However, this is not the only criterion to justify the possibility for such an industry, since Paraguay is essentially a forest country and, apart from its forests, it has relatively few resources to provide a general economic improvement. It is thus important that possibilities for permanent exports be investigated as a basis for developing a paper industry.

Approximately half the area of Paraguay consists of forests, of which 50 to 65 per cent—4 to 5 million hectares—are virgin forests. Setting aside the western part of the country (El Chaco) where quebracho Colorado (*Schinopsis balansae*) and palo santo (*Bulnesia sarmienti*) prevail; the principal forest regions are located between the upper Paraná and the eastern part of the Paraguay River, particularly in the mountain zone of Caaguazú and the upper Paraná valley—from Pedro Juan Caballero to the north to the vicinity of Encarnación to the south.

The forests are heterogeneous, tropical and subtropical, and consist of harder wood and of better quality than is normally found in this type of forest.<sup>1</sup> It is interesting to note that although Paraguay's forests border those of Brazil and Argentina, their composition is entirely different, and even similar species present different characteristics. There are no coniferous species (*Araucaria angustifolia*) such as those found across the Paraná river, in Misiones, Argentina or in the State of Paraná, Brazil. However, these species could probably be successfully planted in Paraguay since the yerba mate. (*Ilex paragua-*

<sup>1</sup> The species more usually exploited and of the highest commercial value are: cedar (*Cedrela fissilis*), lapacho (*Tabebuia ipe*), vyrapata (*Pterigynis nitens*), incienso (*Mycrocarpus frondosus*) and petereby (*Cordia Trichotoma*).

*riensis*), usually associated with the Paraná pine in Brazil and Argentina, grows abundantly in Paraguay.<sup>2</sup>

As far as is known, no experiments have been conducted for determining the paper-making properties of Paraguayan woods, but the recent success obtained in other parts of the world,<sup>3</sup> using hard woods, imply that few technical difficulties will be experienced in developing the industry in Paraguay.

It appears that the best region for locating a paper industry is the upper Paraná, particularly in the area between the Monday and Acaray rivers—tributaries to the upper Paraná. The importance of this zone is due not only to the potential value of the forests, but to its access to river transport provided all the way to Encarnación by the above river tributaries and the Paraná river. These facilities could provide connections with the domestic market at Asunción, as well as Encarnación whence exports could be shipped.

Apart from electric power potentialities, which could be developed in Iguazú, other hydro-electric sources are available from the falls of the Monday and Acaray rivers, near their outlet to the upper Paraná.

A planned paper industry could also utilize the limestone deposits found between San Salvador and the Apa river on the western bank of the Paraguay river. Although sulphur probably exists in the Misiones area, no substantial reserves have yet been found.

Salt beds are perhaps available near Reventón, in the province of Concepción, and the discovery of coal deposits in the upper Paraná has been announced.

<sup>2</sup> Plantations of Paraná pine have been made in Colonia Hohenau, near Encarnación, and results for the moment appear to be satisfactory.

<sup>3</sup> See chapter I.

TABLE 56

*Paraguay: Estimated future demand for paper, chemical pulp for paper and mechanical pulp*

(Thousands of metric tons annually)

		<i>Per capita demand for paper (kg.)</i>	<i>Total demand for paper</i>	<i>Total demand for mechanical pulp<sup>c</sup></i>	<i>Total demand for chemical pulp<sup>c</sup></i>
Newsprint.....	1950 <sup>a</sup>	0.31	0.44	0.40	0.06
	1955 <sup>b</sup>	0.28	0.43	0.39	0.06
	1960	0.34	0.60	0.55	0.08
	1965	0.43	0.85	0.78	0.11
Other paper and paperboard.....	1950 <sup>a</sup>	0.94	1.33	0.11	0.76
	1955 <sup>b</sup>	1.69	2.59	0.21	1.48
	1960	2.12	3.71	0.30	2.12
	1965	2.67	5.32	0.43	3.04
TOTAL.....	1950 <sup>a</sup>	1.26	1.77	0.51	0.81
	1955 <sup>b</sup>	1.97	3.01	0.60	1.53
	1960	2.47	4.31	0.85	2.19
	1965	3.09	6.17	1.21	3.15

*Source:* Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Total and per capita demands for paper for 1950 are to be found in annex I.

<sup>b</sup> Estimates of the 1955, 1960 and 1965 demands were calculated by correlating the world per capita demand for paper to per capita income and by assuming various rates of per capita income in Paraguay. The procedure used and the results obtained can be found in annex II. To simplify this part of the report, the figures correspond only to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demands for mechanical and chemical pulp, the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947:

<i>Mechanical pulp:</i> Newsprint	x 0.92	<i>Chemical pulp:</i> Newsprint	x 0.13
Other papers	x 0.09	Other papers	x 0.68
Paperboard	x 0.07	Paperboard	x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Latin-American consumption.

<i>Mechanical pulp:</i> Other papers and paperboard	x 0.08
<i>Chemical pulp:</i> Other papers and paperboard	x 0.57

## Chapter XI. PERU

### I. Productive capacity and consumption

Peru consumes some 36,000 tons of paper and paperboard annually, of which approximately a third is newsprint.<sup>1</sup> Although there is no newsprint production, Peruvian paper mills satisfy practically all the demand for other paper and paperboard. The entire industry is situated in Lima, with the exception of a mill recently installed in Lambayaque in the north. Of the six existing mills, only three may be considered as important.

Two paper mills produce chemical pulp from sugar-cane bagasse, the others use imported chemical pulp and waste paper. The total capacity, including the new mill at Lambayaque, amounts to 13,000 tons of chemical pulp annually, which is only slightly less than the total consumption of this raw material by the industry.

The preceding data illustrate that the only predominant problem in Peru is the supply of newsprint.

Table 57 shows the estimates of future consumption for paper, mechanical and chemical pulp, which, compared with the figures for installed capacity (see table 58), indicate that, in order to supply domestic requirements, Peru must develop its newsprint production to 12,000 tons annually by 1955, 16,000 by 1960 and 22,000 tons by 1965. For the production of other paper and paperboard, in which considerable progress has already taken place, output will only have to be increased 5,000 tons by 1955, 16,000 by 1960 and 29,000 tons by 1965.

Future expansion in the paper industry will require an increase in the productive capacity of chemical pulp of 6,000 tons annually by 1955, 12,000 by 1960 and 21,000 by 1965. For mechanical pulp—there being no production equipment—13,000 tons annually by 1955 in productive capacity will be necessary, 18,000 by 1960 and 24,000 by 1965.

### II. Principal resources for pulp and paper production in Peru

#### A. RESOURCES IN THE AMAZON AREA

The two most important fibrous raw materials in Peru are the forests of the Amazon region and the sugar-cane bagasse on the coast. Until recently, the Amazon region, which is the only forested area in Peru, has been completely inaccessible owing to the lack of means of communication, except for entrance by way of the Amazon river through Brazil, travelling upstream to Iquitos in Peru. In other words, paper production based on wood from the Amazon area would have to be exported in a direction diametrically opposite to the domestic market. This situation has been somewhat solved by the construction of a road from Lima to Pucallpa, the latter situated on the Ucayali river, a tributary of the Amazon.

To save the foreign exchange used at present for

<sup>1</sup> 1951 data.

importing newsprint and in order to develop the Amazon basin, the Peruvian Government has conducted extensive research into the possibility of utilizing wood from the Amazon for producing newsprint. The principal raw material that would be used in the process is cético (*Cecropia spp.*), a tree common to practically all the tropical forests of Latin America, particularly where a forest has been cut clear or where land has been abandoned following banana plantations. The cético is characterized by very rapid growth, but is easily killed when other trees begin to grow and to compete for the space and light. The cético grows profusely along the Amazon river and tributaries; it is found in virgin forests located on alluvial land deposited by the river. It also grows extensively in the upper reaches of the Amazon basin, and along some Peruvian rivers, such as the Putinahua, the Pacaya, the Ucayali, the Marañón and the Tigre.

The Banco de Fomento Agropecuario has conducted considerable research into the use of the cético,<sup>2</sup> and at the moment is planning the establishment of a newsprint mill with a capacity of 18,000 tons annually. The plant will be located in Pucallpa, using cético as the primary raw material. Studies performed in England and France have shown cético to possess excellent possibilities as a raw material for chemical pulp, as well as for mechanical pulp and newsprint. In addition, in the Pucallpa studies, it has been shown that sufficient quantities of cético are available to provide a constant supply of raw material for newsprint and that the production costs may well be less than those of imported newsprint. The FAO mission which recently studied the paper industry of Peru confirmed estimates made by the French engineers and agreed with their favourable opinions concerning this project.<sup>3</sup>

The area selected for establishing the newsprint mill offers distinct advantages for the transport of pulpwood from the forests to Pucallpa. The raw material can be carried entirely by river, in lighters or rafts. There is an abundance of water available as well as low-cost petroleum from the Ganso Azul oilfield nearby.

The only important disadvantage is the considerable distance between Pucallpa and Lima—842 kilometres—which would undoubtedly increase the production costs considerably.

It is probable that, in addition to utilizing cético for paper production, other broad-leaved species from the heterogeneous forests of the Amazon could also be used. Production capacity based on these latter re-

<sup>2</sup> The Corporación Peruana del Amazonas, recently absorbed by the Banco de Fomento Agropecuario, entrusted the study of cético first to the Cellulose Development Corporation, London, and later to the French firm, Batineyret, which is made up of the industrial firms Locomotives Batignolles-Chatillon and Ateliers Neyret-Beylier.

<sup>3</sup> An FAO mission composed of experts on paper and pulp recently studied the possibilities of expanding and developing the Peruvian paper industry, particularly with regard to newsprint. This organization at the present time is preparing its report for the Peruvian Government.

sources is practically unlimited and it could also be used in other forest industries, such as plywood and saw-milling, integrated with that of pulp and paper. This integration would considerably reduce extraction and transportation costs as well as those for the social welfare, health and administrative services.

It is possible that modern semi-chemical processes<sup>4</sup> could be used to produce cheap pulp from the hard and semi-hard woods which could also be adapted to newsprint production. Manufacture of chemical pulp from mixtures of broad-leaved species has been successfully achieved in other parts of the world,<sup>5</sup> so it is not inconceivable that the same could be done with similar species from the Amazon basin.

#### B. EXPANSION POSSIBILITIES BASED ON SUGAR-CANE BAGASSE

Sugar-cane bagasse is already used as raw material in the Peruvian paper industry, and will probably achieve much greater importance inasmuch as sugar mills operate in this country almost all the year round. It is therefore possible to rely upon a constant supply of raw material which could probably be increased by substituting petroleum for the bagasse at present used for fuel.

Sugar cane is grown along the coast areas, particularly in the northern Departments of Lambayaque and

<sup>4</sup> See description of this process in chapter I.

<sup>5</sup> See chapter I for information concerning the experiments performed in French West Africa by the Régie Industrielle de la Cellulose Coloniale.

La Libertad, where more than 80 per cent of the domestic sugar production comes from.

A total of 50,000 hectares of sugar cane is planted annually, yielding more than 600,000 metric tons of dry bagasse which theoretically could serve to produce 200,000 tons of chemical pulp annually.

If it is considered that only 25 per cent of the total available bagasse is collected and utilized, the potential equivalent of 50,000 tons of chemical pulp annually would exceed the demand estimated for 1965. Therefore, it is evident that a large-scale expansion in the chemical pulp industry, based on bagasse, cannot be considered unless for export purposes.

The only serious problem hindering the development of this industry is the shortage of water in the sugar-cane areas. The largest sugar mill in Peru—Casa Grande—alone produces sufficient bagasse to manufacture 100,000 tons of chemical pulp annually, given sufficient water supplies. The essential water supply could be obtained through the construction of a dam on the river Chicama, but this project would cost more than 10 million dollars, or more than the total investment on the pulp mill itself.

On the other hand, the Peruvian coast is rich in fuel and other raw materials necessary for producing chemical pulp: lime, sulphur, salt and petroleum. Inasmuch as the sugar mills are located near the coast, they would not only benefit from available fuel, etc., but from the added facilities of adequate ocean transport in addition to the network of railways already in existence.

**TABLE 57**  
*Peru: Estimated future demand for paper, chemical pulp for paper and mechanical pulp*  
 (Thousands of metric tons annually)

		Per capita demand for paper (kg.)	Total demand for paper	Total demand for mechanical pulp <sup>a</sup>	Total demand for chemical pulp <sup>a</sup>
Newsprint.....	1950 <sup>a</sup>	0.99	8	7	1
	1951 <sup>a</sup>	1.31	11	10	1
	1955 <sup>b</sup>	1.40	12	11	2
	1960	1.73	16	15	2
	1965	2.14	22	20	3
Other paper and paperboard.....	1950 <sup>a</sup>	2.49	21	1	14
	1951 <sup>a</sup>	2.98	25	1	15
	1955 <sup>b</sup>	3.42	30	2	17
	1960	4.29	41	3	23
	1965	5.38	54	4	31
TOTAL.....	1950 <sup>a</sup>	3.48	29	8	15
	1951 <sup>a</sup>	4.29	36	11	16
	1955 <sup>b</sup>	4.82	42	13	19
	1960	6.02	57	18	25
	1965	7.52	76	24	34

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> The total and per capita demands for paper for 1950 are to be found in Tables 111, 112 and 113, annex I; those for 1951 were based on data furnished by the industry.

<sup>b</sup> Estimates of the 1955, 1960 and 1965 demands were calculated by correlating the world per capita demand for paper to the per capita net income and by assuming various rates of per capita income in Peru. The procedure used and the results obtained can be found in annex II. To simplify this part of the report, the figures correspond only to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demands for mechanical and chemical pulp, the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947:

Mechanical pulp: Newsprint x 0.92      Chemical pulp: Newsprint x 0.13  
 Other papers x 0.09                      Other papers x 0.68  
 Paperboard x 0.07                        Paperboard x 0.32

Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Peruvian consumption.

Mechanical pulp: Other papers and paperboard x 0.08  
 Chemical pulp: Other papers and paperboard x 0.057

**TABLE 58**  
*Peru: Expansion needs of the pulp and paper industry*  
 (Thousands of metric tons annually)

	Present demands <sup>a</sup>	Installed capacity <sup>b</sup>	Expansion required now	Expansion needed in the future		
				Total 1955	Total 1960	Total 1965
<b>Newsprint:</b>						
Domestic.....	—					
Imported.....	11					
TOTAL NEWSPRINT	11	—	11	12	16	22
<b>Other paper and paperboard:</b>						
Domestic.....	22					
Imported.....	3					
TOTAL OTHER PAPER AND PAPERBOARD	25	25	—	5	16	29
TOTAL PAPER AND PAPERBOARD	36	25	11	17	32	51
<b>Chemical pulp:</b>						
Consumption of domestic pulp.....	8					
Consumption of pulp imported as raw material.....	6					
To replace raw material contained in imported paper.....	2					
TOTAL CHEMICAL PULP FOR PAPER	16	13	3	6	12	21
<b>Mechanical pulp:</b>						
Consumption of domestic pulp.....	1					
Consumption of pulp imported as raw material.....	1					
To replace raw material contained in imported paper.....	10					
TOTAL MECHANICAL PULP	11	—	11	13	18	24

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Figures based on 1951 statistical data.

<sup>b</sup> Figures for 1952.

## Chapter XII. SURINAM, BRITISH GUIANA AND FRENCH GUIANA

A number of factors combine to indicate that the geographic zone covered by British Guiana, French Guiana and Surinam (Dutch Guiana) forms an area worthy of consideration for development prospects for the pulp and paper industry in Latin America.

Approximately 87 per cent of the total area<sup>1</sup> of this zone is covered by heterogeneous tropical forests with a dense existing volume of wood per unit of area. Thus surveys have shown an average of 160 cubic metres of wood per hectare in Surinam (table 59), 248 cubic metres per hectare in French Guiana (table 60), and 102 cubic metres per hectare in that part of British Guiana known as the Bortica Triangle (table 61).

In general, the forests of this region are highly heterogeneous; fifty different species per hectare were found in a sampling taken in French Guiana, and twelve to twenty-four in British Guiana. However, in British Guiana, large forested areas are found where some species predominate, as in forests containing greenheart (*Ocotea radiaei*) and wallaba (*Eperua falcata*). These may be found in stands composed almost entirely of these two species.

It is probable that the development of the forest resources of this zone would be an attractive business venture. The high commercial value of certain species would add, within an integrated forest industry, to the profitability of pulp and paper manufacture. In British Guiana, the predominating valuable wood is greenheart, which grows only in this part of the world and is used principally in underwater construction owing to its high resistance to rot and to marine borers. In Surinam and French Guiana, there are large quantities of *Virola surinamensis* (known in the former as baboen, and as guingua madou in French Guiana) which are particularly appropriate for veneer and plywood. In addition, linaloe, cedar, amarant and other well-known species abound in these forests.

Probably the chief advantage of this region is its accessibility by means of the extensive river system, whereby wood can be transported from the very heart of the interior to points where it can be loaded on ocean-going vessels. Naturally, this accessibility is not uniform throughout the three Guianas, nor the rivers equally navigable. British Guiana probably has the best communication system, since such rivers as the Essequibo, Courantyne, Berbice and Demerara are navigable in part by ocean-going ships.<sup>2</sup> Although the rivers of French Guiana are also navigable, in long stretches, few permit the passage of ocean-going ves-

<sup>1</sup> The extent of the forests and their percentage in relation to the total area are as follows:

British Guiana . . . . .	20 million hectares (94 per cent)
French Guiana . . . . .	7 million hectares (80 per cent)
Surinam . . . . .	5 million hectares (74 per cent)

<sup>2</sup> Principal rivers with outlets to the sea are: the Essequibo, which collects more than half of the streams of British Guiana and is navigable to a point a little past Wineperu; the Courantyne, which forms the border with Surinam; the Berbice, navigable for 200 kilometres; the Demerara, which is commercially the most important, is navigable for 160 kilometres.

sels, inasmuch as the sand deposited by the Amazon river and banked by the east-west equatorial current continually obstructs the entrances to the two major ports, Cayenne and St. Laurent-du-Maroni, where the depth is reduced ten centimetres per year. River transport conditions in Surinam are similar to those of British Guiana with no sand deposit problems as in French Guiana.

There are no roads or trails to the interior of the forests from the rivers, apart from certain exceptions, such as the Bartica Triangle in British Guiana. However, road construction costs would not be exorbitant since most of the terrain is fairly level and in many places rock can be found for surfacing. It is obvious that, at first, wood extraction operations would have to be conducted via the rivers, but long-range plans based on a rational utilization of all forest resources will of necessity require the construction of all-weather roads.

Since the majority of the wood of these forests is heavy, raft transport is not possible unless rafts are made from a mixture of hard and soft woods. In the light of the existing terrain, as well as the high commercial value of many of the species and the advantages accruing from integrating the utilization of pulp woods with valuable woods, it appears imperative that a general mechanization of the extraction and transport operations be carried out.

Owing to limited statistical data, it is difficult to determine which locations would be more appropriate for a paper and pulp industry. A decision would depend principally upon accessibility to the rivers and proximity of these to the more important forests. At the same time it would be necessary to consider hydro-electric potentialities as well as other production factors. However, in British Guiana, the Bartica Triangle—bound by the Essequibo, Mazaruni and Kaburi rivers—is the more obvious choice for an industrial site owing to the rich stands of greenheart as well as other woods adaptable to chemical pulp production. Another important factor is the easy access to the sea provided by the rivers.

As seen in tables 59, 60 and 61, the most important species of the Guianas is the *Eperua*—known as wallaba in British Guiana, walaba in Surinam and wapa in French Guiana.<sup>3</sup> Predominance of the *Eperua* has resulted in a relatively lengthy investigation as to its use in pulp and paper production.

Research in British Guiana<sup>4</sup> has been conducted so as to determine the possible uses for wallaba, as well as other species associated with it, to use them in pre-

<sup>3</sup> This species is heavy and hard, the core of which is reddish brown and the sapwood is greyish white. The hardwood has a certain oil content and, owing to its durability, it is commonly used for telephone posts, fence posts and any other uses where resistance to climate is essential. Charcoal and firewood from this species are of excellent quality, and large quantities are used in British Guiana as fuel.

<sup>4</sup> L. G. S. Hebbs, *Report on the Production of Paper Pulp from Woods in British Guiana*, Arlesey, Great Britain, 1948.



paring chemical pulp.<sup>5</sup> Not only were the experiments concerned with individual studies of each wood but of the mixtures as they appear in the forests. The results of this work—still subject to pre-industrial testing—indicate that sulphate pulp, prepared for individual species as well as mixtures, can be used as a raw material to produce practically every grade of paper except those requiring high strength. However, before establishing definite projects for wallaba, certain technical problems will have to be solved, such as wood chipping and resin utilization. More recent studies have dealt with semi-chemical processing of wallaba.<sup>6</sup>

The Guianas have a combined domestic paper market too small to be considered as a basis for industrial development. The incipient general economic development does not provide either with a strong stimulus to action. However, the availability of specialized technicians, as well as modern industrial processes, in the European metropolis of the Guianas, are factors which can be added to abundant forest resources to justify detailed studies for the establishment of pulp industries. An example might be the progress achieved in Surinam in tropical forest surveys by means of aerial photogrammetry. A second example is the use in British Guiana of modern lumbering and transport methods as applied to tropical forests. A third and last example are the substantial efforts of the French Government—although not directed specifically to French Guiana itself—in developing new chemical pulping processes for tropical forest species. La Régie

<sup>5</sup> The species studied are: soft wallaba (*Eperua falcata*), wallaba ituri (*Eperua grandifolia*), baromalli (*Catostemma commune*), maho (*Sterculia guianensis*) and korokororo (*Ormosia coutimhoi*).

<sup>6</sup> H. H. Farmer, W. G. Campbell and C. W. Scott, *Chemical Utilization of Tropical Hardwoods*, report presented by Technical Committee on Wood Chemistry, of the Food and Agriculture Organization, in its meeting held in Appleton, Wisconsin, 1951.

Industrielle de la Cellulose Coloniale established a pilot plant for producing chemical pulp in Abidjan, French West Africa, where methods have been evolved for pulping broad leaved species in mixtures of the same composition found naturally in the tropical forests. The technical progress accomplished so far shows great possibilities for the integral utilization of tropical forests, not only in the Guianas, but in many other regions of Latin America.<sup>7</sup>

A large-scale development of the forests of this zone would ultimately result in silvicultural and soil-conservation problems. Fortunately, considerable progress has been achieved so far in Surinam owing to many years of research into the artificial afforestation of such native tropical species as *Mora*, *Virola* and *Triplaris*,<sup>8</sup> and the highly valuable African okoume species.

The geographic situation of the Guianas in relation to important sea routes—Panama Canal—and large world markets, together with the probability of counting with the financial assistance and the sustained markets of their European metropolises, contribute to ensure a successful forest industry development of this area.

There is insufficient data regarding the remaining factors of production, but it is generally known that the headwaters of the larger rivers, as well as many of the tributaries, possess sufficient hydro-electric potentialities for industrial development. There is no fuel in the area other than what the forests themselves can provide, although abundant supplies of petroleum in Venezuela are relatively near. Most of the chemicals would have to be imported.

<sup>7</sup> For more details, see chapter I.

<sup>8</sup> Some of these plantations of native species were begun some forty years ago.

TABLE 59  
Surinam: Composition of the forest<sup>a</sup>

Species		Specific weight	Volume of wood	
Common name	Scientific name		(cu.mtr./ha.)	%
Anaura	<i>Licania esp. div.</i>	0.92-0.99	1.93	1.2
Baboen	<i>Vriola surinamensis</i>	0.45	2.80	1.8
Basra-locus	<i>Dicorynia paraensis</i>	0.7-0.95	12.06	7.5
Bolletrie	<i>Manilkara bidentata</i>	0.96-1.09	0.80	0.5
Bostamarinde	<i>Artrosamanea corymbosa</i>	1.04-1.06	0.64	0.4
Bruinhart	<i>Voussacoua americana</i>	0.87-0.97	0.64	0.4
Cedar	<i>Cedrela odorata</i>	0.42-0.63	0.08	0.05
Foengoe	<i>Parinari spec. div.</i>	0.86	2.80	1.8
Groenhart	<i>Tabebuia Seratifolia</i>	1.00-1.15	0.97	0.6
Gronfoeloe	<i>Qualea coerulea</i>	0.61	6.59	4.1
Kabbes			2.80	1.8
Kopie	<i>Goupia glabra</i>	0.85-0.94	7.07	4.4
Krappa	<i>Carapa guianensis</i>	0.4-0.75	2.09	1.3
Krom. Kopie	<i>Aspidosperma Woodsonianum</i>	0.80-1.00	0.48	0.3
Kwarie	<i>Vochysia and qualea spec.</i>		2.80	1.8
Laksiri	<i>Caraiipa densifolia</i>	0.40	0.08	0.05
Letterhout	<i>Piratinera spec. div.</i>	0.95-1.33	0.48	0.3
Locus	<i>Hymenaea courbaril</i>	0.88-0.96	0.32	0.2
Manbarklak	<i>Eschweilera longipes</i>	0.98-1.14	8.53	5.3
Matakkie	<i>Symphonia globulifera</i>	0.68-0.75	2.09	1.3
Pakoelie	<i>Platonia insignis</i>	0.73-0.86	0.32	0.2
Pisie	<i>Ocotea spec. div.</i>	0.41-1.02	3.06	1.9
Pinto Kopie			0.48	0.3
Prokonie	<i>Inga spec. div.</i>	0.60-0.66	2.25	1.4
Purperhart	<i>Pellogyne pubescens</i>	0.85-1.07	0.48	0.3
Salie	<i>Tetragastris spec. div.</i>	0.90-1.02	4.66	2.9
Soemaroepa	<i>Simaruba amara</i>	0.45-0.53	0.97	0.6
Slangenhout	<i>Loxopterygiun sagotti</i>	0.65-0.78	0.06	0.04
Tiengie-monie	<i>Trattinickia and Protium</i>	0.70-0.75	2.09	1.3
Tonka	<i>Dipteryx odorata</i>	0.81-1.02	0.32	0.2
Walaba	<i>Eperua falcata</i>	0.85-0.94	12.38	7.7
Wana	<i>Ocotea rubra mes</i>	0.52-0.63	4.34	2.7
Wana Kwarie	<i>Vochysia tomentosa</i>	0.38-0.50	1.77	1.1
Mappa	<i>Macoubea guyanensis</i>	0.35-0.50	0.32	0.2
Panta			0.10	0.06
Other species			70.35	44.0
TOTAL			160.80	100.0

Source: Forestry Service of Surinam.

<sup>a</sup> Results of a sampling on 42,825 hectares.

TABLE 60  
French Guiana: Composition of the forest<sup>a</sup>

Species		Specific weight	Volume of wood	
Common name	Scientific name		(cu.mtr./ha.)	%
Wapa.....	<i>Eperua falcata</i>	0.8	54.76	22.08
Mahot blanc.....			39.80	16.05
Angélique.....	<i>Dicorynia paranaensis</i>	0.8	24.84	10.02
Balata huile.....		0.8-1.2	13.79	5.56
Cèdre blanc.....	<i>Tabebuia tecomia</i>	0.65	6.82	2.75
Maho rouge.....	<i>Crytroma rubiflora</i>	0.5-1.0	6.63	2.68
Gaulette rouge.....	<i>Vanlana paraviflora</i>	1.0	6.18	2.49
Manil.....	<i>Simphonia globulifera</i>	0.7	5.85	2.36
Gaulette blanc.....	<i>Licania canoscena</i>	1.1	5.82	2.35
Gaiac.....			5.51	2.22
Zolive.....			4.39	1.77
Pois sucré.....	<i>Inga pezzifera</i>	0.6-0.7	4.11	1.66
Citronnelle.....			3.96	1.60
Wacapou.....	<i>Vacapona americana</i>	1.0	3.58	1.44
Guingua madou.....	<i>Virola surinamensis</i>	0.5-0.6	3.57	1.44
Bois rouge.....			3.50	1.41
Grignon.....	<i>Ocotea rubra</i>	0.6	3.36	1.36
Mahot noir.....	<i>Eschweilera corrudata</i>	0.9	3.17	1.28
Boco.....	<i>Bocoa provacensis</i>	1.2	2.77	1.12
Grignon fou.....	<i>Qualea rosea</i>	0.7	2.72	1.10
Wapa courbaril.....	<i>Eperua kowronensis</i>	0.8-0.95	2.64	1.07
Gris-gris.....	<i>Licania arborea</i>	1.1-1.2	2.44	0.98
Crawari.....			2.38	0.96
Cèdre jaune.....	<i>Cryptocarya guianensis</i>	0.6	2.18	0.88
Bois corbeau.....			2.13	0.86
Other species.....			35.45	14.29
TOTAL			247.95	100.00

Source: Water and Forest Service of French Guiana.

<sup>a</sup> Results of sampling 54 hectares.

TABLE 61  
British Guiana: Composition of the forest in the Bartica-Kaburi zone<sup>a</sup>

Species		Specific weight	Volume of wood <sup>b</sup>	
Common name	Scientific name		(cu.mtr./ha.)	%
Wallaba.....	<i>Eperua falcata</i>	0.85-0.94	24.01	23.6
Greenheart.....	<i>Ocotea rodiaei</i>	0.96-1.28	23.19	22.7
Morabukea.....	<i>Mora gonggrijpii</i>	0.97-1.05	8.68	8.5
Mora.....	<i>Mora excelsa</i>	0.97	7.00	6.8
Kakaralli.....	<i>Eschweilera spp.</i>	0.98-1.14	5.72	5.6
Purpleheart.....	<i>Peltogyne venosa</i>	0.85-1.07	0.65	0.6
Silverballi.....	<i>Ocotea spec. div.</i>	0.41-1.02	1.59	1.6
Other heavy.....			22.85	22.4
Other light.....			8.32	8.2
TOTAL			102.01	100.0

Source: Handbook of Natural Resources of British Guiana, Internal Development Committee for British Guiana, Georgetown, 1946.

<sup>a</sup> Results of a sampling in the Bartica-Kaburi zone, comprising 86,869 hectares.

<sup>b</sup> Only trees over 40 centimetres in diameter at breast height were considered.

## Chapter XIII. VENEZUELA

### I. Productive capacity, consumption and expansion needs

Venezuela consumes a little over 50,000 tons of paper and paperboard annually, of which approximately 10,000 tons are newsprint. There is only one paper mill,<sup>1</sup> producing about 5,000 tons annually. In addition, there are other small installations with a total production of about 3,000 tons of paperboard annually.

A comparison of the present paper and paperboard capacity with the estimated future consumption (table 62) indicates that Venezuela will have to increase its industrial capacity by 48,000 tons by 1955, 70,000 by 1960 and 112,000 by 1965, if production is to satisfy the domestic demand. Approximately one-fourth of these increases will correspond to newsprint.

If the expansion described above is to be achieved, it would also be necessary to install sufficient capacity to produce 27,000 tons of chemical pulp annually by 1955, 37,000 by 1960 and 59,000 by 1965. For mechanical pulp, 17,000 tons annually will be necessary by 1955, 22,000 by 1960, and 34,000 by 1965.

The market for newsprint by 1965 is estimated as being still too small to warrant the installation of a special newsprint mill of economical size. But the demand for other paper and paperboard is sufficient to justify the establishment of one or two mills of normal size, to produce those grades of paper which show higher consumption figures.

### II. Development possibilities based on forest resources

Examination of the forest resources of Venezuela, together with the other necessary factors for production, indicates that the most appropriate location for pulp and paper mills would probably be in the vicinity of San Félix, in the State of Bolívar, on the Orinoco river. The forests near this area are practically unlimited towards the south-west, extending to the east up to the State boundary with the Delta Amacuro and to the south to British Guiana. This vast area contains virgin forests with a density from 50 to 100 cubic metres of wood per hectare and in some sections more than 100.

Table 63 indicates the principal forest species of the area as well as some of their physical characteristics. The most valuable species are mahogany, cedar, apamate, zapatero, jabillo, mijao, gateado, saquisaqui and samán.

All the species appear in mixed forests, but rarely with a population of more than three or four trees per hectare (a maximum of 15 to 20 cubic metres of wood per hectare). It is thus evident that a project for

<sup>1</sup> *Compañía Anónima Fábrica de Papel*, in the city of Maracay, State of Aragua, producing kraft and sulphite paper of various colours, and using as raw material imported chemical pulp and waste paper. Another project in view is the construction of a paper mill at Guacara, State of Carabobo.

utilizing such species in Venezuela will have to be based upon the pulping of mixed species, with processes similar to those successfully developed in French West Africa and the United States.<sup>2</sup>

Owing to the lack of specific information concerning these forests, it is not possible to determine their potentiality. However, it would appear that an industry located in the zone mentioned above would be able, within economic transport distances, to count upon sufficient raw material for the production of the entire paper requirements of the country.

The utilization of these forests would have to be done by a group of integrated industries, so as to lower the cost of the raw material for paper and pulp.

Principal access to this area is provided by the Orinoco river, navigable by 2,000-ton vessels from San Félix to the sea. In the future, this river will be capable of handling vessels of maximum displacement of 22,000 tons when the canal planned to transport iron ore from Cerro Bolívar is completed. At present, there is a road connecting San Félix with Callao and Timeremo to the south, but for the moment, until a general study has been conducted of the area, it is not possible to state whether or not it will provide adequate facilities for transporting wood. The same is true in the case of the Caroní river and its tributaries. The forest land is generally level with only slightly hilly areas, which presupposes that mechanized equipment may be used for extraction and transport operations.

The area immediately surrounding San Félix will be ideally situated for every type of power sources; a million-kilowatt hydro-electric plant on the Caroní river, near San Félix, is being planned, but its completion presents the serious problem that there is insufficient demand for electric power to justify the necessary expenditure.<sup>3</sup> Abundant supplies of petroleum are produced near this area, which also contribute to the possibility of low-cost electric power. A third favourable factor could be the use of the gas produced by the oil fields of Monagas and Anzoátegui, relatively near the forest area mentioned, and which at present is burned as waste material.

There are salt marshes in the Gulf of Venezuela, as well as in Coche Island and the area in the vicinity of the Cariaco peninsula. There is a possibility that others may be established near the mouth of the Orinoco river.

### III. Development possibilities based on sugar-cane bagasse

Only in the case of small paper mills can sugar-cane-bagasse be considered as a possible fibrous raw mate-

<sup>2</sup> See chapter I for details concerning the heterogeneous process as applied to tropical species.

<sup>3</sup> The installed capacity of this plant could reach 6 million kilowatts, but unless at least a demand of 200,000 to 300,000 kilowatts could be assured for the area, the necessary construction would not be advisable.

rial. It is estimated that the entire production of dry bagasse totals approximately 50,000 tons annually, equivalent to 16,000 tons of chemical pulp or 30,000 tons of semichemical pulp.

Even if a substitution of oil for bagasse in the boilers of the refineries would prove cheaper, an adequate utilization of the potential bagasse supply is hardly feasible since the sugar plantations are dispersed

throughout various States—Aragua, Lara, Trujillo, Zulia and Yaracuy—making the collection and transport of bagasse an extremely high-cost operation. Although Venezuela is a large producer of petroleum, the same high transport costs would cause difficulties in the substitution of petroleum for the bagasse at present used as fuel at the sugar mills.

TABLE 62  
Venezuela: Estimated future demand for paper; chemical pulp for paper and mechanical pulp

(Thousands of metric tons annually)

		Per capita demand for paper (kg.)	Total demand for paper	Total demand for mechanical pulp <sup>c</sup>	Total demand for chemical pulp <sup>c</sup>
Newsprint.....	1950 <sup>a</sup>	2.24	11	10	1
	1955 <sup>b</sup>	2.57	14	13	2
	1960	3.18	19	17	2
	1965	3.94	28	26	4
Other paper and paperboard.....	1950 <sup>a</sup>	8.48	40	4	24
	1955 <sup>b</sup>	8.92	42	4	25
	1960	11.20	59	5	35
	1965	14.06	92	8	55
TOTAL.....	1950 <sup>a</sup>	10.72	51	14	25
	1955 <sup>b</sup>	11.49	56	17	27
	1960	14.38	78	22	37
	1965	18.00	120	34	59

Source: Economic Commission for Latin America and Food and Agriculture Organization.

<sup>a</sup> Total and per capita demands for paper for 1950 are to be found in annex I.

<sup>b</sup> Estimates of the 1955, 1960 and 1965 demands were calculated by correlating the world per capita demand for paper to per capita income, and assuming various rates of per capita income in Venezuela. The procedure used and the results obtained can be found in annex II. To simplify this part of the report, the figures correspond only to an average rate of increase of per capita income of 3 per cent per year.

<sup>c</sup> In calculating the total demands for mechanical and chemical pulp, the following conversion factors were used; these were approved for use by FAO at two international conferences on forestry statistics held in Washington and Rome in 1947.

Mechanical pulp: Newsprint x 0.92      Chemical pulp: Newsprint x 0.13  
Other papers x 0.09                      Other papers x 0.68  
Paperboard x 0.07                         Paperboard x 0.32

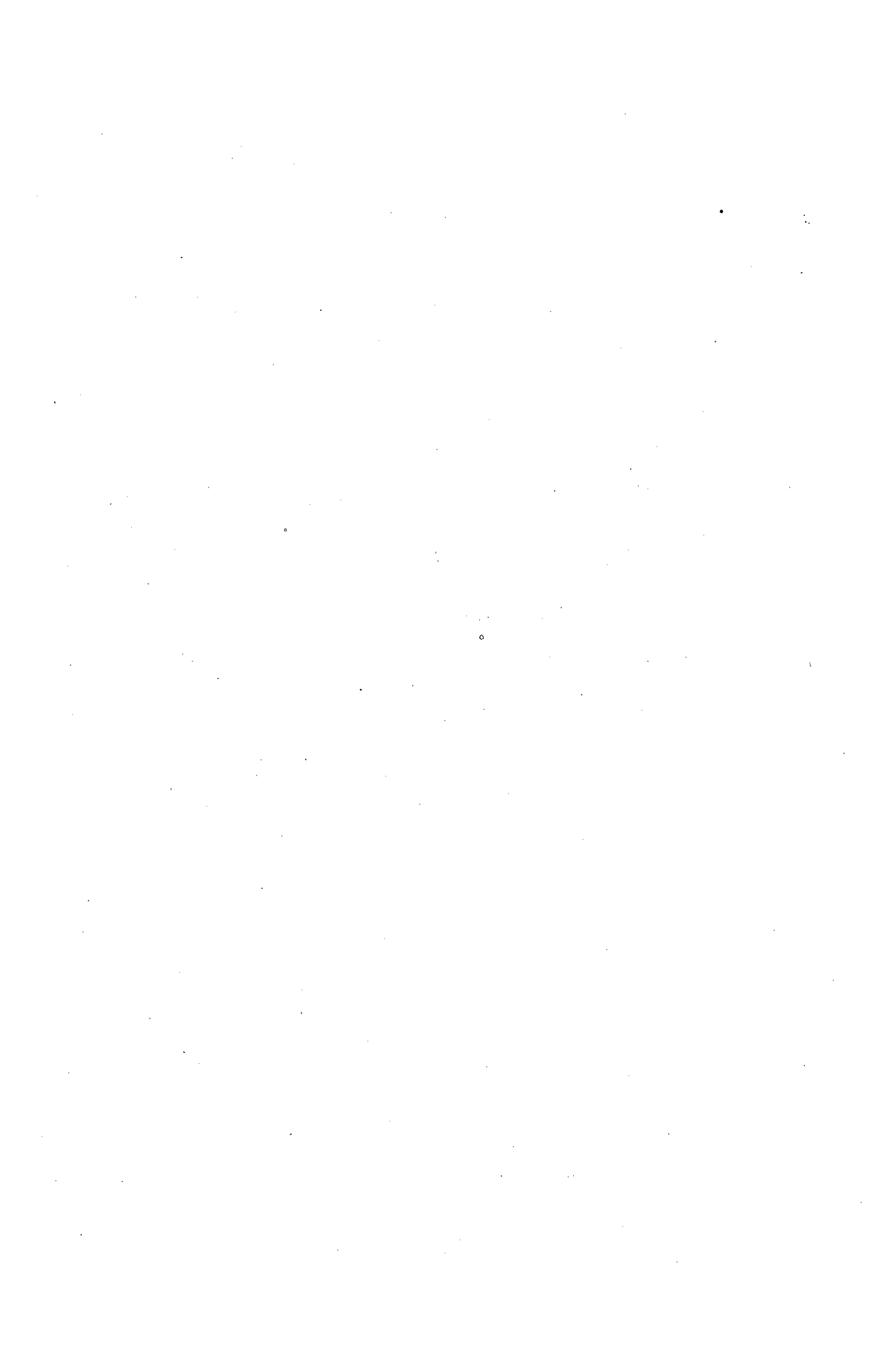
Since "other papers" and "paperboard" are combined in the table, the following averages of the corresponding factors were used, weighted with Venezuelan consumption:

Mechanical pulp: Other papers and paperboard x 0.09  
Chemical pulp: Other papers and paperboard x 0.60

TABLE 63  
Venezuela: Principal exploitable species of the tropical forest

Common name	Scientific name	Height (m.)	Diameter (cm.)	Specific weight	Colour
Amarillo.....	<i>Terminalia hilariana</i>	30-40	70-100	0.63-0.73	Yellow to reddish
Mahogany.....	<i>Swietenia candollei</i>	30-35	100-120	0.46	Light reddish
Cedar.....	<i>Cedrela mexicana</i>	30-35	90-150	0.43-0.53	Pink
Marfil.....	<i>Hebiella pleanna</i>	15-20	40-50	0.9-0.95	Darkish yellow
Zapatero.....	<i>Gossypiospermum praecox</i>	15-25	15-30	0.8-0.9	Light yellow
Araguaney.....	<i>Tabebuia chrysantha</i>	30-35	60-90		Reddish yellow
Betún.....	<i>Callicophyllum candidissimum</i>	15-18	20-50	0.8-0.85	Purple
Ebony.....	<i>Libidibia ebano</i>	15-22	90 max.	1.1-1.3	Darkish red; almost black
Caraball.....	<i>Albizia sp.</i>	27 max.	90 max.	0.73	Pale yellow
Gateado.....	<i>Astronium graveolens</i>	35 max.	90 max.	0.84	Reddish purple
Guayabón.....	<i>Terminalia sp.</i>	22-33	50-65	0.57	Greenish yellow
Mora.....	<i>Chlorophora tinctoria</i>	18-24	50-60	0.71	Golden yellow
Roble.....	<i>Platymiscium pinatum</i>	20-30	50-80	0.75-1.2	Reddish brown
Samán clavellino...	<i>Pseudosamanea guachapele</i>	30 max.	70-100	0.56	Brown
Apamate.....	<i>Tabebuia pentaphylla</i>	20-30	45-90	0.52	Pale brown
Jabillo.....	<i>Hura crepitans</i>	30-40	90-150	0.38	Pale yellowish brown
Mijao.....	<i>Anacardium excelsa</i>	25-45	90-150	0.41	Greyish white
Samán.....	<i>Samanea saman</i>	30 max.	60-120		Various colours to black
Saquisaqui.....	<i>Bombacopsis sepium</i>	30-60	60-150	0.4-0.6	Reddish brown

Source: Forestry Service of the Ministerio de Agricultura y Cría, Caracas, Venezuela.



Annex

STATISTICAL SERIES FOR PRODUCTION, IMPORTS, EXPORTS AND APPARENT CONSUMPTION OF PAPER AND PAPERBOARD

TABLE 1  
*Latin America: Total apparent consumption of paper and paperboard*  
(Metric tons)

Year	Production	Imports	Apparent consumption	
			Total	Per capita (kgs.)
1935.....	253,246	371,820	625,066	5.491
1936.....	270,418	432,862	703,280	6.081
1937.....	308,327	521,293	829,620	7.034
1938.....	339,294	416,396	755,690	6.282
1939.....	400,485	451,000	851,485	6.943
1940.....	402,461	424,128	826,589	6.613
1941.....	450,465	437,878	888,343	6.969
1942.....	454,744	389,555	844,299	6.498
1943.....	441,069	375,399	816,468	6.163
1944.....	455,564	424,923	880,487	6.518
1945.....	518,108	492,876	1,010,984	7.339
1946.....	537,622	625,244	1,162,866	8.280
1947.....	544,321	683,999	1,228,320	8.572
1948.....	598,572	597,407	1,195,979	8.191
1949.....	626,174	595,608	1,221,782	8.202
1950.....	725,289	622,980	1,348,269	8.834

Note: Data for Ecuador were included as from 1937, for Haiti from 1944, and Dominican Republic from 1936.

TABLE 2  
*Latin America: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Apparent consumption	
			Total	Per capita (kgs.)
1935.....	2,182	243,369	245,551	2.157
1936.....	3,072	276,569	279,641	2.418
1937.....	923	329,788	330,711	2.804
1938.....	6,860	252,846	259,706	2.159
1939.....	6,716	288,928	295,644	2.411
1940.....	9,088	266,932	276,020	2.208
1941.....	10,957	276,508	287,465	2.255
1942.....	8,436	206,650	215,086	1.655
1943.....	8,096	226,305	234,401	1.769
1944.....	7,121	261,787	268,908	1.991
1945.....	5,656	279,062	284,718	2.067
1946.....	5,293	349,494	354,787	2.526
1947.....	17,600	356,533	374,133	2.611
1948.....	31,078	335,673	366,751	2.512
1949.....	38,855	325,806	364,661	2.448
1950.....	45,716	329,091	374,807	2.456

Note: Data for Ecuador were included as from 1937, for Haiti from 1944, and Dominican Republic from 1936.

TABLE 3  
*Latin America: Apparent consumption of all paper and paperboard other than newsprint*  
(Metric tons)

Year	Production	Imports	Apparent consumption	
			Total	Per capita (kgs.)
1935.....	251,064	128,451	379,515	3.334
1936.....	267,346	156,293	423,639	3.663
1937.....	307,404	191,505	498,909	4.230
1938.....	332,434	163,550	495,984	4.123
1939.....	393,769	162,072	555,841	4.532
1940.....	393,373	157,196	550,569	4.405
1941.....	439,508	161,370	600,878	4.714
1942.....	446,308	182,905	629,213	4.843
1943.....	432,976	149,091	582,067	4.394
1944.....	448,443	163,136	611,579	4.527
1945.....	512,452	213,814	726,266	5.272
1946.....	532,329	275,750	808,079	5.754
1947.....	526,721	327,466	854,187	5.961
1948.....	567,494	261,734	829,228	5.679
1949.....	587,319	269,802	857,121	5.754
1950.....	679,573	293,889	973,462	6.378

Note: Data for Ecuador were included as from 1937, for Haiti from 1944, and for the Dominican Republic from 1936.

TABLE 4

## Argentina: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	155,532	677	..	..
1926	..	149,441	353	..	..
1927	..	161,125	120	..	..
1928	..	189,332	—	..	..
1929	..	194,111	165	..	..
1930	..	194,728	—	..	..
1931	..	163,043	454	..	..
1932	..	162,702	—	..	..
1933	..	163,219	206	..	..
1934	..	184,917	256	..	..
1935	67,167	187,254	510	253,911	20.009
1936	80,734	201,169	288	281,615	21.740
1937	94,300	239,692	180	333,812	25.237
1938	106,890	185,262	119	292,033	21.626
1939	119,093	201,172	208	320,057	23.270
1940	135,980	184,771	369	320,382	22.862
1941	138,815	169,065	1,789	306,091	21.429
1942	149,981	148,753	1,848	296,886	20.386
1943	146,610	142,081	2,660	286,031	19.286
1944	140,927	152,928	2,343	291,512	19.386
1945	147,829	167,381	1,202	314,008	20.423
1946	153,582	242,651	1,541	394,692	25.194
1947	163,263	258,545	1,201	420,607	26.380
1948	177,189	208,827	583	385,433	23.685
1949	177,786	222,131	227	399,690	23.958
1950	211,407	195,505	180	406,732	23.770

Sources: Production: 1935-37, *Estadística Industrial*, 1938; 1936, average 1935 and 1937; 1938-40, *Estadística Industrial*, 1940; 1942-48, *Anuario Estadístico*, 1948; 1949-50, *Síntesis Estadística*, April 1951. Imports and exports: 1925-48, *Anuarios del Comercio Exterior*; 1949-50, data supplied by the Dirección General de Servicio Estadístico Nacional.

TABLE 5

## Argentina: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	101,837	..	101,837	10.055
1926	..	92,922	..	92,922	7.967
1927	..	100,487	..	100,487	9.376
1928	..	121,754	..	121,754	11.076
1929	..	126,917	..	126,917	11.244
1930	..	136,927	..	136,927	11.839
1931	..	119,752	..	119,752	10.160
1932	..	129,026	..	129,026	9.922
1933	..	121,877	31	121,846	9.970
1934	..	138,822	18	138,804	11.151
1935	..	140,403	13	140,390	11.063
1936	..	148,584	..	148,584	11.470
1937	..	169,071	..	169,071	12.782
1938	..	126,592	..	126,592	9.374
1939	..	146,191	4	146,187	10.629
1940	..	126,547	31	126,516	9.028
1941	..	134,849	36	134,813	9.438
1942	..	75,839	17	75,822	5.206
1943	..	106,781	..	106,781	7.200
1944	..	105,222	..	105,222	6.998
1945	..	98,596	..	98,596	6.413
1946	..	142,576	1	142,575	9.101
1947	..	140,913	..	140,913	8.838
1948	..	121,347	..	121,347	7.457
1949	..	117,196	..	117,196	7.025
1950	..	101,269	..	101,269	5.918

Sources: Same as for table 4.

TABLE 6

## Argentina: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	53,695	677	..	..
1926	..	56,519	353	..	..
1927	..	60,938	120	..	..
1928	..	67,578	—	..	..
1929	..	67,194	165	..	..
1930	..	57,801	—	..	..
1931	..	43,291	454	..	..
1932	..	33,676	—	..	..
1933	..	41,342	175	..	..
1934	..	46,095	238	..	..
1935	67,167	46,851	497	113,521	8.946
1936	80,734	52,585	288	133,031	10.270
1937	94,300	70,621	180	164,741	12.455
1938	106,890	58,670	119	165,441	12.252
1939	119,093	54,981	204	173,870	12.641
1940	135,980	58,224	338	193,866	13.654
1941	138,815	34,216	1,753	171,278	11.991
1942	149,981	72,914	1,831	221,064	15.180
1943	146,610	35,300	2,660	179,250	12.086
1944	140,927	47,706	2,343	186,290	12.388
1945	147,829	68,785	1,202	215,412	14.010
1946	153,582	100,075	1,540	252,117	16.093
1947	163,263	117,632	1,201	279,694	17.542
1948	177,189	87,480	583	264,086	16.228
1949	177,786	104,935	227	282,494	16.933
1950	211,407	94,236	180	305,463	17.852

Sources: Same as for table 4.

TABLE 7

## Argentina: Apparent consumption of writing and printing paper other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	25,319	..	..	..
1926	..	26,398	..	..	..
1927	..	26,872	..	..	..
1928	..	30,629	..	..	..
1929	..	30,006	..	..	..
1930	..	24,168	..	..	..
1931	..	16,112	..	..	..
1932	..	10,846	..	..	..
1933	..	15,752	48	..	..
1934	..	18,317	37	..	..
1935	14,828	17,534	17	32,345	2.549
1936	16,502	20,157	26	36,633	2.828
1937	19,128	31,511	6	50,633	3.828
1938	21,524	22,329	1	43,852	3.247
1939	23,255	23,071	13	46,313	3.367
1940	28,268	29,314	24	57,558	4.107
1941	28,374	14,306	121	42,559	2.979
1942	30,656	23,345	95	53,906	3.702
1943	29,967	13,569	232	43,304	2.920
1944	28,805	18,898	378	47,325	3.147
1945	30,216	21,541	7	51,750	3.366
1946	31,392	34,863	6	66,249	4.229
1947	33,371	39,842	14	73,199	4.591
1948	36,217	25,410	27	61,600	3.785
1949	36,339	26,870	1	63,208	3.789
1950	43,212	31,931	1	75,142	4.391

Sources: Same as for table 4.



TABLE 8

## Argentina: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	5,506	..	..	..
1926	..	5,392	..	..	..
1927	..	6,919	..	..	..
1928	..	7,213	..	..	..
1929	..	7,980	..	..	..
1930	..	6,982	..	..	..
1931	..	5,884	..	..	..
1932	..	5,955	..	..	..
1933	..	6,192	2	..	..
1934	..	7,597	14	..	..
1935	28,493	7,937	23	36,407	2.869
1936	35,240	7,920	14	43,146	3.331
1937	41,158	9,925	18	51,065	3.861
1938	47,987	9,879	17	57,849	4.284
1939	52,673	7,957	23	60,607	4.406
1940	58,141	8,747	27	66,861	4.771
1941	60,593	6,800	145	67,248	4.708
1942	65,467	24,636	198	89,905	6.174
1943	63,995	9,181	318	72,858	4.913
1944	61,515	12,451	294	73,672	4.899
1945	64,527	25,973	48	90,452	5.883
1946	67,039	35,770	30	102,779	6.561
1947	71,264	39,599	25	110,838	6.952
1948	77,343	23,258	9	100,592	6.182
1949	77,604	28,248	4	105,848	6.345
1950	92,279	27,436	—	119,715	6.996

Sources: Same as for table 4.

TABLE 9

## Argentina: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	12,376	..	..	..
1926	..	13,163	..	..	..
1927	..	15,877	..	..	..
1928	..	18,171	..	..	..
1929	..	17,180	..	..	..
1930	..	15,988	..	..	..
1931	..	12,696	..	..	..
1932	..	10,067	..	..	..
1933	..	12,129	24	..	..
1934	..	13,356	7	..	..
1935	12,618	13,354	14	25,958	2.046
1936	14,742	16,112	1	30,853	2.382
1937	14,907	19,116	25	33,998	2.570
1938	16,634	16,521	27	33,128	2.453
1939	24,072	15,515	60	39,527	2.874
1940	27,371	12,391	37	39,725	2.835
1941	34,131	8,082	101	42,112	2.948
1942	39,011	16,479	35	55,455	3.808
1943	38,975	8,028	26	46,977	3.167
1944	38,456	11,952	12	50,396	3.351
1945	43,582	15,836	9	59,409	3.864
1946	46,191	21,134	28	67,297	4.296
1947	50,481	27,949	7	78,423	4.919
1948	52,786	26,878	2	79,662	4.895
1949	55,969	41,670	—	97,639	5.853
1950	64,335	26,012	1	90,346	5.280

Sources: Same as for table 4.

TABLE 10

Argentina: Apparent consumption of sundry papers, not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	10,494	677	..	..
1926	..	11,566	353	..	..
1927	..	10,970	120	..	..
1928	..	11,565	—	..	..
1929	..	12,028	165	..	..
1930	..	10,663	—	..	..
1931	..	8,599	454	..	..
1932	..	6,808	—	..	..
1933	..	7,269	101	..	..
1934	..	6,825	180	..	..
1935	11,228	8,026	443	18,811	1.482
1936	14,250	8,396	247	22,399	1.729
1937	19,107	10,069	131	29,045	2.196
1938	20,745	9,941	74	30,612	2.267
1939	19,093	8,438	108	27,423	1.994
1940	22,200	7,772	250	29,722	2.121
1941	15,717	5,028	1,386	19,359	1.355
1942	14,847	8,454	1,503	21,798	1.497
1943	13,673	4,522	2,084	16,111	1.086
1944	12,151	4,405	1,659	14,897	0.991
1945	9,504	5,435	1,138	13,801	0.898
1946	8,960	8,308	1,476	15,792	1.008
1947	8,147	10,242	1,155	17,234	1.081
1948	10,843	11,934	545	22,232	1.366
1949	7,874	8,147	222	15,799	0.947
1950	11,581	8,857	178	20,260	1.184

Sources: Same as for table 4.

<sup>a</sup> Includes bristleboards.

TABLE 11

## Bolivia: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,164	..	1,164	0.516
1926	..	1,245	..	1,245	0.545
1927	..	1,149	..	1,149	0.497
1928	..	1,533	..	1,533	0.655
1929	..	1,827	..	1,827	0.772
1930	..	1,442	..	1,442	0.602
1931	..	1,098	..	1,098	0.453
1932	..	1,101	..	1,101	0.449
1933	..	1,013	..	1,013	0.408
1934	..	1,602	..	1,602	0.638
1935	..	1,525	..	1,525	0.604
1936	..	1,660	..	1,660	0.646
1937	..	2,636	..	2,636	1.014
1938	155	2,091	..	2,246	0.854
1939	200	2,375	..	2,575	0.968
1940	216	2,578	..	2,794	1.039
1941	266	2,644	..	2,910	1.069
1942	314	3,618	..	3,932	1.428
1943	314	3,329	..	3,643	1.308
1944	312	3,309	..	3,621	1.285
1945	310	2,663	..	2,973	1.043
1946	312	3,452	..	3,764	1.306
1947	547	4,003	..	4,550	1.560
1948	459	3,473	..	3,932	1.333
1949 <sup>a</sup>	488	4,022	..	4,510	1.511
1950 <sup>a</sup>	518	3,754	..	4,272	1.415

Sources: Production: *Industria Manufacturera, Fabril y Estadística*, 1938-39 and 1943; 1945-47, *Cámara Nacional de Industrias 15a, 16a y 17a Memorias*; 1944-48, estimates. Imports: 1927-31 and 1934-46, *Anuarios del Comercio Exterior*; 1925-26, 1932-33, data supplied by the Dirección de Estadística de Bolivia.<sup>a</sup> Estimates.

TABLE 12

*Bolivia: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	314	..	314	0.139
1926	..	362	..	362	0.158
1927	..	260	..	260	0.112
1928	..	358	..	358	0.153
1929	..	513	..	513	0.217
1930	..	335	..	335	0.140
1931	..	593	..	593	0.245
1932	..	646	..	646	0.264
1933	..	599	..	599	0.241
1934	..	840	..	840	0.335
1935	..	803	..	803	0.316
1936	..	906	..	906	0.353
1937	..	1,374	..	1,374	0.529
1938	..	1,041	..	1,041	0.396
1939	..	1,180	..	1,180	0.444
1940	..	1,758	..	1,758	0.654
1941	..	1,964	..	1,964	0.722
1942	..	2,367	..	2,367	0.860
1943	..	2,104	..	2,104	0.756
1944	..	2,225	..	2,225	0.790
1945	..	1,576	..	1,576	0.553
1946	..	1,882	..	1,882	0.653
1947	..	2,941	..	2,941	1.088
1948	..	2,412	..	2,412	0.818
1949	..	2,946	..	2,946	0.987
1950 <sup>a</sup>	..	2,661	..	2,661	0.881

Sources: Same as for table 11.

<sup>a</sup> Estimates.

TABLE 13

*Bolivia: Apparent consumption of all paper and paperboard, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	850	..	850	0.376
1926	..	883	..	883	0.386
1927	..	889	..	889	0.384
1928	..	1,175	..	1,175	0.502
1929	..	1,314	..	1,314	0.555
1930	..	1,107	..	1,107	0.462
1931	..	505	..	505	0.208
1932	..	455	..	455	0.186
1933	..	414	..	414	0.167
1934	..	762	..	762	0.304
1935	..	722	..	722	0.284
1936	..	754	..	754	0.294
1937	..	1,262	..	1,262	0.486
1938	155	1,050	..	1,205	0.458
1939	200	1,195	..	1,395	0.525
1940	216	820	..	1,036	0.385
1941	266	680	..	946	0.348
1942	314	1,251	..	1,565	0.568
1943	314	1,225	..	1,539	0.553
1944	312	1,084	..	1,396	0.496
1945	310	1,087	..	1,397	0.490
1946	312	1,570	..	1,882	0.653
1947	547	1,062	..	1,609	0.552
1948	459	1,061	..	1,520	0.515
1949	488 <sup>a</sup>	1,076	..	1,564	0.524
1950	518 <sup>a</sup>	1,093	..	1,611 <sup>a</sup>	0.534

Sources: Same as for table 11.

<sup>a</sup> Estimates.

TABLE 14

*Bolivia: Apparent consumption of writing and printing paper<sup>a</sup>*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	252	..	252	0.112
1926	..	277	..	277	0.121
1927	..	152	..	152	0.066
1928	..	280	..	280	0.120
1929	..	298	..	298 <sup>a</sup>	0.126
1930	..	198	..	198	0.083
1931	..	156	..	156	0.064
1932	..	180	..	180	0.073
1933	..	186	..	186	0.075
1934	..	366	..	366	0.146
1935	..	337	..	337	0.133
1936	..	298	..	298	0.116
1937	..	520	..	520	0.200
1938	..	386	..	386	0.147
1939	..	431	..	431	0.162
1940	..	244	..	244	0.091
1941	..	309	..	309	0.114
1942	..	315	..	315	0.114
1943	..	321	..	321	0.115
1944	..	327	..	327	0.116
1945	..	333	..	333	0.117
1946	..	338	..	338	0.117
1947	..	344	..	344	0.118
1948	..	350	..	350	0.119
1949	..	356	..	356	0.119
1950	..	362	..	362	0.120

Sources: Same as for table 11.

<sup>a</sup> From 1941 to 1950 consumption was estimated.

TABLE 15

*Bolivia: Apparent consumption of wrapping and packing paper*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	92	..	92	0.041
1926	..	99	..	99	0.043
1927	..	158	..	158	0.068
1928	..	164	..	164	0.070
1929	..	232	..	232	0.098
1930	..	166	..	166	0.069
1931	..	68	..	68	0.028
1932	..	111	..	111	0.045
1933	..	97	..	97	0.039
1934	..	63	..	63	0.025
1935	..	95	..	95	0.033
1936	..	156	..	156	0.061
1937	..	221	..	221	0.085
1938	..	175	..	175	0.066
1939	..	256	..	256	0.096
1940	..	178	..	178	0.066
1941	..	201	..	201	0.074
1942	..	320	..	320	0.116
1943	..	226	..	226	0.081
1944	..	254	..	254	0.090
1945	..	103	..	103	0.036
1946	..	340	..	340	0.118
1947	..	174	..	174	0.060
1948	..	220	..	220	0.074
1949	..	258	..	258	0.086
1950 <sup>a</sup>	..	250	..	250	0.083

Sources: Same as for table 11.

<sup>a</sup> Estimates.

TABLE 16

*Bolivia: Apparent consumption of paperboard*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	30	..	30	0.013
1926	..	142	..	142	0.062
1927	..	90	..	90	0.039
1928	..	230	..	230	0.098
1929	..	341	..	341	0.144
1930	..	339	..	339	0.142
1931	..	64	..	64	0.026
1932	..	25	..	25	0.010
1933	..	21	..	21	0.008
1934	..	20	..	20	0.008
1935	..	41	..	41	0.016
1936	..	26	..	26	0.010
1937	..	111	..	111	0.043
1938	155	132	..	287	0.109
1939	200	80	..	280	0.105
1940	216	54	..	270	0.100
1941	266	66	..	332	0.122
1942	314	186	..	500	0.182
1943	314	204	..	518	0.186
1944	312	38	..	350	0.124
1945	310	42	..	352	0.124
1946	312	50	..	362	0.126
1947	547	150	..	697	0.239
1948	459	40	..	499	0.169
1949 <sup>a</sup>	488	20	..	508	0.170
1950 <sup>a</sup>	518	20	..	538	0.178

Sources: Same as for table 11.

<sup>a</sup> Estimates.

TABLE 17

*Bolivia: Apparent consumption of sundry papers, not classified<sup>a</sup>*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	476	..	476	0.211
1926	..	365	..	365	0.160
1927	..	489	..	489	0.211
1928	..	501	..	501	0.214
1929	..	443	..	443	0.187
1930	..	404	..	404	0.169
1931	..	217	..	217	0.090
1932	..	139	..	139	0.057
1933	..	110	..	110	0.044
1934	..	313	..	313	0.125
1935	..	249	..	249	0.098
1936	..	274	..	274	0.107
1937	..	410	..	410	0.158
1938	..	357	..	357	0.136
1939	..	428	..	428	0.161
1940	..	344	..	344	0.128
1941	..	104	..	104	0.038
1942	..	430	..	430	0.156
1943	..	474	..	474	0.170
1944	..	465	..	465	0.165
1945	..	609	..	609	0.214
1946	..	842	..	842	0.292
1947	..	394	..	394	0.135
1948	..	451	..	451	0.153
1949	..	442 <sup>b</sup>	..	442 <sup>b</sup>	0.148
1950	..	461 <sup>b</sup>	..	461 <sup>b</sup>	0.153

Sources: Same as for table 11.

<sup>a</sup> Includes bristleboards.

<sup>b</sup> Estimates.

TABLE 18

*Brazil: Total apparent consumption of paper and paperboard*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	52,315	51,722	7	104,030	2.980
1931	46,808	33,284	4	80,088	2.266
1932	56,304	33,685	11	89,978	2.514
1933	65,650	43,842	7	109,485	3.021
1934	70,055	47,339	17	117,377	3.199
1935	91,964	51,621	4	143,581	3.865
1936	96,970	58,806	5	155,771	4.141
1937	102,831	68,598	66	171,363	4.445
1938	106,702	50,996	39	157,659	3.996
1939	111,545	53,615	48	165,112	4.092
1940	120,908	50,373	183	171,098	4.149
1941	128,771	62,509	120	191,160	4.535
1942	133,751	30,653	194	164,210	3.814
1943	125,706	40,832	115	166,423	3.787
1944	139,613	48,752	159	188,206	4.196
1945	141,581	57,157	370	198,368	4.336
1946	156,496	73,939	314	230,121	4.933
1947	170,750	85,928	51	256,627	5.397
1948	186,956	63,912	23	250,845	5.177
1949	216,544	53,440	5	269,979	5.471
1950	247,895	70,400	6	318,289	6.334

Sources: Associação dos Fabricantes do Papel, until 1944; Sindicato da Indústria do Papel do Rio de Janeiro e de São Paulo, from 1945. Imports and exports: *Comercio Exterior do Brasil*.

TABLE 19

*Brazil: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	37,922	..	37,922	1.156
1926	..	32,789	..	32,789	0.987
1927	..	32,096	..	32,096	0.954
1928	..	36,539	..	36,539	1.073
1929	..	41,908	..	41,908	1.215
1930	..	38,560	..	38,560	1.104
1931	..	26,105	..	26,105	0.738
1932	..	27,762	..	27,762	0.776
1933	..	35,249	..	35,249	0.973
1934	..	40,422	..	40,422	1.102
1935	..	44,816	..	44,816	1.206
1936	..	51,434	..	51,434	1.367
1937	..	59,541	..	59,541	1.544
1938	..	42,294	..	42,294	1.072
1939	..	45,537	..	45,537	1.128
1940	..	42,816	..	42,816	1.038
1941	..	45,885	..	45,885	1.089
1942	..	22,301	..	22,301	0.518
1943	..	35,826	..	35,826	0.815
1944	..	39,598	..	39,598	0.883
1945	..	46,492	..	46,492	1.016
1946	..	59,369	..	59,369	1.273
1947	12,000 <sup>a</sup>	57,493	..	69,493	1.461
1948	25,000 <sup>a</sup>	52,603	..	77,603	1.602
1949	30,618 <sup>a</sup>	46,701	..	77,319	1.567
1950	30,992 <sup>a</sup>	60,634	..	91,626	1.823

Sources: Same as for table 18.

<sup>a</sup> The production of newsprint was calculated on the basis of figures supplied by Industrias Klabin do Paraná de Celulose, S.A.

TABLE 20

*Brazil: Apparent consumption of all paper and paperboard, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	52,315	13,162	7	65,470	1.875
1931	46,808	7,179	4	53,983	1.527
1932	56,304	5,923	11	62,216	1.738
1933	65,650	8,593	7	74,236	2.048
1934	70,055	6,917	17	76,955	2.097
1935	91,964	6,805	4	98,765	2.658
1936	96,970	7,372	5	104,337	2.774
1937	102,831	9,057	.66	111,822	2.901
1938	106,702	8,702	39	115,365	2.924
1939	111,545	8,078	48	119,575	2.963
1940	120,908	7,557	183	128,282	3.111
1941	128,771	16,624	120	145,275	3.447
1942	133,751	8,352	194	141,909	3.296
1943	125,706	5,006	115	130,597	2.971
1944	139,613	9,154	159	148,608	3.313
1945	141,581	10,665	370	151,876	3.320
1946	156,496	14,570	314	170,752	3.660
1947	158,750	28,435	51	187,134	3.936
1948	161,956	11,309	23	173,242	3.576
1949	185,926	6,739	5	192,660	3.904
1950	216,903	9,766	6	226,663	4.511

Sources: Same as for table 18.

TABLE 21

*Brazil: Apparent consumption of writing and printing paper other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	40,654	1,628	..	42,282	1.097
1938	38,364	1,686	..	40,050	1.015
1939	41,761	1,436	..	43,197	1.071
1940	45,276	1,223	..	46,499	1.128
1941	43,590	2,038	..	45,628	1.083
1942	48,850	1,995	..	50,845	1.181
1943	44,610	858	..	45,468	1.035
1944	45,429	1,968	2	47,395	1.057
1945	47,505	2,661	1	50,165	1.097
1946	53,631	4,355	..	57,986	1.243
1947	51,185	9,526	..	60,711	1.277
1948	46,773	3,185	..	49,958	1.031
1949	54,793	689	..	55,482	1.124
1950	66,470	3,982	..	70,452	1.402

Sources: Same as for table 18.

TABLE 22

*Brazil: Apparent consumption of wrapping and packing paper*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	49,561	761	..	50,322	1.306
1938	54,976	1,602	..	56,578	1.434
1939	55,340	1,937	..	57,277	1.420
1940	59,682	379	..	60,061	1.457
1941	64,702	615	..	65,317	1.550
1942	65,238	202	25	65,415	1.520
1943	62,030	22	3	62,049	1.412
1944	69,925	442	19	70,348	1.569
1945	69,310	669	23	69,956	1.529
1946	76,587	516	..	77,103	1.653
1947	77,918	1,027	..	78,945	1.660
1948	91,101	323	..	91,424	1.887
1949	97,237	951	..	98,188	1.990
1950	112,158	853	..	113,011	2.249

Sources: Same as for table 18.

TABLE 23

*Brazil: Apparent consumption of paperboard*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	7,766	1,542	..	9,308	0.241
1938	7,992	1,354	..	9,346	0.237
1939	7,722	1,072	..	8,794	0.218
1940	8,391	869	107	9,153	0.222
1941	12,504	1,170	..	13,674	0.324
1942	12,280	1,007	..	13,287	0.309
1943	12,139	377	..	12,516	0.285
1944	16,529	1,311	..	17,840	0.398
1945	16,722	1,380	..	18,102	0.396
1946	18,753	1,918	..	20,671	0.443
1947	21,000	3,203	..	24,203	0.509
1948	14,871	1,275	..	16,146	0.333
1949	20,383	767	..	21,150	0.429
1950	23,093	1,128	..	24,221	0.482

Sources: Same as for table 18.

TABLE 24

Brazil: Apparent consumption of sundry papers,  
not classified

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	4,850	5,126	66	9,910	0.257
1938	5,370	4,060	39	9,391	0.238
1939	6,722	3,633	48	10,307	0.255
1940	7,559	5,086	76	12,569	0.305
1941	7,975	12,801	120	20,656	0.490
1942	7,383	5,148	169	12,362	0.287
1943	6,927	3,749	112	10,564	0.240
1944	7,730	5,433	138	13,025	0.290
1945	8,044	5,955	346	13,653	0.298
1946	7,525	7,781	314	14,992	0.321
1947	8,647	14,679	51	23,275	0.489
1948	9,211	6,526	23	15,714	0.324
1949	13,513	4,332	5	17,840	0.361
1950	15,182	3,803	6	18,979	0.378

Sources: Same as for table 18.

TABLE 25

Chile: Total apparent consumption of paper  
and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	14,947	23,603	45	38,505	8.982
1931	10,581	20,871	65	31,387	7.260
1932	18,384	16,448	38	34,794	7.924
1933	21,012	8,010	32	28,990	6.498
1934	20,455	11,865	123	32,197	7.101
1935	23,192	14,876	80	37,988	8.249
1936	22,490	13,286	92	35,684	7.597
1937	23,419	17,515	46	40,888	8.601
1938	29,748	15,064	20	44,792	9.272
1939	31,985	13,262	35	45,212	9.214
1940	38,620	13,079	278	51,421	10.315
1941	39,232	12,282	442	51,072	10.099
1942	37,738	8,660	579	45,819	8.931
1943	35,872	7,535	517	42,890	8.249
1944	33,326	13,805	112	47,019	8.917
1945	34,476	21,348	71	55,753	10.423
1946	37,586	23,485	94	60,977	11.230
1947	39,058	18,061	117	57,002	10.317
1948	43,647	18,529	21	62,155	11.060
1949	44,345	18,312	51	62,606	10.966
1950	44,829	21,838	17	66,650	11.474

Sources: Production: *Revista de Estadística e Industrias*, and figures from Compañía Manufacturera de Papeles y Cartones, S.A. Imports and exports: 1925-49, *Comercio Exterior*; 1950, *Boletín Estadístico de Intercambio Comercial*, December 1950; *Sinopsis*, 1950.

TABLE 26

Chile: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	11,826	5	11,821	2.757
1931	..	15,837	..	15,837	3.663
1932	2,300	14,783	..	17,083	3.890
1933	4,328	7,173	5	11,496	2.577
1934	4,340	10,597	13	14,924	3.292
1935	2,182	12,720	2	14,900	3.236
1936	3,072	11,042	1	14,113	3.005
1937	923	14,796	..	15,719	3.306
1938	6,860	11,732	..	18,592	3.849
1939	6,716	10,244	..	16,960	3.456
1940	9,088	10,344	..	19,432	3.898
1941	10,957	9,520	..	20,477	4.049
1942	8,436	5,453	..	13,889	2.707
1943	8,093	4,888	..	12,981	2.497
1944	7,121	11,041	..	18,162	3.444
1945	5,656	17,766	..	23,422	4.379
1946	5,293	19,136	..	24,429	4.499
1947	5,109	14,465	..	19,574	3.543
1948	6,078	14,675	..	20,753	3.693
1949	8,237	13,786	..	22,023	3.858
1950	11,001	19,037	..	30,038	5.171

Sources: Same as for table 25.

TABLE 27

Chile: Apparent consumption of all paper and  
and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	14,947	11,777	40	26,684	6.225
1931	10,581	5,034	65	15,550	3.597
1932	16,084	1,665	38	17,711	4.034
1933	16,684	837	27	17,494	3.921
1934	16,115	1,268	110	17,273	3.809
1935	21,010	2,156	78	23,088	5.013
1936	19,418	2,244	91	21,571	4.592
1937	22,496	2,719	46	25,169	5.295
1938	22,888	3,332	20	26,200	5.423
1939	25,269	3,018	35	28,252	5.758
1940	29,532	2,735	278	31,989	6.417
1941	28,275	2,762	442	30,595	6.050
1942	29,302	3,207	579	31,930	6.224
1943	27,779	2,647	517	29,909	5.752
1944	26,205	2,764	112	28,857	5.473
1945	28,820	3,582	71	32,331	6.044
1946	32,293	4,349	94	36,548	6.731
1947	33,949	3,596	117	37,428	6.774
1948	37,569	3,854	21	41,402	7.367
1949	36,108	4,526	51	40,583	7.108
1950	33,828	2,801	17	36,612	6.303

Sources: Same as for table 25.

TABLE 28

Chile: Apparent consumption of writing and printing paper other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	3,800	5,997	..	9,797	2.285
1931	2,504	1,824	1	4,327	1.001
1932	4,540	347	..	4,887	1.113
1933	4,482	68	..	4,550	1.020
1934	4,732	98	1	4,829	1.065
1935	8,080	529	3	8,606	1.869
1936	6,445	373	1	6,817	1.451
1937	9,652	547	12	10,187	2.143
1938	7,234	874	2	8,106	1.678
1939	8,562	916	1	9,447	1.931
1940	11,347	491	..	11,838	2.375
1941	10,276	592	..	10,868	2.149
1942	11,627	524	3	12,148	2.368
1943	11,383	406	3	11,786	2.267
1944	10,001	384	..	10,385	1.969
1945	11,929	537	..	12,466	2.331
1946	13,007	1,030	..	14,037	2.585
1947	13,453	423	..	13,876	2.512
1948	15,165	477	..	15,642	2.783
1949	14,781	594	..	15,375	2.693
1950	11,951	834	..	12,785	2.201

Sources: Same as for table 25.

TABLE 29

Chile: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	6,194	447	7	6,634	1.547
1931	5,541	748	1	6,288	1.455
1932	8,037	142	..	8,179	1.863
1933	7,976	80	..	8,056	1.806
1934	7,605	395	..	8,000	1.764
1935	8,970	431	..	9,401	2.041
1936	9,526	615	36	10,105	2.151
1937	9,277	640	9	9,908	2.084
1938	11,487	752	1	12,238	2.533
1939	11,762	428	1	12,189	2.484
1940	13,298	396	1	13,693	2.747
1941	12,951	434	6	13,379	2.646
1942	12,789	588	4	13,373	2.607
1943	12,754	323	19	13,058	2.512
1944	12,736	499	..	13,235	2.510
1945	13,335	505	..	13,840	2.587
1946	15,377	277	3	15,651	2.882
1947	16,312	190	..	16,502	2.987
1948	18,119	170	..	18,289	3.254
1949	16,541	255	..	16,796	2.942
1950	16,456	107	3	16,560	2.851

Sources: Same as for table 25.

TABLE 30

Chile: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	3,953	1,152	3	5,102	1.190
1931	1,536	514	..	2,050	0.474
1932	2,507	37	..	2,544	0.579
1933	3,226	14	3	3,237	0.726
1934	2,778	26	31	2,773	0.612
1935	2,960	73	1	3,032	0.658
1936	2,447	43	1	2,489	0.530
1937	2,567	56	..	2,623	0.552
1938	2,900	121	1	3,020	0.625
1939	3,249	134	2	3,381	0.689
1940	3,146	144	215	3,075	0.617
1941	3,252	165	390	3,027	0.599
1942	3,144	229	530	2,843	0.554
1943	2,194	237	448	1,983	0.381
1944	2,480	178	81	2,577	0.489
1945	2,365	472	46	2,791	0.522
1946	2,448	271	72	2,647	0.487
1947	2,662	223	94	2,791	0.505
1948	2,553	970	15	3,508	0.624
1949	3,114	1,258	51	4,321	0.757
1950	3,645	243	12	3,876	0.667

Sources: Same as for table 25.

TABLE 31

Chile: Apparent consumption of sundry papers, not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	1,000	4,181	30	5,151	1.202
1931	1,000	1,948	63	2,885	0.667
1932	1,000	1,139	38	2,101	0.478
1933	1,000	675	24	1,651	0.370
1934	1,000	749	78	1,671	0.369
1935	1,000	1,123	74	2,049	0.445
1936	1,000	1,213	53	2,160	0.460
1937	1,000	1,476	25	2,451	0.516
1938	1,267	1,585	16	2,836	0.587
1939	1,696	1,540	31	3,205	0.653
1940	1,741	1,704	62	3,383	0.679
1941	1,796	1,571	46	3,321	0.657
1942	1,742	1,866	42	3,566	0.695
1943	1,448	1,681	47	3,082	0.593
1944	988	1,703	31	2,660	0.504
1945	1,191	2,068	25	3,234	0.605
1946	1,461	2,771	19	4,213	0.776
1947	1,522	2,760	23	4,259	0.771
1948	1,732	2,237	6	3,963	0.705
1949	1,672	2,419	—	4,091	0.717
1950	1,776	1,617	2	3,391	0.584

Sources: Same as for table 25.

<sup>a</sup>Includes bristleboards.

TABLE 32

## Colombia: Apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	7,932	..	7,932	1.186
1926	..	10,429	..	10,429	1.526
1927	..	10,035	..	10,035	1.439
1928	..	11,127	..	11,127	1.565
1929	..	12,256	..	12,256	1.688
1930	..	8,624	..	8,624	1.164
1931	..	9,837	..	9,837	1.301
1932	..	10,789	..	10,789	1.396
1933	..	14,555	..	14,555	1.847
1934	..	15,653	..	15,653	1.947
1935	..	17,694	..	17,694	2.158
1936	..	19,497	..	19,497	2.331
1937	..	23,624	..	23,624	2.769
1938	..	23,998	..	23,998	2.758
1939	..	25,171	..	25,171	2.833
1940	..	21,544	..	21,544	2.374
1941	..	28,826	..	28,826	3.110
1942	..	18,212	..	18,212	1.923
1943	..	26,258	..	26,253	2.715
1944	..	29,305	..	29,305	2.965
1945	..	33,660	..	33,660	3.333
1946	..	36,139	..	36,139	3.503
1947	..	44,003	..	44,003	4.173
1948	..	38,959	..	38,959	3.615
1949	..	40,294	..	40,294	3.658
1950	..	61,720	..	61,720	5.481

Sources: 1925-26 and 1932-48, *Anuarios del Comercio Exterior*; 1927-31 and 1949-50, data supplied by the Dirección de Estadística de Colombia.

TABLE 33

## Colombia: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	2,319	..	2,319	0.347
1926	..	2,906	..	2,906	0.425
1927	..	3,028	..	3,028	0.434
1928	..	3,357	..	3,357	0.472
1929	..	3,698	..	3,698	0.509
1930	..	2,602	..	2,602	0.351
1931	..	2,968	..	2,968	0.392
1932	..	4,086	..	4,086	0.529
1933	..	4,740	..	4,740	0.602
1934	..	4,495	..	4,495	0.559
1935	..	5,120	..	5,120	0.624
1936	..	5,538	..	5,538	0.662
1937	..	7,456	..	7,456	0.874
1938	..	7,195	..	7,195	0.827
1939	..	7,950	..	7,950	0.895
1940	..	5,687	..	5,687	0.627
1941	..	7,452	..	7,452	0.804
1942	..	6,118	..	6,118	0.646
1943	..	6,679	..	6,679	0.690
1944	..	9,610	..	9,610	0.972
1945	..	7,215	..	7,215	0.714
1946	..	10,739	..	10,739	1.041
1947	..	15,178	..	15,178	1.439
1948	..	15,161	..	15,161	1.407
1949	..	11,156	..	11,156	1.013
1950	..	19,962	..	19,962	1.773

Sources: Same as for table 32.

TABLE 34

## Colombia: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	5,613	..	5,613	0.839
1926	..	7,523	..	7,523	1.101
1927	..	7,007	..	7,007	1.005
1928	..	7,770	..	7,770	1.093
1929	..	8,558	..	8,558	1.179
1930	..	6,022	..	6,022	0.813
1931	..	6,869	..	6,869	0.909
1932	..	6,703	..	6,703	0.867
1933	..	9,815	..	9,815	1.245
1934	..	11,158	..	11,158	1.388
1935	..	12,574	..	12,574	1.534
1936	..	13,959	..	13,959	1.669
1937	..	16,168	..	16,168	1.895
1938	..	16,803	..	16,803	1.931
1939	..	17,221	..	17,221	1.938
1940	..	15,857	..	15,857	1.747
1941	..	21,374	..	21,374	2.306
1942	..	12,094	..	12,094	1.277
1943	..	19,579	..	19,579	2.025
1944	..	19,695	..	19,695	1.993
1945	..	26,445	..	26,445	2.619
1946	..	25,400	..	25,400	2.462
1947	..	28,825	..	28,825	2.734
1948	..	23,798	..	23,798	2.208
1949	..	29,138	..	28,138	2.645
1950	..	41,758	..	41,758	3.708

Sources: Same as for table 32.

TABLE 35

## Colombia: Apparent consumption of writing and printing paper, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,437	..	1,437	0.215
1926	..	1,904	..	1,904	0.279
1927	..	1,857	..	1,857	0.266
1928	..	2,059	..	2,059	0.290
1929	..	2,268	..	2,268	0.312
1930	..	1,596	..	1,596	0.215
1931	..	1,820	..	1,820	0.241
1932	..	1,470	..	1,470	0.190
1933	..	3,063	..	3,063	0.389
1934	..	2,676	..	2,676	0.333
1935	..	3,120	..	3,120	0.381
1936	..	3,539	..	3,539	0.423
1937	..	4,790	..	4,790	0.561
1938	..	4,110	..	4,110	0.472
1939	..	4,356	..	4,356	0.490
1940	..	4,341	..	4,341	0.478
1941	..	4,826	..	4,826	0.521
1942	..	3,830	..	3,830	0.404
1943	..	4,969	..	4,969	0.514
1944	..	7,500	..	7,500	0.759
1945	..	5,697	..	5,697	0.564
1946	..	5,369	..	5,369	0.520
1947	..	10,428	..	10,428	0.989
1948	..	6,536	..	6,536	0.606
1949	..	6,062	..	6,062	0.550
1950	..	7,122	..	7,122	0.633

Sources: Same as for table 32.

TABLE 36

Colombia: Apparent consumption of wrapping  
and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	1,550	..	1,550	0.232
1926....	..	2,142	..	2,142	0.314
1927....	..	2,362	..	2,362	0.339
1928....	..	2,234	..	2,234	0.314
1929....	..	3,106	..	3,106	0.428
1930....	..	2,536	..	2,536	0.342
1931....	..	2,674	..	2,674	0.354
1932....	..	3,715	..	3,715	0.481
1933....	..	2,969	..	2,969	0.377
1934....	..	4,906	..	4,906	0.610
1935....	..	4,441	..	4,441	0.542
1936....	..	5,443	..	5,443	0.651
1937....	..	6,135	..	6,135	0.719
1938....	..	6,877	..	6,877	0.790
1939....	..	6,527	..	6,527	0.735
1940....	..	6,350	..	6,350	0.700
1941....	..	9,309	..	9,309	1.004
1942....	..	4,004	..	4,004	0.423
1943....	..	6,294	..	6,294	0.651
1944....	..	5,173	..	5,173	0.523
1945....	..	12,274	..	12,274	1.215
1946....	..	8,743	..	8,743	0.847
1947....	..	7,664	..	7,664	0.727
1948....	..	9,112	..	9,112	0.846
1949....	..	12,789	..	12,789	1.161
1950....	..	15,485	..	15,485	1.375

Sources: Same as for table 32.

TABLE 37

Colombia: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	872	..	872	0.130
1926....	..	1,244	..	1,244	0.182
1927....	..	1,222	..	1,222	0.175
1928....	..	1,491	..	1,491	0.210
1929....	..	1,349	..	1,349	0.186
1930....	..	767	..	767	0.103
1931....	..	762	..	762	0.101
1932....	..	843	..	843	0.109
1933....	..	1,657	..	1,657	0.210
1934....	..	1,289	..	1,289	0.160
1935....	..	2,142	..	2,142	0.261
1936....	..	2,340	..	2,340	0.280
1937....	..	2,883	..	2,883	0.338
1938....	..	2,998	..	2,998	0.345
1939....	..	3,242	..	3,242	0.365
1940....	..	2,386	..	2,386	0.263
1941....	..	4,404	..	4,404	0.475
1942....	..	2,414	..	2,414	0.255
1943....	..	4,280	..	4,280	0.442
1944....	..	3,370	..	3,370	0.341
1945....	..	4,703	..	4,703	0.466
1946....	..	6,596	..	6,596	0.639
1947....	..	6,301	..	6,301	0.598
1948....	..	3,143	..	3,143	0.292
1949....	..	4,079	..	4,079	0.370
1950....	..	6,151	..	6,151	0.546

Sources: Same as for table 32.

TABLE 38

Colombia: Apparent consumption of sundry papers,  
not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	1,754	..	1,754	0.262
1926....	..	2,233	..	2,233	0.327
1927....	..	1,566	..	1,566	0.225
1928....	..	1,986	..	1,986	0.279
1929....	..	1,835	..	1,835	0.253
1930....	..	1,123	..	1,123	0.152
1931....	..	1,613	..	1,613	0.213
1932....	..	675	..	675	0.087
1933....	..	2,126	..	2,126	0.270
1934....	..	2,287	..	2,287	0.285
1935....	..	2,871	..	2,871	0.350
1936....	..	2,637	..	2,637	0.315
1937....	..	2,360	..	2,360	0.277
1938....	..	2,818	..	2,818	0.324
1939....	..	3,096	..	3,096	0.348
1940....	..	2,780	..	2,780	0.306
1941....	..	2,835	..	2,835	0.306
1942....	..	1,846	..	1,846	0.195
1943....	..	4,036	..	4,036	0.417
1944....	..	3,652	..	3,652	0.370
1945....	..	3,771	..	3,771	0.373
1946....	..	4,692	..	4,692	0.455
1947....	..	4,432	..	4,432	0.420
1948....	..	5,007	..	5,007	0.465
1949....	..	6,208	..	6,208	0.564
1950....	..	13,000	..	13,000	1.155

Sources: Same as for table 32.

<sup>a</sup> Includes bristleboards.

TABLE 39

Costa Rica: Total apparent consumption of paper  
and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	1,225	..	1,225	2.716
1926....	..	1,750	..	1,750	3.788
1927....	..	1,954	..	1,954	4.131
1928....	..	1,847	..	1,847	3.816
1929....	..	2,385	..	2,385	4.818
1930....	..	1,565	..	1,565	3.093
1931....	..	1,762	..	1,762	3.402
1932....	..	1,740	..	1,740	3.277
1933....	..	1,635	..	1,635	3.017
1934....	..	2,032	..	2,032	3.668
1935....	..	1,997	..	1,997	3.522
1936....	..	2,172	..	2,172	3.745
1937....	..	2,912	..	2,912	4.911
1938....	..	2,372	..	2,372	3.908
1939....	..	3,214	..	3,214	5.184
1940....	..	2,535	..	2,535	3.992
1941....	..	2,735	..	2,735	4.214
1942....	..	2,429	..	2,429	3.658
1943....	..	3,516	..	3,516	5.171
1944....	..	2,867	..	2,867	4.125
1945....	..	2,485	..	2,485	3.495
1946....	..	3,758	..	3,758	5.169
1947....	..	3,755	..	3,755	5.047
1948....	..	3,687	..	3,687	4.838
1949....	..	3,834	..	3,834	4.928
1950....	..	3,342	..	3,342	4.199

Sources: 1925-26, 1930, 1935-37, 1947-50, data supplied by the Dirección de Estadística de Costa Rica; 1927-29, 1931-34, 1938-46, *Anuarios del Comercio Exterior*.



TABLE 40

*Costa Rica: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	287	..	287	0.636
1926	..	408	..	408	0.883
1927	..	585	..	585	1.237
1928	..	540	..	540	1.116
1929	..	553	..	553	1.117
1930	..	420	..	420	0.830
1931	..	506	..	506	0.977
1932	..	409	..	409	0.770
1933	..	515	..	515	0.950
1934	..	551	..	551	0.995
1935	..	671	..	671	1.183
1936	..	630	..	630	1.086
1937	..	787	..	787	1.327
1938	..	621	..	621	1.023
1939	..	1,352	..	1,352	2.181
1940	..	906	..	906	1.427
1941	..	863	..	863	1.330
1942	..	594	..	594	0.895
1943	..	1,188	..	1,188	1.747
1944	..	1,261	..	1,261	1.814
1945	..	764	..	764	1.075
1946	..	1,226	..	1,226	1.686
1947	..	1,357	..	1,357	1.824
1948	..	1,119	..	1,119	1.468
1949	..	1,397	..	1,397	1.796
1950	..	1,679	..	1,679	2.109

Sources: Same as for table 39.

TABLE 41

*Costa Rica: Apparent consumption of all paper and paperboard, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	938	..	938	2.080
1926	..	1,342	..	1,342	2.905
1927	..	1,369	..	1,369	2.894
1928	..	1,307	..	1,307	2.700
1929	..	1,832	..	1,832	3.701
1930	..	1,145	..	1,145	2.263
1931	..	1,256	..	1,256	2.425
1932	..	1,331	..	1,331	2.507
1933	..	1,120	..	1,120	2.067
1934	..	1,481	..	1,481	2.673
1935	..	1,326	..	1,326	2.339
1936	..	1,542	..	1,542	2.659
1937	..	2,125	..	2,125	3.584
1938	..	1,751	..	1,751	2.885
1939	..	1,862	..	1,862	3.003
1940	..	1,629	..	1,629	2.565
1941	..	1,872	..	1,872	2.884
1942	..	1,835	..	1,835	2.763
1943	..	2,328	..	2,328	3.424
1944	..	1,606	..	1,606	2.311
1945	..	1,721	..	1,721	2.420
1946	..	2,532	..	2,532	3.483
1947	..	2,398	..	2,398	3.223
1948	..	2,568	..	2,568	3.370
1949	..	2,437	..	2,437	3.132
1950	..	1,663	..	1,663	2.090

Sources: Same as for table 39.

TABLE 42

*Costa Rica: Apparent consumption of writing and printing paper, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	148	..	148	0.328
1926	..	212	..	212	0.459
1927	..	275	..	275	0.581
1928	..	262	..	262	0.541
1929	..	255	..	255	0.515
1930	..	204	..	204	0.403
1931	..	240	..	240	0.463
1932	..	185	..	185	0.348
1933	..	235	..	235	0.434
1934	..	253	..	253	0.457
1935	..	290	..	290	0.511
1936	..	468	..	468	0.807
1937	..	557	..	557	0.939
1938	..	250	..	250	0.412
1939	..	544	..	544	0.877
1940	..	364	..	364	0.573
1941	..	347	..	347	0.535
1942	..	239	..	239	0.360
1943	..	478	..	478	0.703
1944	..	508	..	508	0.731
1945	..	307	..	307	0.432
1946	..	493	..	493	0.678
1947	..	592	..	592	0.796
1948	..	616	..	616	0.808
1949	..	458	..	458	0.589
1950	..	27	..	27	0.034

Sources: Same as for table 39.

TABLE 43

*Costa Rica: Apparent consumption of wrapping and packing paper*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	473	..	473	1.049
1926	..	739	..	739	1.600
1927	..	694	..	694	1.467
1928	..	646	..	646	1.335
1929	..	1,117	..	1,117	2.257
1930	..	637	..	637	1.259
1931	..	720	..	720	1.390
1932	..	911	..	911	1.716
1933	..	616	..	616	1.137
1934	..	908	..	908	1.639
1935	..	762	..	762	1.344
1936	..	713	..	713	1.229
1937	..	1,143	..	1,143	1.927
1938	..	1,041	..	1,041	1.715
1939	..	914	..	914	1.474
1940	..	878	..	878	1.383
1941	..	1,058	..	1,058	1.630
1942	..	1,107	..	1,107	1.667
1943	..	1,283	..	1,283	1.887
1944	..	762	..	762	1.096
1945	..	981	..	981	1.380
1946	..	1,414	..	1,414	1.945
1947	..	1,253	..	1,253	1.684
1948	..	1,354	..	1,354	1.777
1949	..	1,373	..	1,373	1.765
1950	..	1,094	..	1,094	1.374

Sources: Same as for table 39.

TABLE 44

Costa Rica: Apparent consumption of paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	43	..	43	0.095
1926....	..	43	..	43	0.093
1927....	..	71	..	71	0.150
1928....	..	39	..	39	0.081
1929....	..	41	..	41	0.083
1930....	..	24	..	24	0.047
1931....	..	36	..	36	0.069
1932....	..	32	..	32	0.060
1933....	..	42	..	42	0.077
1934....	..	51	..	51	0.092
1935....	..	52	..	52	0.092
1936....	..	65	..	65	0.112
1937....	..	78	..	78	0.132
1938....	..	64	..	64	0.105
1939....	..	56	..	56	0.090
1940....	..	54	..	54	0.085
1941....	..	65	..	65	0.100
1942....	..	68	..	68	0.102
1943....	..	79	..	79	0.116
1944....	..	47	..	47	0.068
1945....	..	60	..	60	0.084
1946....	..	87	..	87	0.120
1947....	..	77	..	77	0.103
1948....	..	83	..	83	0.109
1949....	..	84	..	84	0.108
1950....	..	59	..	59	0.074

Sources: Same as for table 39.

TABLE 45

Costa Rica: Apparent consumption of sundry papers,  
not classified<sup>a</sup>  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	274	..	274	0.608
1926....	..	348	..	348	0.753
1927....	..	329	..	329	0.696
1928....	..	360	..	360	0.744
1929....	..	419	..	419	0.846
1930....	..	280	..	280	0.553
1931....	..	260	..	260	0.502
1932....	..	203	..	203	0.382
1933....	..	227	..	227	0.419
1934....	..	269	..	269	0.486
1935....	..	222	..	222	0.392
1936....	..	296	..	296	0.510
1937....	..	347	..	347	0.585
1938....	..	396	..	396	0.652
1939....	..	348	..	348	0.561
1940....	..	333	..	333	0.524
1941....	..	402	..	402	0.619
1942....	..	421	..	421	0.634
1943....	..	488	..	488	0.718
1944....	..	289	..	289	0.416
1945....	..	373	..	373	0.525
1946....	..	538	..	538	0.740
1947....	..	476	..	476	0.640
1948....	..	515	..	515	0.676
1949....	..	522	..	522	0.671
1950....	..	483	..	483	0.607

Sources: Same as for table 39.

<sup>a</sup> Includes bristleboards.

TABLE 46

Cuba: Total apparent consumption of paper  
and paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	14,936	37,865	..	52,801	15.389
1926....	19,037	42,786	..	61,823	17.568
1927....	20,995	43,976	..	64,971	18.017
1928....	20,082	43,974	..	64,056	17.350
1929....	22,425	41,459	..	63,884	16.909
1930....	28,586	37,150	..	65,736	17.021
1931....	18,175	23,724	..	41,899	10.618
1932....	19,182	21,086	..	40,268	9.997
1933....	18,807	18,664	..	37,471	9.121
1934....	14,412	35,027	2	49,437	11.807
1935....	5,937	37,521	17	43,441	10.188
1936....	14,494	40,066	55	54,505	12.562
1937....	19,575	48,700	86	68,189	15.459
1938....	30,299	38,579	87	68,791	15.355
1939....	57,535	38,090	170	95,455	20.993
1940....	17,069	40,230	652	56,647	12.285
1941....	29,710	45,482	132	75,060	16.069
1942....	22,000	49,227	53	71,174	15.054
1943....	17,249	52,398	130	69,517	14.537
1944....	10,434	45,440	141	55,733	11.489
1945....	56,992	63,323	117	120,198	24.416
1946....	48,517	70,337	201	118,653	23.754
1947....	19,979	84,713	285	104,407	20.613
1948....	25,990	81,808	184	107,614	20.957
1949....	22,150	75,826	126	97,850	18.803
1950....	34,349	102,801	251	136,899	25.952

Sources: Production: estimated on the basis of imports of raw materials. Imports and exports: 1925-32, *Importación y Exportación*, Secretaría de Hacienda; 1933-46, *Anuarios del Comercio Exterior*; 1949, *Boletín de Estadística*, May-June 1950 and September-December 1950; 1950, data from the Dirección General de Estadística.

TABLE 47

Cuba: Apparent consumption of newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	9,957	..	9,957	2.902
1926....	..	13,306	..	13,306	3.781
1927....	..	14,611	..	14,611	4.052
1928....	..	18,308	..	18,308	4.959
1929....	..	14,228	..	14,228	3.766
1930....	..	13,714	..	13,714	3.551
1931....	..	10,441	..	10,441	2.646
1932....	..	9,588	..	9,588	2.380
1933....	..	6,880	..	6,880	1.675
1934....	..	9,230	..	9,230	2.204
1935....	..	9,634	..	9,634	2.259
1936....	..	12,996	..	12,996	2.995
1937....	..	15,206	..	15,206	3.447
1938....	..	14,843	..	14,843	3.313
1939....	..	13,877	..	13,877	3.052
1940....	..	16,626	..	16,626	3.606
1941....	..	15,866	..	15,866	3.397
1942....	..	14,937	..	14,937	3.159
1943....	..	15,278	..	15,278	3.195
1944....	..	11,830	..	11,830	2.439
1945....	..	13,354	..	13,354	2.713
1946....	..	19,544	..	19,544	3.913
1947....	..	22,860	..	22,860	4.513
1948....	..	26,807	..	26,807	5.220
1949....	..	27,411	..	27,411	5.267
1950....	..	37,532	..	37,532	7.115

Sources: Same as for table 46.

TABLE 48

*Cuba: Apparent consumption of all paper and paperboard, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	14,936	27,908	..	42,844	12.487
1926	19,037	29,480	..	48,517	13.787
1927	20,995	29,365	..	50,360	13.965
1928	20,082	25,666	..	45,748	12.391
1929	22,425	27,231	..	49,656	13.143
1930	28,586	23,436	..	52,022	13.470
1931	18,175	13,283	..	31,458	7.972
1932	19,182	11,498	..	30,680	7.617
1933	18,807	11,784	..	30,591	7.446
1934	14,412	25,797	2	40,207	9.603
1935	5,937	27,887	17	33,807	7.929
1936	14,494	27,070	55	41,509	9.567
1937	19,575	33,494	86	52,983	12.012
1938	30,299	23,736	87	53,948	12.042
1939	57,535	24,213	170	81,578	17.941
1940	17,069	23,604	652	40,021	8.679
1941	29,710	29,616	132	59,194	12.672
1942	22,000	34,290	53	56,237	11.895
1943	17,249	37,120	130	54,239	11.342
1944	10,434	33,610	141	43,903	9.050
1945	56,992	49,969	117	106,844	21.703
1946	48,517	50,793	201	99,109	19.841
1947	19,979	61,853	285	81,547	16.100
1948	25,990	55,001	184	80,807	15.737
1949	22,150	48,415	126	70,439	13.536
1950	34,349	65,269	251	99,367	18.837

Sources: Same as for table 46.

TABLE 49

*Dominican Republic: Total apparent consumption of paper and paperboard*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	2,629	..	2,629	1.727
1937	..	2,808	..	2,808	1.803
1938	..	3,455	..	3,455	2.167
1939	..	3,322	..	3,322	2.036
1940	..	3,255	..	3,255	1.949
1941	..	3,317	..	3,317	1.940
1942	34	4,040	..	4,074	2.328
1943	33	2,899	..	2,932	1.636
1944	42	3,392	..	3,434	1.872
1945	75	3,476	..	3,551	1.891
1946	99	5,342	..	5,441	2.829
1947	79	5,294	..	5,373	2.729
1948	..	7,191	..	7,191	3.567
1949	..	4,964	..	4,964	2.405
1950	196	5,895	..	6,091	2.883

Sources: Data supplied by the Dirección de Estadística de la República Dominicana.

TABLE 50

*Dominican Republic: Apparent consumption of newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	708	..	708	0.465
1937	..	884	..	884	0.568
1938	..	820	..	820	0.514
1939	..	1,204	..	1,204	0.738
1940	..	920	..	920	0.551
1941	..	935	..	935	0.547
1942	..	1,273	..	1,273	0.727
1943	..	805	..	805	0.449
1944	..	905	..	905	0.493
1945	..	998	..	998	0.531
1946	..	1,469	..	1,469	0.764
1947	..	1,599	..	1,599	0.812
1948	..	1,879	..	1,879	0.932
1949	..	1,419	..	1,419	0.688
1950	..	1,168	..	1,168	0.553

Sources: Same as for table 49.

TABLE 51

*Dominican Republic: Apparent consumption of all paper and paperboard, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	1,921	..	1,921	1.262
1937	..	1,924	..	1,924	1.235
1938	..	2,635	..	2,635	1.653
1939	..	2,118	..	2,118	1.298
1940	..	2,335	..	2,335	1.398
1941	..	2,382	..	2,382	1.393
1942	34	2,767	..	2,801	1.601
1943	33	2,094	..	2,127	1.187
1944	42	2,487	..	2,529	1.379
1945	75	2,478	..	2,553	1.360
1946	99	3,873	..	3,972	2.065
1947	79	3,695	..	3,774	1.917
1948	..	5,312	..	5,312	2.635
1949	..	3,545	..	3,545	1.717
1950	196	4,727	..	4,923	2.330

Sources: Same as for table 49.

TABLE 52

*Dominican Republic: Apparent consumption of writing and printing paper, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	124	..	124	0.081
1937	..	153	..	153	0.098
1938	..	142	..	142	0.089
1939	..	208	..	208	0.127
1940	..	160	..	160	0.096
1941	..	162	..	162	0.095
1942	..	150	..	150	0.086
1943	..	116	..	116	0.065
1944	..	127	..	127	0.069
1945	..	132	..	132	0.070
1946	..	197	..	197	0.102
1947	..	232	..	232	0.118
1948	..	267	..	267	0.132
1949	..	291	..	291	0.141
1950	..	425	..	425	0.201

Sources: Same as for table 49.

TABLE 53

*Dominican Republic: Apparent consumption of wrapping and packing paper*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	1,254	..	1,254	0.824
1937	..	1,105	..	1,105	0.710
1938	..	1,707	..	1,707	1.071
1939	..	1,032	..	1,032	0.632
1940	..	1,471	..	1,471	0.881
1941	..	1,337	..	1,337	0.782
1942	..	1,694	..	1,694	0.968
1943	..	1,002	..	1,002	0.559
1944	..	1,553	..	1,553	0.846
1945	..	1,539	..	1,539	0.819
1946	..	2,067	..	2,067	1.075
1947	..	1,746	..	1,746	0.887
1948	..	3,420	..	3,420	1.696
1949	..	1,486	..	1,486	0.720
1950	..	2,269	..	2,269	1.074

Sources: Same as for table 49.

TABLE 54

*Dominican Republic: Apparent consumption of paperboard*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	96	..	96	0.063
1937	..	220	..	220	0.141
1938	..	230	..	230	0.144
1939	..	380	..	380	0.233
1940	..	311	..	311	0.186
1941	..	488	..	488	0.285
1942	34	534	..	568	0.325
1943	33	622	..	655	0.365
1944	42	460	..	502	0.274
1945	75	445	..	520	0.277
1946	99	991	..	1,090	0.567
1947	79	838	..	917	0.466
1948	..	911	..	911	0.452
1949	..	1,017	..	1,017	0.493
1950	196	1,061	..	1,257	0.595

Sources: Same as for table 49.

TABLE 55

*Dominican Republic: Apparent consumption of sundry papers, not classified<sup>a</sup>*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	477	..	477	0.294
1937	..	446	..	446	0.286
1938	..	556	..	556	0.349
1939	..	498	..	498	0.305
1940	..	393	..	393	0.235
1941	..	395	..	395	0.231
1942	..	389	..	389	0.222
1943	..	354	..	354	0.198
1944	..	347	..	347	0.189
1945	..	362	..	352	0.193
1946	..	618	..	618	0.321
1947	..	879	..	879	0.446
1948	..	714	..	714	0.354
1949	..	751	..	751	0.364
1950	..	972	..	972	0.460

Sources: Same as for table 49.

<sup>a</sup> Includes bristleboards.

TABLE 56

## Ecuador: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	4,211	..	4,211	1.831
1938	..	4,048	..	4,048	1.717
1939	..	4,702	..	4,702	1.948
1940	..	4,794	..	4,794	1.942
1941	..	3,858	..	3,858	1.529
1942	..	5,726	..	5,726	2.222
1943	..	4,264	..	4,264	1.613
1944	..	4,117	..	4,117	1.517
1945	..	3,065	..	3,065	1.101
1946	100	5,014	..	5,114	1.791
1947	166	6,946	..	7,112	2.421
1948	233	6,036	..	6,269	2.077
1949	300	6,151	..	6,451	2.077
1950	367	11,039	..	11,406	3.565

Sources: Production: data from the industrial survey made by ECLA in Ecuador. Imports: 1937, 1943-46, data supplied by the Dirección General de Estadística del Ecuador; 1938-42, Ecuador en Cifras; 1947-50, Boletín del Banco Central del Ecuador (Comercio Exterior).

TABLE 57

## Ecuador: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	2,603	..	2,603	1.132
1938	..	2,356	..	2,356	1.000
1939	..	2,533	..	2,533	1.049
1940	..	2,979	..	2,979	1.207
1941	..	2,188	..	2,188	0.867
1942	..	2,603	..	2,603	1.010
1943	..	1,941	..	1,941	0.734
1944	..	2,247	..	2,247	0.828
1945	..	1,792	..	1,792	0.644
1946	..	2,728	..	2,728	0.956
1947	..	3,738	..	3,738	1.272
1948	..	2,908	..	2,908	0.963
1949	..	2,364	..	2,364	0.761
1950	..	5,679	..	5,679	1.775

Sources: Same as for table 56.

TABLE 58

## Ecuador: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	1,608	..	1,608	0.699
1938	..	1,692	..	1,692	0.717
1939	..	2,169	..	2,169	0.899
1940	..	1,815	..	1,815	0.735
1941	..	1,670	..	1,670	0.662
1942	..	3,123	..	3,123	1.212
1943	..	2,323	..	2,323	0.879
1944	..	1,870	..	1,870	0.689
1945	..	1,273	..	1,273	0.457
1946	100	2,286	..	2,386	0.835
1947	166	3,208	..	3,374	1.149
1948	233	3,128	..	3,361	1.114
1949	300	3,787	..	4,087	1.316
1950	367	5,360	..	5,727	1.790

Sources: Same as for table 56.

TABLE 59

## Ecuador: Apparent consumption of writing and printing paper, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	108	..	108	0.047
1938	..	594	..	594	0.252
1939	..	762	..	762	0.316
1940	..	638	..	638	0.259
1941	..	587	..	587	0.233
1942	..	1,097	..	1,097	0.426
1943	..	755	..	755	0.286
1944	..	476	..	476	0.175
1945	..	388	..	388	0.139
1946	..	502	..	502	0.176
1947	..	1,280	..	1,280	0.436
1948	..	1,181	..	1,181	0.391
1949	..	1,438	..	1,438	0.463
1950	..	2,142	..	2,142	0.670

Sources: Same as for table 56.

TABLE 60

Ecuador: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	1,044	..	1,044	0.454
1938	..	705	..	705	0.299
1939	..	903	..	903	0.374
1940	..	756	..	756	0.306
1941	..	696	..	696	0.276
1942	..	1,300	..	1,300	0.504
1943	..	1,135	..	1,135	0.429
1944	..	725	..	725	0.267
1945	..	611	..	611	0.220
1946	..	1,384	..	1,384	0.485
1947	..	1,037	..	1,037	0.353
1948	..	1,307	..	1,307	0.433
1949	..	1,410	..	1,410	0.454
1950	..	2,065	..	2,065	0.646

Sources: Same as for table 56.

TABLE 61

Ecuador: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	175	..	175	0.076
1938	..	121	..	121	0.051
1939	..	155	..	155	0.064
1940	..	129	..	129	0.052
1941	..	119	..	119	0.047
1942	..	223	..	223	0.087
1943	..	177	..	177	0.067
1944	..	78	..	78	0.029
1945	..	25	..	25	0.009
1946	100	82	..	182	0.064
1947	166	351	..	517	0.176
1948	233	209	..	442	0.146
1949	300	512	..	812	0.261
1950	367	222	..	589	0.184

Sources: Same as for table 56.

TABLE 62

Ecuador: Apparent consumption of sundry papers, not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	281	..	281	0.122
1938	..	272	..	272	0.115
1939	..	349	..	349	0.145
1940	..	292	..	292	0.118
1941	..	268	..	268	0.106
1942	..	503	..	503	0.195
1943	..	256	..	256	0.097
1944	..	591	..	591	0.218
1945	..	249	..	249	0.089
1946	..	318	..	318	0.111
1947	..	540	..	540	0.184
1948	..	431	..	431	0.143
1949	..	427	..	427	0.137
1950	..	931	..	931	0.291

Sources: Same as for table 56.  
\*Includes bristleboards.

TABLE 63

El Salvador: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	2,516	..	2,516	1.853
1926	..	2,026	..	2,026	1.473
1927	..	1,536	..	1,536	1.103
1928	..	2,013	..	2,013	1.428
1929	..	1,944	..	1,944	1.362
1930	..	1,920	..	1,920	1.329
1931	..	1,654	..	1,654	1.131
1932	..	1,537	..	1,537	1.034
1933	..	1,594	..	1,594	1.063
1934	..	2,149	..	2,149	1.416
1935	..	2,821	..	2,821	1.835
1936	..	1,754	..	1,754	1.127
1937	..	2,015	..	2,015	1.279
1938	..	1,804	..	1,804	1.130
1939	..	3,129	..	3,129	1.936
1940	..	1,636	..	1,636	1.000
1941	..	2,384	..	2,384	1.440
1942	..	2,394	..	2,394	1.428
1943	..	2,634	..	2,634	1.551
1944	..	2,092	..	2,092	1.216
1945	..	1,747	..	1,747	1.003
1946	..	3,145	..	3,145	1.784
1947	..	2,952	..	2,952	1.654
1948	..	4,004	..	4,004	2.216
1949	..	3,802	..	3,802	2.078
1950 <sup>a</sup>	..	3,872	..	3,872	2.084

Sources: 1926, 1931-46, *Anuarios del Comercio Exterior*; 1925, 1927-30, 1947-49, data supplied by the Dirección General de Estadística de El Salvador.<sup>a</sup> Estimated.

TABLE 64

*El Salvador: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	461	..	461	0.339
1926	..	1,179	..	1,179	0.857
1927	..	682	..	682	0.490
1928	..	1,132	..	1,132	0.803
1929	..	1,111	..	1,111	0.779
1930	..	1,146	..	1,146	0.793
1931	..	1,057	..	1,057	0.722
1932	..	1,006	..	1,006	0.677
1933	..	1,052	..	1,052	0.701
1934	..	1,442	..	1,442	0.950
1935	..	1,975	..	1,975	1.285
1936	..	1,003	..	1,003	0.644
1937	..	1,209	..	1,209	0.767
1938	..	1,082	..	1,082	0.678
1939	..	1,877	..	1,877	1.162
1940	..	1,020	..	1,020	0.623
1941	..	1,645	..	1,645	0.993
1942	..	1,699	..	1,699	1.013
1943	..	1,870	..	1,870	1.101
1944	..	1,484	..	1,484	0.863
1945	..	857	..	857	0.492
1946	..	2,054	..	2,054	1.165
1947	..	1,306	..	1,306	0.732
1948	..	1,991	..	1,991	1.102
1949	..	1,946	..	1,946	1.063
1950 <sup>a</sup>	..	1,969	..	1,969	1.060

Sources: Same as for table 63.

<sup>a</sup> Estimated.

TABLE 65

*El Salvador: Apparent consumption of all paper and paperboard, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	2,055	..	2,055	1.514
1926	..	847	..	847	1.169
1927	..	854	..	854	1.046
1928	..	881	..	881	0.625
1929	..	833	..	833	0.583
1930	..	774	..	774	0.536
1931	..	597	..	597	0.409
1932	..	531	..	531	0.357
1933	..	542	..	542	0.362
1934	..	707	..	707	0.466
1935	..	846	..	846	0.550
1936	..	751	..	751	0.483
1937	..	806	..	806	0.512
1938	..	722	..	722	0.452
1939	..	1,252	..	1,252	0.774
1940	..	616	..	616	0.377
1941	..	739	..	739	0.447
1942	..	695	..	695	0.415
1943	..	764	..	764	0.450
1944	..	608	..	608	0.352
1945	..	890	..	890	0.211
1946	..	1,091	..	1,091	0.619
1947	..	1,646	..	1,646	0.922
1948	..	2,013	..	2,013	1.114
1949	..	1,856	..	1,856	1.015
1950	..	1,903	..	1,903 <sup>a</sup>	1.024

Sources: Same as for table 63.

<sup>a</sup> Estimated.

TABLE 66

*El Salvador: Apparent consumption of writing and printing paper, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	319	..	319	0.235
1926	..	257	..	257	0.187
1927	..	195	..	195	0.140
1928	..	255	..	255	0.181
1929	..	247	..	247	0.173
1930	..	244	..	244	0.169
1931	..	210	..	210	0.144
1932	..	195	..	195	0.131
1933	..	202	..	202	0.135
1934	..	273	..	273	0.180
1935	..	358	..	358	0.233
1936	..	223	..	223	0.143
1937	..	256	..	256	0.162
1938	..	229	..	229	0.143
1939	..	397	..	397	0.246
1940	..	208	..	208	0.127
1941	..	303	..	303	0.183
1942	..	304	..	304	0.181
1943	..	334	..	334	0.197
1944	..	265	..	265	0.154
1945	..	222	..	222	0.128
1946	..	399	..	399	0.226
1947	..	375	..	375	0.210
1948	..	508	..	508	0.281
1949	..	482	..	482	0.263
1950 <sup>a</sup>	..	491	..	491	0.264

Sources: Same as for table 63.

<sup>a</sup> Estimated.

TABLE 67

*El Salvador: Apparent consumption of wrapping paper*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,402	..	1,402	1.032
1926	..	201	..	201	0.146
1927	..	384	..	384	0.276
1928	..	58	..	58	0.041
1929	..	26	..	26	0.018
1930	..	44	..	44	0.030
1931	..	17	..	17	0.012
1932	..	20	..	20	0.013
1933	..	46	..	46	0.031
1934	..	60	..	60	0.040
1935	..	180	..	180	0.117
1936	..	139	..	139	0.089
1937	..	129	..	129	0.082
1938	..	116	..	116	0.073
1939	..	200	..	200	0.124
1940	..	78	..	78	0.048
1941	..	113	..	113	0.068
1942	..	139	..	139	0.083
1943	..	153	..	153	0.090
1944	..	103	..	103	0.060
1945	..	228	..	228	0.131
1946	..	391	..	391	0.222
1947	..	511	..	511	0.286
1948	..	376	..	376	0.208
1949	..	569	..	569	0.311
1950 <sup>a</sup>	..	546	..	546	0.294

Sources: Same as for table 63.

<sup>a</sup> Estimated.

TABLE 68

*El Salvador: Apparent consumption of paperboard*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	135	..	135	0.099
1926....	..	109	..	109	0.079
1927....	..	82	..	82	0.059
1928....	..	108	..	108	0.077
1929....	..	104	..	104	0.073
1930....	..	103	..	103	0.071
1931....	..	89	..	89	0.061
1932....	..	83	..	83	0.056
1933....	..	86	..	86	0.057
1934....	..	115	..	115	0.076
1935....	..	152	..	152	0.099
1936....	..	94	..	94	0.060
1937....	..	108	..	108	0.069
1938....	..	97	..	97	0.061
1939....	..	168	..	168	0.104
1940....	..	88	..	88	0.054
1941....	..	128	..	128	0.077
1942....	..	129	..	129	0.077
1943....	..	141	..	141	0.083
1944....	..	112	..	112	0.065
1945....	..	94	..	94	0.054
1946....	..	169	..	169	0.096
1947....	..	159	..	159	0.089
1948....	..	215	..	215	0.119
1949....	..	204	..	204	0.111
1950 <sup>a</sup> ....	..	208	..	208	0.112

Sources: Same as for table 63.

<sup>a</sup> Estimated.

TABLE 69

*El Salvador: Apparent consumption of sundry papers, not classified<sup>a</sup>*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	199	..	199	0.147
1926....	..	280	..	280	0.204
1927....	..	193	..	193	0.139
1928....	..	460	..	460	0.326
1929....	..	456	..	456	0.320
1930....	..	383	..	383	0.265
1931....	..	281	..	281	0.192
1932....	..	233	..	233	0.157
1933....	..	208	..	208	0.139
1934....	..	259	..	259	0.171
1935....	..	156	..	156	0.101
1936....	..	295	..	295	0.189
1937....	..	313	..	313	0.199
1938....	..	280	..	280	0.175
1939....	..	487	..	487	0.301
1940....	..	242	..	242	0.148
1941....	..	195	..	195	0.118
1942....	..	123	..	123	0.073
1943....	..	136	..	136	0.080
1944....	..	128	..	128	0.074
1945....	..	346	..	346	0.199
1946....	..	132	..	132	0.075
1947....	..	601	..	601	0.337
1948....	..	914	..	914	0.506
1949....	..	601	..	601	0.328
1950 <sup>b</sup> ....	..	658	..	658	0.354

Sources: Same as for table 63.

<sup>a</sup> Includes bristleboards.

<sup>b</sup> Estimated.

TABLE 70

*Guatemala: Total apparent consumption of paper and paperboard*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	1,701	..	1,701	0.902
1926....	..	1,722	..	1,722	0.897
1927....	..	1,523	..	1,523	0.780
1928....	..	1,627	..	1,627	0.819
1929....	..	1,638	..	1,638	0.811
1930....	..	2,024	..	2,024	0.985
1931....	..	1,759	..	1,759	0.842
1932....	..	1,371	..	1,371	0.646
1933....	..	1,507	..	1,507	0.698
1934....	..	1,592	..	1,592	0.726
1935....	..	1,938	..	1,938	0.869
1936....	..	2,096	..	2,096	0.925
1937....	..	2,843	..	2,843	1.234
1938....	..	2,396	..	2,396	1.023
1939....	..	2,663	..	2,663	1.120
1940....	..	2,795	..	2,795	1.157
1941....	..	4,131	..	4,131	1.684
1942....	..	3,691	..	3,691	1.482
1943....	..	3,473	..	3,473	1.373
1944....	..	2,811	..	2,811	1.094
1945....	..	2,776	..	2,776	1.064
1946....	..	4,370	..	4,370	1.650
1947....	..	4,038	..	4,038	1.502
1948....	..	6,253	..	6,253	2.292
1949....	..	5,867	..	5,867	2.119
1950....	..	5,846	..	5,846	2.080

Sources: 1925-48, *Anuarios Estadísticos* and *Memorias de las Labores del Poder Ejecutivo en el Ramo de Hacienda y Crédito Público*; 1949, data supplied by the Dirección General de Estadística de Guatemala; 1950, *Boletín de la Dirección General de Estadística*, June 1951.

TABLE 71

*Guatemala: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925....	..	459	..	459	0.243
1926....	..	465	..	465	0.242
1927....	..	415	..	415	0.213
1928....	..	518	..	518	0.261
1929....	..	449	..	449	0.222
1930....	..	1,098	..	1,098	0.535
1931....	..	956	..	956	0.458
1932....	..	724	..	724	0.341
1933....	..	825	..	825	0.382
1934....	..	852	..	852	0.388
1935....	..	1,027	..	1,027	0.461
1936....	..	798	..	798	0.352
1937....	..	1,356	..	1,356	0.589
1938....	..	979	..	979	0.418
1939....	..	1,209	..	1,209	0.508
1940....	..	1,106	..	1,106	0.458
1941....	..	1,303	..	1,303	0.531
1942....	..	1,226	..	1,226	0.492
1943....	..	1,208	..	1,208	0.477
1944....	..	1,281	..	1,281	0.499
1945....	..	1,108	..	1,108	0.425
1946....	..	1,448	..	1,448	0.547
1947....	..	999	..	999	0.372
1948....	..	2,014	..	2,014	0.738
1949....	..	2,017	..	2,017	0.728
1950....	..	1,817	..	1,817	0.647

Sources: Same as for table 70.



TABLE 72

Guatemala: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,242	..	1,242	0.659
1926	..	1,257	..	1,257	0.655
1927	..	1,108	..	1,108	0.567
1928	..	1,109	..	1,109	0.558
1929	..	1,189	..	1,189	0.589
1930	..	926	..	926	0.450
1931	..	803	..	803	0.384
1932	..	647	..	647	0.305
1933	..	682	..	682	0.316
1934	..	740	..	740	0.338
1935	..	911	..	911	0.408
1936	..	1,298	..	1,298	0.573
1937	..	1,487	..	1,487	0.645
1938	..	1,417	..	1,417	0.605
1939	..	1,454	..	1,454	0.612
1940	..	1,689	..	1,689	0.699
1941	..	2,828	..	2,828	1.153
1942	..	2,465	..	2,465	0.990
1943	..	2,265	..	2,265	0.896
1944	..	1,530	..	1,530	0.595
1945	..	1,668	..	1,668	0.639
1946	..	2,922	..	2,922	1.103
1947	..	3,039	..	3,039	1.130
1948	..	4,239	..	4,239	1.554
1949	..	3,850	..	3,850	1.391
1950	..	4,029	..	4,029	1.433

Sources: Same as for table 70.

TABLE 73

Guatemala: Apparent consumption of writing and printing paper, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	472	..	472	0.250
1926	..	478	..	478	0.249
1927	..	418	..	418	0.214
1928	..	439	..	439	0.221
1929	..	444	..	444	0.220
1930	..	382	..	382	0.186
1931	..	300	..	300	0.144
1932	..	286	..	286	0.135
1933	..	261	..	261	0.121
1934	..	223	..	223	0.102
1935	..	269	..	269	0.121
1936	..	591	..	591	0.261
1937	..	627	..	627	0.272
1938	..	466	..	466	0.199
1939	..	561	..	561	0.236
1940	..	723	..	723	0.299
1941	..	453	..	453	0.185
1942	..	594	..	594	0.238
1943	..	684	..	684	0.270
1944	..	407	..	407	0.158
1945	..	482	..	482	0.185
1946	..	874	..	874	0.330
1947	..	873	..	873	0.325
1948	..	1,573	..	1,573	0.577
1949	..	936	..	936	0.338
1950	..	982	..	982	0.349

Sources: Same as for table 70.

TABLE 74

Guatemala: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	174	..	174	0.092
1926	..	176	..	176	0.092
1927	..	156	..	156	0.080
1928	..	218	..	218	0.110
1929	..	247	..	247	0.122
1930	..	82	..	82	0.040
1931	..	105	..	105	0.050
1932	..	83	..	83	0.039
1933	..	82	..	82	0.038
1934	..	137	..	137	0.062
1935	..	231	..	231	0.104
1936	..	228	..	228	0.101
1937	..	218	..	218	0.095
1938	..	186	..	186	0.079
1939	..	333	..	333	0.140
1940	..	372	..	372	0.154
1941	..	1,851	..	1,851	0.755
1942	..	1,340	..	1,340	0.538
1943	..	678	..	678	0.268
1944	..	363	..	363	0.141
1945	..	484	..	484	0.186
1946	..	822	..	822	0.310
1947	..	920	..	920	0.342
1948	..	1,225	..	1,225	0.449
1949	..	1,111	..	1,111	0.401
1950	..	1,564	..	1,564	0.557

Sources: Same as for table 70.

TABLE 75

Guatemala: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	87	..	87	0.046
1926	..	88	..	88	0.046
1927	..	79	..	79	0.040
1928	..	102	..	102	0.051
1929	..	130	..	130	0.064
1930	..	76	..	76	0.037
1931	..	109	..	109	0.052
1932	..	65	..	65	0.031
1933	..	106	..	106	0.049
1934	..	100	..	100	0.046
1935	..	154	..	154	0.069
1936	..	212	..	212	0.094
1937	..	219	..	219	0.095
1938	..	258	..	258	0.110
1939	..	264	..	264	0.111
1940	..	245	..	245	0.101
1941	..	240	..	240	0.098
1942	..	303	..	303	0.122
1943	..	444	..	444	0.175
1944	..	419	..	419	0.163
1945	..	346	..	346	0.133
1946	..	880	..	880	0.332
1947	..	754	..	754	0.281
1948	..	889	..	889	0.326
1949	..	914	..	914	0.330
1950	..	668	..	668	0.238

Sources: Same as for table 70.

TABLE 76

Guatemala: Apparent consumption of sundry papers,  
not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	509	..	509	0.270
1926	..	515	..	515	0.268
1927	..	455	..	455	0.233
1928	..	350	..	350	0.176
1929	..	368	..	368	0.182
1930	..	386	..	386	0.188
1931	..	289	..	289	0.138
1932	..	213	..	213	0.100
1933	..	233	..	233	0.108
1934	..	280	..	280	0.128
1935	..	257	..	257	0.115
1936	..	267	..	267	0.118
1937	..	423	..	423	0.184
1938	..	507	..	507	0.217
1939	..	296	..	296	0.124
1940	..	349	..	349	0.145
1941	..	284	..	284	0.116
1942	..	228	..	228	0.092
1943	..	459	..	459	0.181
1944	..	341	..	341	0.133
1945	..	356	..	356	0.136
1946	..	346	..	346	0.131
1947	..	492	..	492	0.183
1948	..	552	..	552	0.202
1949	..	889	..	889	0.321
1950	..	815	..	815	0.290

Sources: Same as for table 70.

<sup>a</sup> Includes bristleboards.

TABLE 77

Haiti: Apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	1,152	..	1,152	0.384
1945	..	1,192	..	1,192	0.388
1946	..	1,883	..	1,883	0.598
1947	..	1,339	..	1,339	0.416
1948	..	1,802	..	1,802	0.546
1949	..	1,836	..	1,836	0.544
1950	..	2,144	..	2,144	0.620

Sources: Data supplied by the Institut Haïtien de Statistique.

TABLE 78

Haiti: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	183	..	183	0.064
1943	..	225	..	225	0.077
1944	..	176	..	176	0.059
1945	..	230	..	230	0.075
1946	..	307	..	307	0.098
1947	..	189	..	189	0.059
1948	..	296	..	296	0.090
1949	..	210	..	210	0.062
1950	..	302	..	302	0.087

Sources: Same as for table 77.

TABLE 79

Haiti: Apparent consumption of all paper and  
paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	976	..	976	0.325
1945	..	962	..	962	0.313
1946	..	1,576	..	1,576	0.500
1947	..	1,150	..	1,150	0.357
1948	..	1,506	..	1,506	0.456
1949	..	1,626	..	1,626	0.482
1950	..	1,842	..	1,842	0.533

Sources: Same as for table 77.

TABLE 80

*Haiti: Apparent consumption of writing and printing paper, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	50	..	50	0.017
1945	..	92	..	92	0.030
1946	..	70	..	70	0.022
1947	..	76	..	76	0.024
1948	..	177	..	177	0.054
1949	..	41	..	41	0.012
1950	..	112	..	112	0.032

Sources: Same as for table 77.

TABLE 81

*Haiti: Apparent consumption of wrapping and packing paper*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	64	..	64	0.021
1945	..	94	..	94	0.031
1946	..	451	..	451	0.143
1947	..	100	..	100	0.031
1948	..	90	..	90	0.027
1949	..	269	..	269	0.080
1950	..	199	..	199	0.058

Sources: Same as for table 77.

TABLE 82

*Haiti: Apparent consumption of paperboard*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	212	..	212	0.071
1945	..	156	..	156	0.051
1946	..	173	..	173	0.055
1947	..	154	..	154	0.048
1948	..	301	..	301	0.091
1949	..	270	..	270	0.080
1950	..	160	..	160	0.046

Sources: Same as for table 77.

TABLE 83

*Haiti: Apparent consumption of sundry papers, not classified<sup>a</sup>*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	..	..	..	..
1935	..	..	..	..	..
1936	..	..	..	..	..
1937	..	..	..	..	..
1938	..	..	..	..	..
1939	..	..	..	..	..
1940	..	..	..	..	..
1941	..	..	..	..	..
1942	..	..	..	..	..
1943	..	..	..	..	..
1944	..	650	..	650	0.217
1945	..	620	..	620	0.202
1946	..	882	..	882	0.280
1947	..	820	..	820	0.255
1948	..	938	..	938	0.284
1949	..	1,046	..	1,046	0.310
1950	..	1,371	..	1,371	0.397

Sources: Same as for table 77.

<sup>a</sup> Includes bristleboards.

TABLE 84

Honduras: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	458	..	458	0.660
1926	..	502	..	502	0.716
1927	..	554	..	554	0.755
1928	..	626	..	626	0.814
1929	..	808	..	808	1.002
1930	..	688	..	688	0.806
1931	..	856	..	856	0.979
1932	..	658	..	658	0.735
1933	..	799	..	799	0.872
1934	..	866	..	866	0.924
1935	..	783	..	783	0.814
1936	..	914	..	914	0.924
1937	..	834	..	834	0.818
1938	..	1,005	..	1,005	0.957
1939	..	1,056	..	1,056	0.979
1940	..	1,251	..	1,251	1.129
1941	..	1,879	..	1,879	1.660
1942	..	944	..	944	0.818
1943	..	703	..	703	0.599
1944	..	765	..	765	0.640
1945	..	960	..	960	0.800
1946	..	1,217	..	1,217	0.998
1947	..	1,562	..	1,562	1.260
1948	..	1,293	..	1,293	1.026
1949	..	1,120	..	1,120	0.875
1950	..	1,766	..	1,766	1.151

Sources: Data supplied by the Dirección de Estadística de Honduras.

TABLE 85

Honduras: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	216	..	216	0.311
1926	..	220	..	220	0.314
1927	..	295	..	295	0.402
1928	..	260	..	260	0.338
1929	..	249	..	249	0.309
1930	..	283	..	283	0.331
1931	..	432	..	432	0.494
1932	..	412	..	412	0.460
1933	..	494	..	494	0.539
1934	..	444	..	444	0.474
1935	..	399	..	399	0.415
1936	..	418	..	418	0.423
1937	..	390	..	390	0.382
1938	..	399	..	399	0.380
1939	..	345	..	345	0.320
1940	..	422	..	422	0.381
1941	..	512	..	512	0.452
1942	..	254	..	254	0.220
1943	..	250	..	250	0.213
1944	..	243	..	243	0.203
1945	..	228	..	228	0.190
1946	..	429	..	429	0.352
1947	..	503	..	503	0.406
1948	..	382	..	382	0.303
1949	..	300	..	300	0.234
1950	..	545	..	545	0.355

Sources: Same as for table 84.

TABLE 86

Honduras: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	242	..	242	0.349
1926	..	282	..	282	0.402
1927	..	259	..	259	0.353
1928	..	366	..	366	0.476
1929	..	559	..	559	0.693
1930	..	405	..	405	0.475
1931	..	424	..	424	0.485
1932	..	246	..	246	0.275
1933	..	305	..	305	0.333
1934	..	422	..	422	0.450
1935	..	384	..	384	0.399
1936	..	496	..	496	0.501
1937	..	444	..	444	0.436
1938	..	606	..	606	0.577
1939	..	711	..	711	0.659
1940	..	829	..	829	0.748
1941	..	1,367	..	1,367	1.208
1942	..	690	..	690	0.598
1943	..	453	..	453	0.386
1944	..	522	..	522	0.437
1945	..	732	..	732	0.610
1946	..	788	..	788	0.646
1947	..	1,059	..	1,059	0.854
1948	..	911	..	911	0.723
1949	..	820	..	820	0.641
1950	..	1,221	..	1,221	0.796

Sources: Same as for table 84.

TABLE 87

Mexico: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	54,017	9,190	61	63,146	3.552
1935	56,969	14,174	68	71,075	3.929
1936	43,253	41,332	53	84,532	4.592
1937	55,045	55,233	113	110,165	5.880
1938	55,516	36,810	134	92,192	4.834
1939	59,015	46,578	76	105,517	5.435
1940	66,630	46,261	357	112,534	5.694
1941	74,701	48,077	393	122,385	6.056
1942	73,484	77,821	970	150,335	7.278
1943	86,196	51,011	1,472	135,735	6.413
1944	92,388	68,728	970	160,146	7.389
1945	96,637	84,431	853	180,215	8.106
1946	97,200	89,630	1,116	185,714	8.153
1947	103,999	88,471	2,886	189,584	8.090
1948	113,917	79,872	442	193,347	8.098
1949	117,049	75,317	374	191,992	7.853
1950	131,464	44,490	397	175,557	6.920

Sources: Production: 1934-45, *Anuarios Estadísticos*; 1946-49, ECLA, *Economic Survey of Latin America*, 1949, annex K, and thesis by María del Carmen Espinosa de los Monteros Aguilar, Universidad Nacional Autónoma de México; 1950, *Revista de Estadística*. Imports: 1925-48, *Anuarios Estadísticos del Comercio Exterior*; 1948-50, data supplied by the Dirección General de Estadística de México and *Revista de Estadística*, February 1951.

TABLE 88

*Mexico: Apparent consumption of newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	..	191	..	191	0.011
1935	..	3,044	..	3,044	0.168
1936	..	16,304	..	16,304	0.886
1937	..	30,165	..	30,165	1.610
1938	..	21,029	..	21,029	1.103
1939	..	28,122	..	28,122	1.449
1940	..	27,754	..	27,754	1.404
1941	..	24,707	..	24,707	1.223
1942	..	53,239	..	53,239	2.577
1943	..	28,308	..	28,308	1.337
1944	..	46,804	..	46,804	2.159
1945	..	58,570	..	58,570	2.634
1946	..	53,878	..	53,878	2.365
1947	491	52,803	..	53,294	2.274
1948	..	58,040	..	58,040	2.431
1949	..	58,317	..	58,317	2.385
1950	3,723	36,171	..	39,894	1.573

Sources: Same as for table 87.

TABLE 89

*Mexico: Apparent consumption of all paper and paperboard, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	54,017	8,999	61	62,955	3.541
1935	56,969	11,130	68	68,031	3.761
1936	43,253	25,028	53	68,228	3.706
1937	55,045	25,068	113	80,000	4.270
1938	55,516	15,781	134	71,163	3.731
1939	59,015	18,456	76	77,395	3.986
1940	66,630	18,507	357	84,780	4.290
1941	74,701	23,370	393	97,678	4.833
1942	73,484	24,582	970	97,096	4.701
1943	86,196	22,703	1,472	107,427	5.076
1944	92,388	21,924	970	113,342	5.230
1945	96,637	25,861	853	121,645	5.472
1946	97,200	35,752	1,116	131,836	5.788
1947	102,508	35,668	2,886	136,290	5.816
1948	113,917	21,832	442	135,307	5.667
1949	117,049	17,000	374	133,675	5.468
1950	127,741	8,319	397	135,663	5.347

Sources: Same as for table 87.

TABLE 90

*Mexico: Apparent consumption of writing and printing paper, other than newsprint*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	29,226	..	..	29,226	1.644
1935	39,441	..	..	39,441	2.180
1936	16,994	..	..	16,994	0.923
1937	22,388	..	..	22,388	1.195
1938	21,340	..	..	21,340	1.119
1939	23,104	1,978	..	25,082	1.292
1940	22,719	1,947	..	24,666	1.248
1941	26,174	1,214	..	27,388	1.355
1942	22,573	1,992	..	24,565	1.189
1943	28,343	821	..	29,164	1.378
1944	27,331	2,807	..	30,138	1.391
1945	27,936	1,310	..	29,246	1.315
1946	27,032	2,046	..	29,078	1.277
1947	28,591	2,786	..	31,377	1.339
1948	26,478	4,021	..	30,499	1.277
1949	27,831	2,871	..	30,702	1.256
1950	33,829	1,250	..	35,079	1.383

Sources: Same as for table 87.

TABLE 91

*Mexico: Apparent consumption of wrapping and packing paper*  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	16,791	3,557	..	20,348	1.145
1935	8,428	4,279	..	12,707	0.702
1936	16,059	7,082	..	23,141	1.257
1937	20,813	8,591	..	29,404	1.569
1938	21,676	5,450	..	27,126	1.422
1939	22,311	10,150	..	32,461	1.672
1940	29,211	9,789	..	39,000	1.973
1941	32,727	11,421	..	44,148	2.185
1942	33,984	4,890	..	38,874	1.882
1943	37,592	8,654	..	46,246	2.185
1944	42,243	7,034	..	49,277	2.274
1945	42,637	10,119	..	52,756	2.373
1946	40,207	15,307	..	55,514	2.437
1947	37,805	10,539	..	48,344	2.063
1948	44,127	1,438	..	45,565	1.908
1949	43,789	1,902	..	45,691	1.869
1950	47,148	6,509	..	53,657	2.115

Sources: Same as for table 87.

TABLE 92

Mexico: Apparent consumption of paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	7,000	808	..	7,808	0.439
1935	8,000	588	..	8,588	0.475
1936	9,000	478	..	9,478	0.515
1937	10,461	562	..	11,023	0.588
1938	11,000	297	..	11,297	0.592
1939	12,000	339	..	12,339	0.636
1940	13,000	323	..	13,323	0.674
1941	14,000	477	..	14,477	0.716
1942	15,027	496	..	15,523	0.751
1943	18,000	1,101	..	19,101	0.902
1944	21,000	1,444	..	22,444	1.036
1945	24,000	1,662	..	25,662	1.154
1946	27,704	1,277	..	28,981	1.272
1947	35,026	2,172	..	37,198	1.587
1948	40,626	62	..	40,688	1.704
1949	42,300	82	..	42,382	1.734
1950	44,000	..	..	44,000	1.734

Sources: Same as for table 87.

TABLE 93

Mexico: Apparent consumption of sundry papers,  
not classified<sup>a</sup>  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	..	..	..	..
1932	..	..	..	..	..
1933	..	..	..	..	..
1934	1,000	4,634	61	5,573	0.314
1935	1,100	6,263	68	7,295	0.403
1936	1,200	17,468	53	18,615	1.011
1937	1,383	15,915	113	17,185	0.917
1938	1,500	10,034	134	11,400	0.598
1939	1,600	5,989	76	7,513	0.387
1940	1,700	6,448	357	7,791	0.394
1941	1,800	10,258	393	11,665	0.577
1942	1,900	17,204	970	18,134	0.878
1943	2,261	12,127	1,472	12,916	0.610
1944	1,814	10,639	970	11,483	0.530
1945	2,064	12,770	853	13,981	0.629
1946	2,257	17,122	1,116	18,263	0.802
1947	2,086	20,171	2,886	19,371	0.827
1948	2,686	16,311	442	18,555	0.777
1949	3,129	11,198	374	13,953	0.571
1950	2,764	560	397	2,927	0.115

Sources: Same as for table 87.

<sup>a</sup> Includes bristleboards.

TABLE 94

Nicaragua: Apparent consumption of paper  
and paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	881	..	881	1.060
1932	..	777	..	777	0.923
1933	..	896	..	896	1.050
1934	..	851	..	851	0.979
1935	..	1,158	..	1,158	1.306
1936	..	1,147	..	1,147	1.266
1937	..	807	..	807	0.871
1938	..	850	..	850	0.897
1939	..	797	..	797	0.824
1940	..	870	..	870	0.883
1941	..	1,174	..	1,174	1.183
1942	..	709	..	709	0.710
1943	..	2,278	..	2,278	2.264
1944	..	1,474	..	1,474	1.471
1945	..	582	..	582	0.571
1946	..	793	..	793	0.773
1947	..	1,389	..	1,389	1.345
1948	..	1,731	..	1,731	1.663
1949	..	1,536	..	1,536	1.466
1950	..	1,894	..	1,894	1.795

Sources: Data supplied by the Departamento de Investigaciones Económicas de Nicaragua.

TABLE 95

Nicaragua: Apparent consumption of newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	227	..	227	0.273
1932	..	249	..	249	0.296
1933	..	452	..	452	0.530
1934	..	502	..	502	0.578
1935	..	760	..	760	0.857
1936	..	764	..	764	0.843
1937	..	421	..	421	0.455
1938	..	453	..	453	0.478
1939	..	336	..	336	0.347
1940	..	562	..	562	0.571
1941	..	570	..	570	0.575
1942	..	302	..	302	0.302
1943	..	893	..	893	0.888
1944	..	734	..	734	0.733
1945	..	52	..	52	0.051
1946	..	364	..	364	0.355
1947	..	575	..	575	0.557
1948	..	663	..	663	0.637
1949	..	582	..	582	0.555
1950	..	839	..	839	0.795

Sources: Same as for table 94.

TABLE 96

Nicaragua: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	..	..	..	..
1926	..	..	..	..	..
1927	..	..	..	..	..
1928	..	..	..	..	..
1929	..	..	..	..	..
1930	..	..	..	..	..
1931	..	654	..	654	0.787
1932	..	528	..	528	0.627
1933	..	444	..	444	0.521
1934	..	349	..	349	0.402
1935	..	398	..	398	0.449
1936	..	383	..	383	0.423
1937	..	386	..	386	0.417
1938	..	397	..	397	0.419
1939	..	461	..	461	0.477
1940	..	308	..	308	0.313
1941	..	604	..	604	0.609
1942	..	407	..	407	0.407
1943	..	1,385	..	1,385	1.377
1944	..	740	..	740	0.739
1945	..	530	..	530	0.520
1946	..	429	..	429	0.418
1947	..	814	..	814	0.788
1948	..	1,068	..	1,068	1.026
1949	..	954	..	954	0.910
1950	..	1,055	..	1,055	1.000

Sources: Same as for table 94.

TABLE 97

Panama: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,461	..	1,461	3.204
1926	..	1,756	..	1,756	3.834
1927	..	1,489	..	1,489	3.237
1928	..	1,750	..	1,750	3.788
1929	..	2,664	..	2,664	5.741
1930	..	2,131	..	2,131	4.563
1931	..	2,307	..	2,307	4.796
1932	..	2,012	..	2,012	4.065
1933	..	2,166	..	2,166	4.247
1934	..	2,431	..	2,431	4.630
1935	..	2,597	..	2,597	4.809
1936	..	2,764	..	2,764	4.971
1937	..	3,075	..	3,075	5.348
1938	..	3,125	..	3,125	5.297
1939	..	3,104	..	3,104	5.131
1940	..	4,071	..	4,071	6.566
1941	..	5,038	..	5,038	7.959
1942	..	5,969	..	5,969	9.240
1943	..	6,225	..	6,225	9.418
1944	..	5,881	..	5,881	8.687
1945	..	5,561	..	5,561	8.013
1946	..	6,713	..	6,713	9.442
1947	..	7,851	..	7,851	10.770
1948	..	7,054	..	7,054	9.456
1949	..	6,771	..	6,771	8.863
1950	..	6,463	..	6,463	8.069

Sources: Data supplied by the Dirección de Estadística y Censos de Panamá.

TABLE 98

Panama: Apparent consumption of newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	328	..	328	0.719
1926	..	483	..	483	1.055
1927	..	516	..	516	1.122
1928	..	600	..	600	1.299
1929	..	1,089	..	1,089	2.347
1930	..	827	..	827	1.771
1931	..	716	..	716	1.489
1932	..	379	..	379	0.766
1933	..	850	..	850	1.667
1934	..	773	..	773	1.472
1935	..	1,014	..	1,014	1.878
1936	..	890	..	890	1.601
1937	..	901	..	901	1.567
1938	..	958	..	958	1.624
1939	..	1,018	..	1,018	1.683
1940	..	1,585	..	1,585	2.556
1941	..	2,204	..	2,204	3.482
1942	..	2,320	..	2,320	3.591
1943	..	2,220	..	2,220	3.359
1944	..	3,163	..	3,163	4.672
1945	..	2,993	..	2,993	4.313
1946	..	2,914	..	2,914	4.098
1947	..	3,248	..	3,248	4.455
1948	..	2,919	..	2,919	3.913
1949	..	2,448	..	2,448	3.204
1950	..	2,357	..	2,357	2.943

Sources: Same as for table 97.

TABLE 99

Panama: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,133	..	1,133	2.485
1926	..	1,273	..	1,273	2.779
1927	..	973	..	973	2.115
1928	..	1,150	..	1,150	2.489
1929	..	1,575	..	1,575	3.394
1930	..	1,304	..	1,304	2.792
1931	..	1,591	..	1,591	3.307
1932	..	1,633	..	1,633	3.299
1933	..	1,316	..	1,316	2.580
1934	..	1,658	..	1,658	3.158
1935	..	1,583	..	1,583	2.931
1936	..	1,874	..	1,874	3.370
1937	..	2,174	..	2,174	3.781
1938	..	2,167	..	2,167	3.673
1939	..	2,086	..	2,086	3.448
1940	..	2,486	..	2,486	4.010
1941	..	2,834	..	2,834	4.477
1942	..	3,649	..	3,649	5.649
1943	..	4,005	..	4,005	6.059
1944	..	2,718	..	2,718	4.015
1945	..	2,568	..	2,568	3.700
1946	..	3,799	..	3,799	5.344
1947	..	4,603	..	4,603	6.315
1948	..	4,135	..	4,135	5.543
1949	..	4,323	..	4,323	5.659
1950	..	4,106	..	4,106	5.126

Sources: Same as for table 97.

TABLE 100

*Panama: Apparent consumption of writing and printing paper, other than newsprint*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	56	..	56	0.123
1926	..	83	..	83	0.181
1927	..	88	..	88	0.191
1928	..	103	..	103	0.223
1929	..	186	..	186	0.401
1930	..	141	..	141	0.302
1931	..	122	..	122	0.254
1932	..	65	..	65	0.131
1933	..	145	..	145	0.284
1934	..	113	..	113	0.215
1935	..	164	..	164	0.304
1936	..	214	..	214	0.385
1937	..	275	..	275	0.478
1938	..	243	..	243	0.412
1939	..	258	..	258	0.426
1940	..	271	..	271	0.437
1941	..	387	..	387	0.611
1942	..	531	..	531	0.822
1943	..	532	..	532	0.805
1944	..	334	..	334	0.493
1945	..	285	..	285	0.411
1946	..	266	..	266	0.374
1947	..	755	..	755	1.036
1948	..	323	..	323	0.433
1949	..	444	..	444	0.581
1950	..	421	..	421	0.526

Sources: Same as for table 97.

TABLE 101

*Panama: Apparent consumption of wrapping and packing paper*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	648	..	648	1.421
1926	..	777	..	777	1.697
1927	..	422	..	422	0.917
1928	..	591	..	591	1.279
1929	..	710	..	710	1.530
1930	..	442	..	442	0.946
1931	..	713	..	713	1.482
1932	..	708	..	708	1.430
1933	..	569	..	569	1.116
1934	..	538	..	538	1.025
1935	..	693	..	693	1.283
1936	..	699	..	699	1.257
1937	..	817	..	817	1.421
1938	..	982	..	982	1.664
1939	..	870	..	870	1.438
1940	..	817	..	817	1.318
1941	..	680	..	680	1.074
1942	..	1,483	..	1,483	2.296
1943	..	585	..	585	0.885
1944	..	595	..	595	0.879
1945	..	605	..	605	0.872
1946	..	1,199	..	1,199	1.686
1947	..	1,021	..	1,021	1.401
1948	..	1,053	..	1,053	1.412
1949	..	1,039	..	1,039	1.360
1950	..	1,186	..	1,186	1.481

Sources: Same as for table 97.

TABLE 102

*Panama: Apparent consumption of paperboard*

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	22	..	22	0.048
1926	..	14	..	14	0.031
1927	..	26	..	26	0.057
1928	..	52	..	52	0.113
1929	..	60	..	60	0.129
1930	..	71	..	71	0.152
1931	..	63	..	63	0.131
1932	..	96	..	96	0.194
1933	..	107	..	107	0.210
1934	..	27	..	27	0.051
1935	..	29	..	29	0.054
1936	..	78	..	78	0.140
1937	..	86	..	86	0.150
1938	..	81	..	81	0.137
1939	..	103	..	103	0.170
1940	..	129	..	129	0.208
1941	..	151	..	151	0.239
1942	..	148	..	148	0.229
1943	..	215	..	215	0.325
1944	..	313	..	313	0.462
1945	..	232	..	232	0.334
1946	..	366	..	366	0.515
1947	..	239	..	239	0.328
1948	..	213	..	213	0.286
1949	..	128	..	128	0.168
1950	..	121	..	121	0.151

Sources: Same as for table 97.

TABLE 103

*Panama: Apparent consumption of sundry papers, not classified\**

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	407	..	407	0.893
1926	..	399	..	399	0.871
1927	..	437	..	437	0.950
1928	..	404	..	404	0.874
1929	..	619	..	619	1.334
1930	..	650	..	650	1.392
1931	..	693	..	693	1.441
1932	..	764	..	764	1.543
1933	..	495	..	495	0.971
1934	..	980	..	980	1.867
1935	..	697	..	697	1.291
1936	..	883	..	883	1.588
1937	..	996	..	996	1.732
1938	..	861	..	861	1.459
1939	..	855	..	855	1.413
1940	..	1,269	..	1,269	2.047
1941	..	1,616	..	1,616	2.553
1942	..	1,487	..	1,487	2.302
1943	..	2,673	..	2,673	4.044
1944	..	1,476	..	1,476	2.180
1945	..	1,446	..	1,446	2.084
1946	..	1,968	..	1,968	2.768
1947	..	2,588	..	2,588	3.550
1948	..	2,546	..	2,546	3.413
1949	..	2,712	..	2,712	3.550
1950	..	2,378	..	2,378	2.969

Sources: Same as for table 97.

\*Includes bristleboards.



TABLE 104

Paraguay: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	600	..	600	0.716
1926	..	794	..	794	0.939
1927	..	1,083	..	1,083	1.268
1928	..	1,224	..	1,224	1.420
1929	..	1,216	..	1,216	1.398
1930	..	1,209	..	1,209	1.406
1931	..	983	..	983	1.147
1932	..	991	..	991	1.147
1933	..	735	..	735	0.844
1934	..	1,281	..	1,281	1.444
1935	..	1,335	..	1,335	1.461
1936	..	1,129	..	1,129	1.215
1937	..	1,398	..	1,398	1.497
1938	..	1,476	..	1,476	1.562
1939	..	1,263	..	1,263	1.301
1940	..	1,234	..	1,234	1.233
1941	..	1,371	..	1,371	1.334
1942	..	1,545	..	1,545	1.463
1943	..	1,487	..	1,487	1.364
1944	..	1,841	..	1,841	1.635
1945	..	1,457	..	1,457	1.252
1946	..	1,439	..	1,439	1.195
1947	..	3,027	..	3,027	2.443
1948	..	1,826	..	1,826	1.438
1949	..	1,868	..	1,868	1.433
1950	..	1,766	..	1,766	1.256

Sources: Data supplied by the Dirección de Estadística del Paraguay.

TABLE 105

Paraguay: Apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	135	..	135	0.161
1926	..	288	..	288	0.340
1927	..	366	..	366	0.429
1928	..	366	..	366	0.425
1929	..	273	..	273	0.314
1930	..	460	..	460	0.535
1931	..	335	..	335	0.391
1932	..	333	..	333	0.385
1933	..	264	..	264	0.303
1934	..	377	..	377	0.425
1935	..	485	..	485	0.531
1936	..	277	..	277	0.298
1937	..	473	..	473	0.506
1938	..	254	..	254	0.269
1939	..	271	..	271	0.279
1940	..	359	..	359	0.359
1941	..	327	..	327	0.318
1942	..	185	..	185	0.175
1943	..	183	..	183	0.168
1944	..	221	..	221	0.196
1945	..	162	..	162	0.139
1946	..	264	..	264	0.219
1947	..	416	..	416	0.336
1948	..	257	..	257	0.202
1949	..	267	..	267	0.205
1950	..	438	..	438	0.312

Sources: Same as for table 104.

TABLE 106

Paraguay: Apparent consumption of all paper and paperboard, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	465	..	465	0.555
1926	..	506	..	506	0.599
1927	..	717	..	717	0.839
1928	..	858	..	858	0.995
1929	..	943	..	943	1.084
1930	..	749	..	749	0.871
1931	..	648	..	648	0.756
1932	..	658	..	658	0.762
1933	..	471	..	471	0.541
1934	..	904	..	904	1.019
1935	..	850	..	850	0.930
1936	..	852	..	852	0.917
1937	..	925	..	925	0.991
1938	..	1,222	..	1,222	1.293
1939	..	992	..	992	1.022
1940	..	875	..	875	0.874
1941	..	1,044	..	1,044	1.016
1942	..	1,360	..	1,360	1.288
1943	..	1,304	..	1,304	1.196
1944	..	1,620	..	1,620	1.439
1945	..	1,295	..	1,295	1.113
1946	..	1,175	..	1,175	0.976
1947	..	2,611	..	2,611	2.107
1948	..	1,569	..	1,569	1.236
1949	..	1,601	..	1,601	1.228
1950	..	1,328	..	1,328	0.944

Sources: Same as for table 104.

TABLE 107

Paraguay: Apparent consumption of writing and printing paper, other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	130	..	130	0.155
1926	..	89	..	89	0.105
1927	..	236	..	236	0.276
1928	..	290	..	290	0.336
1929	..	263	..	263	0.302
1930	..	200	..	200	0.233
1931	..	195	..	195	0.228
1932	..	158	..	158	0.183
1933	..	121	..	121	0.139
1934	..	195	..	195	0.220
1935	..	262	..	262	0.287
1936	..	268	..	268	0.288
1937	..	325	..	325	0.348
1938	..	391	..	391	0.414
1939	..	241	..	241	0.248
1940	..	243	..	243	0.243
1941	..	270	..	270	0.263
1942	..	180	..	180	0.170
1943	..	376	..	376	0.345
1944	..	389	..	389	0.345
1945	..	466	..	466	0.400
1946	..	274	..	274	0.228
1947	..	1,024	..	1,024	0.826
1948	..	391	..	391	0.308
1949	..	348	..	348	0.267
1950	..	465	..	465	0.331

Sources: Same as for table 104.

TABLE 108

## Paraguay: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	208	..	208	0.248
1926	..	197	..	197	0.233
1927	..	265	..	265	0.310
1928	..	286	..	286	0.332
1929	..	421	..	421	0.484
1930	..	230	..	230	0.267
1931	..	282	..	282	0.329
1932	..	309	..	309	0.358
1933	..	196	..	196	0.225
1934	..	496	..	496	0.559
1935	..	391	..	391	0.428
1936	..	354	..	354	0.381
1937	..	283	..	283	0.303
1938	..	566	..	566	0.599
1939	..	451	..	451	0.464
1940	..	283	..	283	0.283
1941	..	428	..	428	0.416
1942	..	747	..	747	0.707
1943	..	589	..	589	0.540
1944	..	901	..	901	0.800
1945	..	496	..	496	0.426
1946	..	412	..	412	0.342
1947	..	1,201	..	1,201	0.969
1948	..	798	..	798	0.628
1949	..	907	..	907	0.696
1950	..	490	..	490	0.349

Sources: Same as for table 104.

TABLE 109

## Paraguay: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	49	..	49	0.058
1926	..	87	..	87	0.103
1927	..	80	..	80	0.094
1928	..	117	..	117	0.136
1929	..	100	..	100	0.115
1930	..	125	..	125	0.145
1931	..	31	..	31	0.036
1932	..	94	..	94	0.109
1933	..	90	..	90	0.103
1934	..	115	..	115	0.130
1935	..	95	..	95	0.104
1936	..	131	..	131	0.141
1937	..	154	..	154	0.165
1938	..	99	..	99	0.105
1939	..	158	..	158	0.163
1940	..	158	..	158	0.158
1941	..	165	..	165	0.161
1942	..	152	..	152	0.144
1943	..	111	..	111	0.102
1944	..	78	..	78	0.069
1945	..	105	..	105	0.090
1946	..	176	..	176	0.146
1947	..	133	..	133	0.107
1948	..	81	..	81	0.064
1949	..	91	..	91	0.070
1950	..	73	..	73	0.052

Sources: Same as for table 104.

TABLE 110

Paraguay: Apparent consumption of sundry papers, not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	78	..	78	0.093
1926	..	133	..	133	0.157
1927	..	136	..	136	0.159
1928	..	165	..	165	0.191
1929	..	159	..	159	0.183
1930	..	194	..	194	0.226
1931	..	140	..	140	0.163
1932	..	97	..	97	0.112
1933	..	64	..	64	0.073
1934	..	98	..	98	0.110
1935	..	102	..	102	0.112
1936	..	99	..	99	0.107
1937	..	163	..	163	0.175
1938	..	166	..	166	0.176
1939	..	142	..	142	0.146
1940	..	191	..	191	0.191
1941	..	181	..	181	0.176
1942	..	281	..	281	0.266
1943	..	228	..	228	0.209
1944	..	252	..	252	0.224
1945	..	228	..	228	0.196
1946	..	313	..	313	0.260
1947	..	253	..	253	0.204
1948	..	299	..	299	0.235
1949	..	255	..	255	0.196
1950	..	300	..	300	0.213

Sources: Same as for table 104.

<sup>a</sup> Includes bristleboards.

TABLE 111

## Peru: Total apparent consumption of paper and paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	8,510	..	8,510	1.428
1926	..	9,167	..	9,167	1.516
1927	..	10,002	..	10,002	1.631
1928	..	10,907	..	10,907	1.753
1929	..	12,504	..	12,504	1.981
1930	..	10,750	..	10,750	1.679
1931	..	8,497	1	8,496	1.309
1932	..	8,979	3	8,976	1.364
1933	..	10,404	6	10,398	1.558
1934	..	15,571	21	15,550	2.298
1935	..	14,402	46	14,356	2.094
1936	..	17,687	29	17,658	2.541
1937	4,342	15,694	36	20,000	2.840
1938	2,830	11,729	23	14,536	2.037
1939	5,478	14,168	3	19,643	2.716
1940	10,382	14,288	86	24,584	3.356
1941	15,192	15,135	417	29,910	4.030
1942	13,413	7,904	1,080	20,237	2.691
1943	10,293	7,045	1,440	15,898	2.087
1944	11,828	11,340	1,190	21,978	2.848
1945	13,428	12,384	2,034	23,778	3.042
1946	14,930	15,754	829	29,855	3.771
1947	16,615	14,100	305	30,410	3.792
1948	17,851	8,737	156	26,432	3.254
1949	19,679	13,953	68	33,564	4.080
1950	16,546	13,129	656	29,019	3.483

Sources: Production: 1934-50, *Anuarios Estadísticos*, and data supplied by the Dirección de Estadística and by the Dirección de Industrias y Electricidad. Imports: 1925-48, *Anuarios del Comercio Exterior*; 1949-50, data supplied by the Dirección de Industrias y Electricidad. Exports: 1925-48, *Anuarios del Comercio Exterior*; 1949, report by Tulio de Andrea and *Boletín de Aduanas*, No. 318/320; 1950, *Boletín de Aduanas*, No. 333/335.

TABLE 112

Peru: Apparent consumption of paper and paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	3,546	..	3,546	0.595
1926	..	4,055	..	4,055	0.671
1927	..	4,228	..	4,228	0.689
1928	..	5,084	..	5,084	0.817
1929	..	6,085	..	6,085	0.964
1930	..	5,492	..	5,492	0.858
1931	..	4,391	..	4,391	0.676
1932	..	4,651	..	4,651	0.707
1933	..	5,618	..	5,618	0.842
1934	..	9,050	..	9,050	1.338
1935	..	7,740	..	7,740	1.129
1936	..	9,847	..	9,847	1.417
1937	..	6,553	..	6,553	0.930
1938	..	5,402	..	5,402	0.757
1939	..	7,885	..	7,885	1.090
1940	..	9,676	..	9,676	1.321
1941	..	10,878	..	10,878	1.466
1942	..	3,896	..	3,896	0.518
1943	..	4,466	..	4,466	0.586
1944	..	7,486	..	7,486	0.970
1945	..	8,024	..	8,024	1.027
1946	..	11,008	..	11,008	1.390
1947	..	9,800	..	9,800	1.222
1948	..	5,786	..	5,786	0.712
1949	..	9,933	..	9,933	1.208
1950	..	8,256	..	8,256	0.991

Sources: Production and imports: same as for table 111. Exports: 1925-48, *Anuarios del Comercio Exterior*; 1949-50, data supplied by the Dirección de Industrias y Electricidad; 1950, *Boletín de Aduanas*, No. 333/335.

TABLE 113

Peru: Apparent consumption of all paper and paperboard, other than newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	4,964	..	4,964	0.833
1926	..	5,112	..	5,112	0.841
1927	..	5,774	..	5,774	0.933
1928	..	5,823	..	5,823	0.936
1929	..	6,419	..	6,419	1.017
1930	..	5,258	..	5,258	0.821
1931	..	4,106	1	4,105	0.633
1932	..	4,328	3	4,325	0.657
1933	..	4,786	6	4,780	0.716
1934	..	6,521	21	6,500	0.960
1935	..	6,662	46	6,616	0.965
1936	..	7,840	29	7,811	1.124
1937	4,342	9,141	36	13,447	1.910
1938	2,830	6,327	23	9,134	1.280
1939	5,478	6,283	3	11,758	1.626
1940	10,382	4,612	86	14,908	2.035
1941	15,192	4,257	417	19,032	2.564
1942	13,413	4,008	1,080	16,341	2.173
1943	10,293	2,579	1,440	11,432	1.501
1944	11,828	3,854	1,190	14,492	1.878
1945	13,428	4,360	2,034	15,754	2.015
1946	14,930	4,746	829	18,847	2.381
1947	16,615	4,300	305	20,610	2.570
1948	17,851	2,951	156	20,646	2.542
1949	19,679	4,020	68	23,631	2.872
1950	16,546	4,873	656	20,763	..

Sources: Same as for table 111.

TABLE 114

Peru: Apparent consumption of writing and printing paper, other than newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,216	..	1,216	0.204
1926	..	1,241	..	1,241	0.205
1927	..	1,387	..	1,387	0.226
1928	..	1,628	..	1,628	0.262
1929	..	1,702	..	1,702	0.270
1930	..	1,164	..	1,164	0.182
1931	..	942	..	942	0.145
1932	..	894	..	894	0.136
1933	..	1,244	..	1,244	0.186
1934	..	1,653	..	1,653	0.244
1935	..	2,028	..	2,028	0.296
1936	..	1,989	..	1,989	0.286
1937	820	2,156	..	2,976	0.423
1938	535	1,308	..	1,843	0.258
1939	1,035	1,202	..	2,237	0.309
1940	1,961	1,208	8	3,161	0.431
1941	2,870	1,269	20	4,119	0.555
1942	2,534	1,688	7	4,215	0.561
1943	1,552	950	20	2,482	0.326
1944	2,350	1,499	60	3,789	0.491
1945	3,479	1,352	90	4,741	0.606
1946	2,820	1,782	33	4,569	0.577
1947	2,884	1,392	..	4,276	0.533
1948	3,581	1,261	..	4,842	0.596
1949	3,093	2,102	..	5,195	0.632
1950	2,078	2,140	117	4,101	0.492

Sources: Same as for table 112.

TABLE 115

Peru: Apparent consumption of wrapping and packing paper  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	1,096	..	1,096	0.184
1926	..	758	..	758	0.125
1927	..	1,667	..	1,667	0.272
1928	..	1,521	..	1,521	0.244
1929	..	1,863	..	1,863	0.295
1930	..	1,855	..	1,855	0.290
1931	..	1,704	..	1,704	0.262
1932	..	1,943	..	1,943	0.295
1933	..	1,919	..	1,919	0.288
1934	..	2,906	..	2,906	0.430
1935	..	2,336	..	2,336	0.341
1936	..	3,164	..	3,164	0.455
1937	1,713	4,114	..	5,827	0.827
1938	1,117	2,693	..	3,810	0.534
1939	2,162	3,055	..	5,217	0.721
1940	4,097	1,466	23	5,540	0.756
1941	5,995	518	385	6,128	0.826
1942	5,293	306	969	4,630	0.616
1943	4,062	83	1,046	3,099	0.407
1944	4,977	170	974	4,173	0.541
1945	5,623	545	1,770	4,398	0.563
1946	5,431	199	619	5,011	0.633
1947	6,937	345	252	7,030	0.877
1948	6,716	207	115	6,808	0.838
1949	7,539	302	59	7,782	0.946
1950	6,937	168	436	6,669	0.800

Sources: Same as for table 112.

TABLE 116

Peru: Apparent consumption of paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		848		848	0.142
1926		1,446		1,446	0.239
1927		876		876	0.143
1928		1,059		1,059	0.170
1929		917		917	0.145
1930		721		721	0.113
1931		338		338	0.052
1932		357		357	0.054
1933		480		480	0.072
1934		677		677	0.100
1935		747		747	0.109
1936		1,021		1,021	0.147
1937	1,439	1,038		2,477	0.352
1938	938	733		1,671	0.234
1939	1,815	741		2,556	0.353
1940	3,441	636	53	4,024	0.549
1941	5,035	831	4	5,862	0.790
1942	4,445	745	77	5,113	0.680
1943	3,532	265	277	3,520	0.462
1944	3,890	654	80	4,464	0.579
1945	3,843	911	121	4,633	0.593
1946	4,265	1,030	158	5,137	0.649
1947	6,148	916	39	7,025	0.876
1948	5,845	518	7	6,356	0.783
1949	7,148	394	4	7,538	0.916
1950	5,786	844	77	6,533	0.787

Sources: Same as for table 112.

TABLE 117

Peru: Apparent consumption of sundry papers,  
not classified<sup>a</sup>  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		1,804		1,804	0.303
1926		1,667		1,667	0.276
1927		1,844		1,844	0.301
1928		1,615		1,615	0.260
1929		1,937		1,937	0.307
1930		1,518		1,518	0.237
1931		1,122	1	1,121	0.173
1932		1,134	3	1,131	0.172
1933		1,143	6	1,137	0.170
1934		1,285	21	1,264	0.187
1935		1,551	46	1,505	0.219
1936		1,666	29	1,637	0.236
1937	370	1,833	36	2,167	0.308
1938	240	1,593	23	1,810	0.254
1939	466	1,285	3	1,748	0.242
1940	883	1,302	2	2,183	0.298
1941	1,292	1,639	8	2,923	0.394
1942	1,141	1,269	27	2,383	0.317
1943	1,147	1,281	97	2,331	0.306
1944	611	1,531	76	2,066	0.268
1945	483	1,552	53	1,982	0.254
1946	2,414	1,735	19	4,130	0.522
1947	646	1,647	14	2,279	0.284
1948	1,709	965	34	2,640	0.325
1949	1,899	1,222	5	3,116	0.379
1950	1,745	1,721	26	3,440	0.413

Sources: Same as for table 112.

<sup>a</sup> Includes bristleboards.

TABLE 118

Uruguay: Total apparent consumption of paper  
and paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	3,608	12,829		16,437	9.908
1926	3,797	12,956		16,753	9.861
1927	3,553	13,883		17,436	10.015
1928	4,813	15,442		20,255	11.203
1929	4,748	14,558		19,306	10.436
1930	4,504	11,947		16,451	8.645
1931	8,622	15,594		24,216	12.476
1932	5,226	9,471		14,697	7.514
1933	6,391	15,825	114	22,102	11.151
1934	4,802	16,710		21,512	10.718
1935	6,553	16,477		23,030	11.345
1936	7,596	20,120		27,716	13.500
1937	6,128	20,312		26,440	12.712
1938	4,190	21,925		26,115	12.388
1939	12,914	20,070		32,984	15.449
1940	9,719	17,745		27,464	12.744
1941	19,542	17,672	208	37,006	17.014
1942	19,308	14,120	357	33,071	15.073
1943	14,197	11,428	384	25,241	11.375
1944	21,480	17,700		39,180	17.475
1945	20,659	20,058		40,717	18.008
1946	19,857	19,373		39,230	17.198
1947	21,238	20,254		41,492	18.040
1948	23,641	22,040		45,681	19.614
1949	19,501	23,233		42,734	18.161
1950	30,000	24,143		54,143	22.749

Sources: Production: 1925-49, estimated on the basis of imports of raw materials; 1950, estimated on the basis of information by Uruguayan industrialists. Imports and exports: 1925, 1927, 1929, 1931-34 and 1936-43, *Anuarios Estadísticos*; 1926, 1928, 1930 and 1935, data supplied by the Dirección de Estadística del Uruguay; 1944-49, *Memoria de la Contraloría de Importaciones y Exportaciones*; 1950, *Suplemento Estadístico de la Revista Económica*, January 1951.

TABLE 119

Uruguay: Apparent consumption of newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		6,160		6,160	3.713
1926		6,144		6,144	3.616
1927		6,129		6,129	3.520
1928		6,687		6,687	3.699
1929		6,903		6,903	3.731
1930		4,022		4,022	2.114
1931		7,688		7,688	3.961
1932		5,081		5,081	2.598
1933		9,604		9,604	4.846
1934		10,387		10,387	5.175
1935		10,837		10,837	5.338
1936		13,223		13,223	6.441
1937		12,823		12,823	6.165
1938		11,875		11,875	5.633
1939		12,568		12,568	5.887
1940		12,056		12,056	5.594
1941		9,673		9,673	4.447
1942		9,348		9,348	4.261
1943		8,625		8,625	3.887
1944		12,176		12,176	5.431
1945		13,871		13,871	6.135
1946		11,717		11,717	5.136
1947		13,759		13,759	5.982
1948		16,442		16,442	7.060
1949		17,034		17,034	7.239
1950		16,251		16,251	6.828

Sources: Same as for table 118.

TABLE 120

Uruguay: Apparent consumption of all paper and paperboard, other than newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	3,608	6,669	..	10,277	6.195
1926	3,797	6,812	..	10,609	6.245
1927	3,553	7,754	..	11,307	6.495
1928	4,813	8,755	..	13,568	7.504
1929	4,748	7,655	..	12,403	6.705
1930	4,504	7,925	..	12,429	6.531
1931	8,622	7,906	..	16,528	8.515
1932	5,226	4,390	..	9,616	4.916
1933	6,391	6,221	114	12,498	6.305
1934	4,802	6,323	..	11,125	5.543
1935	6,553	5,640	..	12,193	6.007
1936	7,596	6,897	..	14,493	7.059
1937	6,128	7,489	..	13,617	6.547
1938	4,190	10,050	..	14,240	6.755
1939	12,914	7,502	..	20,416	9.562
1940	9,719	5,689	..	15,408	7.150
1941	19,542	7,999	208	27,333	12.567
1942	19,308	4,772	357	23,723	10.812
1943	14,197	2,803	384	16,616	7.488
1944	21,480	5,524	..	27,004	12.044
1945	20,659	6,187	..	26,846	11.873
1946	19,857	7,656	..	27,513	12.062
1947	21,238	6,495	..	27,733	12.058
1948	23,641	5,598	..	29,239	12.554
1949	19,501	6,199	..	25,700	10.922
1950	30,000	7,892	..	37,892	15.921

Sources: Same as for table 118.

TABLE 121

Venezuela: Apparent consumption of paper and paperboard  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	190	1,156	..	1,346	0.480
1926	279	1,934	..	2,213	0.765
1927	896	2,210	..	3,106	1.059
1928	1,391	2,501	..	3,892	1.307
1929	783	5,510	..	6,293	2.082
1930	1,396	4,857	..	6,253	2.038
1931	1,529	4,174	..	5,703	1.831
1932	1,753	3,882	..	5,635	1.778
1933	2,629	4,161	..	6,790	2.113
1934	1,321	3,710	..	5,031	1.545
1935	1,464	4,372	..	5,836	1.768
1936	4,881	5,156	..	10,037	3.002
1937	2,687	8,913	..	11,600	3.397
1938	2,964	9,833	..	12,797	3.643
1939	2,720	13,789	..	16,509	4.572
1940	2,937	12,743	..	15,680	4.226
1941	4,236	13,800	..	18,036	4.736
1942	4,721	8,221	..	12,942	3.313
1943	4,599	12,721	..	17,320	4.325
1944	5,214	12,139	..	17,353	4.229
1945	6,121	11,817	..	17,938	4.270
1946	8,943	20,905	..	29,848	6.941
1947	8,627	32,613	..	41,240	9.377
1948	8,689	31,782	..	40,471	9.002
1949	8,332	32,182	..	40,514	8.817
1950	7,718	42,680	..	50,398	10.723

Sources: Production: 1925-38 and 1950, estimated on the basis of imports of raw materials; 1939-49, *Cuadernos de Información Económica*, and figures on paperboard supplied by the manufacturer. Imports: 1925-28, data supplied by the Dirección de Estadística de Venezuela; 1929-47, *Estadística Mercantil y Marítima*; 1948, *Cuadernos de Información Económica*, May and June 1951; 1949-50, *Boletín Estadístico*, January 1950 and January 1951.

TABLE 122

Venezuela: Apparent consumption of newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	..	66	..	66	0.024
1926	..	334	..	334	0.116
1927	..	264	..	264	0.090
1928	..	310	..	310	0.104
1929	..	85	..	85	0.028
1930	..	1,631	..	1,631	0.532
1931	..	1,402	..	1,402	0.450
1932	..	1,304	..	1,304	0.411
1933	..	1,398	..	1,398	0.435
1934	..	1,699	..	1,699	0.522
1935	..	1,936	..	1,936	0.587
1936	..	1,208	..	1,208	0.361
1937	..	3,779	..	3,779	1.107
1938	..	2,921	..	2,921	0.831
1939	..	5,233	..	5,233	1.449
1940	..	3,840	..	3,840	1.035
1941	..	5,203	..	5,203	1.366
1942	..	2,713	..	2,713	0.695
1943	..	2,795	..	2,795	0.698
1944	..	4,080	..	4,080	0.994
1945	..	4,414	..	4,414	1.051
1946	..	6,443	..	6,443	1.498
1947	..	12,391	..	12,391	2.817
1948	..	7,972	..	7,972	1.773
1949	..	8,376	..	8,376	1.823
1950	..	10,525	..	10,525	2.239

Sources: Same as for table 121.

TABLE 123

Venezuela: Apparent consumption of all paper and paperboard, other than newsprint  
(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	190	1,090	..	1,280	0.456
1926	279	1,600	..	1,879	0.649
1927	896	1,946	..	2,842	0.969
1928	1,391	2,191	..	3,582	1.203
1929	783	5,425	..	6,208	2.054
1930	1,396	3,226	..	4,622	1.506
1931	1,529	2,772	..	4,301	1.381
1932	1,753	2,578	..	4,331	1.367
1933	2,629	2,763	..	5,392	1.678
1934	1,321	2,011	..	3,332	1.023
1935	1,464	2,436	..	3,900	1.181
1936	4,881	3,948	..	8,829	2.641
1937	2,687	5,134	..	7,821	2.290
1938	2,964	6,912	..	9,876	2.812
1939	2,720	8,556	..	11,276	3.123
1940	2,937	8,903	..	11,840	3.191
1941	4,236	8,597	..	12,833	3.370
1942	4,721	5,508	..	10,229	2.618
1943	4,599	9,926	..	14,525	3.627
1944	5,214	8,059	..	13,273	3.235
1945	6,121	7,403	..	13,524	3.219
1946	8,943	14,462	..	23,405	5.443
1947	8,627	20,222	..	28,849	6.560
1948	8,689	23,810	..	32,499	7.229
1949	8,332	23,806	..	32,138	6.994
1950	7,718	32,155	..	39,873	8.484

Sources: Same as for table 121.

TABLE 124

Venezuela: Apparent consumption of writing and printing paper other than newsprint

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		6		6	0.002
1926		255		255	0.088
1927		328		328	0.112
1928		339		339	0.114
1929		358		358	0.118
1930		348		348	0.113
1931		292		292	0.094
1932		233		233	0.074
1933		157		157	0.049
1934		398		398	0.122
1935		620		620	0.188
1936		774		774	0.232
1937		1,921		1,921	0.563
1938		1,757		1,757	0.500
1939		2,648		2,648	0.733
1940		2,725		2,725	0.735
1941		2,444		2,444	0.642
1942		1,422		1,422	0.364
1943		3,477		3,477	0.868
1944		2,013		2,013	0.491
1945		2,006		2,006	0.478
1946		4,944		4,944	1.150
1947		2,597		2,597	0.590
1948		6,871		6,871	1.528
1949		5,331		5,331	1.160
1950		8,874		8,874	1.888

Sources: Same as for table 121.

TABLE 125

Venezuela: Apparent consumption of wrapping and packing paper

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925	190			190	0.068
1926	279			279	0.096
1927	896			896	0.305
1928	1,391			1,391	0.467
1929	783			783	0.259
1930	1,396			1,396	0.455
1931	1,529			1,529	0.491
1932	1,753			1,753	0.553
1933	2,629			2,629	0.818
1934	1,321			1,321	0.406
1935	1,464	1		1,465	0.444
1936	4,881	24		4,905	1.467
1937	2,687	8		2,695	0.789
1938	2,964	2		2,966	0.844
1939	2,720	6		2,726	0.755
1940	2,937	2		2,939	0.792
1941	4,236	56		4,292	1.127
1942	4,721	6		4,727	1.210
1943	4,599	91		4,690	1.171
1944	5,214	5		5,219	1.272
1945	6,121	515		6,636	1.580
1946	6,173	866		7,039	1.637
1947	5,714	6,376		12,090	2.749
1948	5,585	1,951		7,536	1.676
1949	5,281	1,616		6,897	1.501
1950	4,750	2,251		7,001	1.490

Sources: Same as for table 121.

TABLE 126

Venezuela: Apparent consumption of paperboard

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		557		557	0.199
1926		634		634	0.219
1927		668		668	0.228
1928		841		841	0.282
1929		906		906	0.300
1930		591		591	0.193
1931		422		422	0.136
1932		373		373	0.118
1933		490		490	0.153
1934		394		394	0.121
1935		423		423	0.128
1936		731		731	0.219
1937		1,180		1,180	0.346
1938		1,361		1,361	0.387
1939		1,578		1,578	0.437
1940		1,416		1,416	0.382
1941		2,193		2,193	0.576
1942		1,531		1,531	0.392
1943		3,002		3,002	0.750
1944		2,001		2,001	0.488
1945		1,794		1,794	0.427
1946	2,770	3,323		6,093	1.417
1947	2,913	4,541		7,454	1.695
1948	3,104	5,474		8,578	1.908
1949	3,051	5,701		8,752	1.905
1950	2,911	4,887		7,798	1.659

Sources: Same as for table 121.

TABLE 127

Venezuela: Apparent consumption of sundry papers, not classified<sup>a</sup>

(Metric tons)

Year	Production	Imports	Exports	Apparent consumption	
				Total	Per capita (kgs.)
1925		527		527	0.188
1926		711		711	0.246
1927		950		950	0.324
1928		1,011		1,011	0.339
1929		4,161		4,161	1.376
1930		2,287		2,287	0.745
1931		2,058		2,058	0.661
1932		1,972		1,972	0.622
1933		2,116		2,116	0.659
1934		1,219		1,219	0.374
1935		1,392		1,392	0.422
1936		2,419		2,419	0.724
1937		2,025		2,025	0.593
1938		3,792		3,792	1.079
1939		4,324		4,324	1.197
1940		4,760		4,760	1.283
1941		3,904		3,904	1.025
1942		2,549		2,549	0.653
1943		3,356		3,356	0.838
1944		4,040		4,040	0.985
1945		3,088		3,088	0.735
1946		5,329		5,329	1.239
1947		6,708		6,708	1.525
1948		9,514		9,514	2.116
1949		11,158		11,158	2.428
1950		16,143		16,143	3.435

Sources: Same as for table 121.

<sup>a</sup>Includes bristleboards.

## Annex II

### ESTIMATE OF FUTURE CONSUMPTION FOR PAPER AND PAPERBOARD

#### METHOD USED FOR ESTIMATING THE FUTURE CONSUMPTION OF PULP AND PAPER

Several procedures for estimating the future demand for pulp and paper were considered before adopting the method illustrated in the following tables of this annex. The first method was based on historic trends of per capita consumption as applied to estimated future population. In some countries the existing production data were only available for recent years and the resulting series were too short to ensure acceptable projections. The difference in periods in these series, from country to country, also gave rise to a mixed basis for calculation. A second method attempted was to make both simple and multiple correlations of per capita consumption with one or more economic or cultural factors, particularly for those countries which are typically representative of conditions in Latin America. The examination of each country individually was considerably hindered owing to the lack of complete series on per capita income, relative prices of paper, industrialization indices, literacy statistics or educational progress. The third method, finally decided upon, was a correlation of per capita income with per capita paper consumption, as applied to the year 1949 and including the largest number of countries possible, not only from Latin America but from the rest of the world.

The method adopted provided extremely satisfactory results, since for Latin America alone correlation indices of 0.83 for newsprint and 0.89 for other paper and paperboard resulted. For the correlation including

countries throughout the world, the indices were 0.91 for newsprint and 0.95 for other paper and paperboard. The world figure was taken as the basis for the subsequent operations.

The data utilized appear in table 1 and plates 1 and 2. The income-elasticity was 1.438 for newsprint and 1.538 for other paper and paperboard.<sup>1</sup>

Estimates of future paper consumption were based on the supposition that the annual rate of increase of per capita income in the Latin-American countries would be between 1 per cent and 5 per cent. Although the calculations appearing in this annex show rates of 1, 2, 3, 4 and 5 per cent, in the chapters dealing with each country and with Latin America as a whole only the rate of 3 per cent has been used, in order to simplify the presentation of the work.

Table 2 shows the computation of the growth rates which were applied to the 1950 consumption in order to establish future demand. Table 3 contains the population figures used in the projections. The following tables give estimates of future demand for newsprint, other paper and paperboard until 1965. As indicated in the footnotes of the tables, the statistical data for consumption in 1950 were not used as a basis for the projections. The figures actually employed were those calculated by means of regression formulae corresponding to past trends of consumption growth.

<sup>1</sup> The equations for regression lines were the following:

$$\text{For newsprint: } \log y = 1.438 \log x + 0.0347$$

$$\text{For other papers and paperboard: } \log y = 1.538 \log x + 0.218$$

where:

$y$  = average paper consumption in grammes per capita  
 $x$  = per capita dollar income.

PLATE 1

Correlation between per capita consumption of newsprint and per capita income (1949 figures)

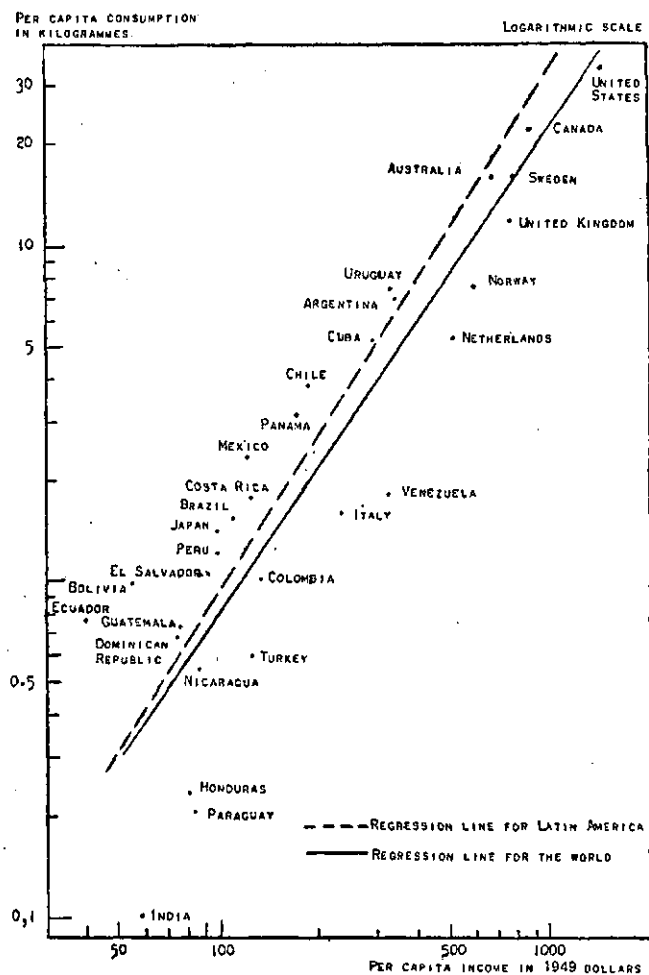


PLATE 2

Correlation between per capita consumption of paper-board and paper other than newsprint and per capita income (1949 figures)

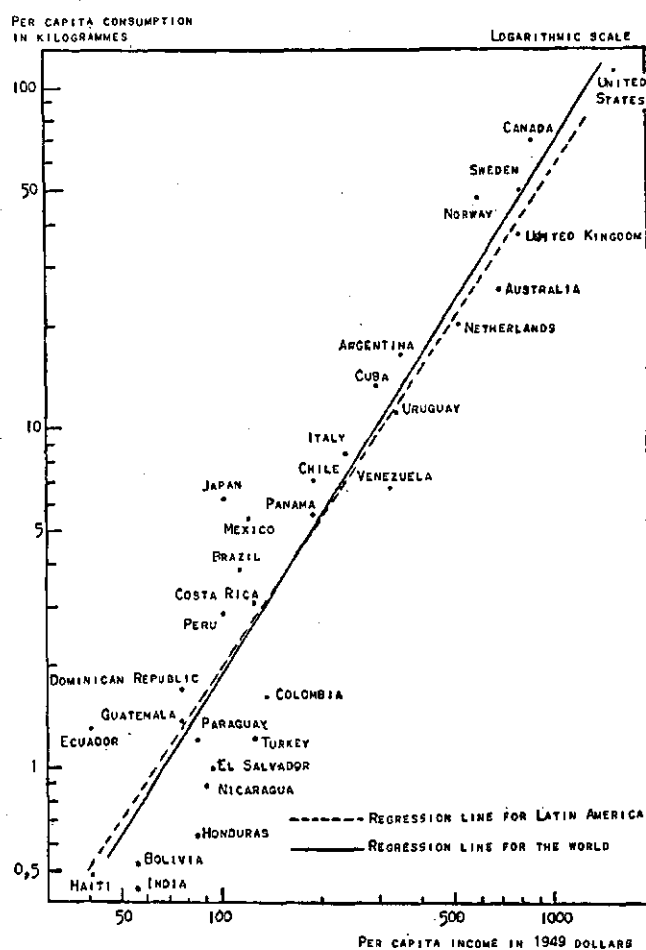


TABLE 1

Data used to determine the income-elasticity of paper and paperboard consumption

Countries	Per capita income (1949 dollars)	Per capita consumption of newsprint (kgs.)	Per capita consumption of other paper and paperboard (kgs.)
<b>Europe:</b>			
Italy	235	1.600	8.544
Netherlands	502	5.300	20.892
Norway	587	7.600	48.886
Sweden	780	16.000	50.891
United Kingdom	773	12.000	38.381
<b>Asia:</b>			
India	57	0.100	0.448
Japan	100	1.400	6.371
Turkey	125	0.600	1.223
<b>Oceania:</b>			
Australia	679	16.000	26.036
<b>North America:</b>			
Canada	870	22.000	73.511
United States	1.453	34.000	116.783
<b>Latin America:</b>			
Argentina	346	7.025	16.933
Bolivia	55	0.987	0.524
Brazil	112	1.567	3.904
Dominican Republic	75	0.688	1.717
Chile	188	3.858	7.108
Colombia	132	1.013	2.645
Costa Rica	125	1.796	3.132
Cuba	296	5.267	13.536
Ecuador	40	0.761	1.316
El Salvador	92	1.063	1.015
Guatemala	77	0.728	1.391
Haiti	40	0.062	0.482
Honduras	83	0.234	0.641
Mexico	121	2.385	5.468
Nicaragua	89	0.555	0.911
Panama	183	3.204	5.659
Paraguay	84	0.205	1.228
Peru	100	1.208	2.872
Uruguay	331	7.239	10.922
Venezuela	322	1.823	6.994

Sources: Consumption: annex I of this report; Food and Agriculture Organization, *Yearbook of Forest Products Statistics—1950*; United Nations, *Statistical Yearbook, 1951*. Income: United Nations Statistical Office, *National and per capita Incomes of Seventy Countries in 1949*. Statistical Papers, Series E, No. 1, October 1950.



TABLE 2  
*Computation of growth factors used to estimate future consumption of paper and paperboard in Latin America*

Year	Rate of increase of per capita income (in %)	Per capita income growth factor <sup>a</sup>	Consumption growth factors	
			For newsprint (e = 1.438)	For other paper and paperboard (e = 1.538)
	(t)	(m)	(m <sup>e</sup> )	(m <sup>e</sup> )
1955....	1	1.0510	1.074	1.080
	2	1.1041	1.153	1.165
	3	1.1593	1.237	1.255
	4	1.2167	1.326	1.352
	5	1.2763	1.420	1.455
1960....	1	1.1046	1.154	1.165
	2	1.2190	1.330	1.356
	3	1.3439	1.530	1.576
	4	1.4802	1.758	1.828
	5	1.6289	2.017	2.118
1965....	1	1.1610	1.239	1.258
	2	1.3459	1.533	1.579
	3	1.5580	1.892	1.978
	4	1.8009	2.331	2.472
	5	2.0789	2.865	3.083

<sup>a</sup> Unit per capita income in base period (1950) compounded at corresponding rate of increase.

TABLE 3  
*Latin America: Population estimates used in the computation of paper consumption*  
(In thousands)

Country	1950	1955	1960	1965	Country	1950	1955	1960	1965
Argentina.....	17,111 <sup>a</sup>	19,057	21,223	23,636	Haiti.....	3,456	3,884	4,366	4,907
Bolivia.....	3,019	3,199	3,389	3,591	Honduras.....	1,534	1,804	2,123	2,497
Brazil.....	50,250	55,094	60,406	66,230	Mexico.....	25,368	28,161	31,683	35,646
Chile.....	5,809	6,297	6,826	7,400	Nicaragua.....	1,055	1,093	1,132	1,172
Colombia.....	11,260	12,561	14,012	15,632	Panama.....	801	882	994	1,121
Costa Rica.....	796	891	997	1,116	Paraguay.....	1,406	1,530	1,747	1,996
Cuba.....	5,275	5,645	6,040	6,463	Peru.....	8,330	8,875	9,456	10,076
Dominican Republic....	2,113	2,377	2,673	3,007	Uruguay.....	2,380	2,520	2,667	2,824
Ecuador.....	3,199 <sup>a</sup>	3,686	4,248	4,896	Venezuela.....	4,700	5,247	5,861	6,546
El Salvador.....	1,858	1,986	2,124	2,270					
Guatemala.....	2,810	3,026	3,258	3,508					
					TOTAL	152,530	167,815	185,225	204,534

<sup>a</sup> According to recent official figures, the population of Argentina in 1950 was 17,196,810 and that of Ecuador 3,202,530.

TABLE 4  
Latin America: Future consumption of paper and paperboard

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		2.457	374,807	6.382	973,462	8.839	1,348,269
1950: Computed data*..		3.110	474,433	5.920	912,911	9.096	1,387,344
1955.....	1	3.351	562,331	6.445	1,081,536	9.796	1,643,867
	2	3.597	603,643	6.952	1,166,649	10.549	1,770,292
	3	3.859	647,628	7.489	1,256,815	11.348	1,814,277
	4	4.137	694,197	8.068	1,353,915	12.205	2,048,112
	5	4.430	743,465	8.681	1,456,733	13.111	2,200,198
1960.....	1	3.608	668,272	6.954	1,288,122	10.562	1,956,394
	2	4.158	770,216	8.094	1,499,288	12.253	2,269,504
	3	4.783	886,008	9.408	1,742,546	14.191	2,628,554
	4	5.496	1,018,072	10.920	2,022,629	16.416	3,040,701
	5	6.306	1,168,043	12.643	2,341,787	18.949	3,509,830
1965.....	1	3.881	793,835	7.542	1,542,444	10.934	2,336,279
	2	4.802	982,207	9.467	1,936,072	14.268	2,918,279
	3	5.927	1,212,290	11.860	2,425,331	17.785	3,637,621
	4	7.302	1,493,553	14.821	3,031,014	22.121	4,524,567
	5	8.975	1,835,654	18.485	3,780,219	27.457	5,615,873

\* The sum of the computed 1950 data for all countries, based on the projection of their respective trend lines.

TABLE 5  
Argentina: Estimates of future consumption of paper and paperboard

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		5.918	101,269	17.852	305,463	23.770	406,732
1950: Computed data*..		12.400	212,176	17.520	299,785	29.920	511,961
1955.....	1	23.318	253,801	18.922	360,597	32.240	614,398
	2	14.297	272,458	20.411	388,972	34.708	661,430
	3	15.339	292,315	21.988	419,025	37.327	711,340
	4	16.442	313,335	23.687	451,403	40.129	764,738
	5	17.608	335,556	25.492	485,801	43.100	821,357
1960.....	1	14.310	303,701	20.411	433,183	34.721	736,884
	2	16.492	350,010	23.757	504,195	40.249	854,205
	3	18.972	402,643	27.612	586,009	46.584	988,652
	4	21.799	462,640	32.027	679,709	53.826	1,142,349
	5	25.011	530,808	37.107	787,522	62.118	1,318,330
1965.....	1	15.364	363,144	22.040	520,937	37.404	884,081
	2	19.009	449,297	27.664	653,866	46.673	1,103,163
	3	23.461	554,524	34.655	819,106	58.116	1,373,630
	4	28.904	683,175	43.309	1,023,652	72.213	1,706,827
	5	35.526	839,693	54.014	1,276,675	89.540	2,116,368

\* For newsprint data were computed as projection of the trend line for the years 1925-1939. For "other papers and paperboard" the years 1935-1950 were used as a base.

TABLE 6

*Bolivia: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data <sup>a</sup> . . . . .		0.881	2,661	0.534	1,611	1.415	4,272
1950: Computed data <sup>b</sup> . . . . .		0.938	2,832	0.541	1,633	1.479	4,465
1955 . . . . .	1	1.007	3,221	0.584	1,868	1.591	5,089
	2	1.082	3,461	0.630	2,015	1.712	5,476
	3	1.160	3,711	0.679	2,172	1.839	5,883
	4	1.244	3,980	0.731	2,338	1.975	6,318
	5	1.332	4,261	0.787	2,518	2.119	6,779
1960 . . . . .	1	1.082	3,667	0.630	2,135	1.712	5,802
	2	1.248	4,229	0.734	2,488	1.982	6,717
	3	1.435	4,863	0.853	2,891	2.288	7,754
	4	1.649	5,588	0.989	3,352	2.638	8,940
	5	1.892	6,412	1.146	3,884	3.038	10,296
1965 . . . . .	1	1.162	4,173	0.681	2,445	1.843	6,618
	2	1.438	5,164	0.854	3,067	2.292	8,231
	3	1.775	6,374	1.070	3,842	2.845	10,216
	4	2.186	7,850	1.337	4,801	3.523	12,651
	5	2.687	9,649	1.668	5,990	4.355	15,639

<sup>a</sup> Estimates.

<sup>b</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 7

*Brazil: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		1.823	91,626	4.511	226,663	6.334	318,289
1950: Computed data <sup>a</sup> . . . . .		1.642	82,511	3.877	194,819	5.519	277,330
1955 . . . . .	1	1.764	97,186	4.187	230,679	5.951	327,865
	2	1.893	104,293	4.517	248,860	6.410	353,153
	3	2.031	111,896	4.866	268,087	6.897	379,983
	4	2.177	119,940	5.242	288,803	7.419	408,743
	5	2.332	128,479	5.641	310,785	7.973	439,264
1960 . . . . .	1	1.895	114,469	4.517	272,854	6.412	387,323
	2	2.184	131,927	5.257	317,554	7.441	449,481
	3	2.512	151,740	6.110	369,081	8.622	520,821
	4	2.887	174,392	7.087	428,097	9.974	602,489
	5	3.312	200,065	8.211	495,994	11.523	696,059
1965 . . . . .	1	2.034	234,712	4.877	323,004	6.911	457,716
	2	2.517	166,701	6.122	405,460	8.639	572,161
	3	3.107	205,777	7.669	507,918	10.776	713,695
	4	3.828	253,528	9.584	634,748	13.412	888,276
	5	4.704	311,546	11.953	791,647	16.657	1,103,193

<sup>a</sup> Computed as the projection of the trend line for the years 1937 to 1950.

TABLE 8

*Chile: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		5.171	30,038	6.303	36,612	11.474	66,650
1950: Computed data <sup>a</sup> .		4.102	23,829	7.023	40,796	11.125	64,625
1955.....	1	4.406	27,745	7.585	47,763	11.991	75,508
	2	4.730	29,785	8.182	51,522	12.912	81,307
	3	5.074	31,951	8.814	55,502	13.888	87,453
	4	5.439	34,249	9.495	59,790	14.934	94,039
	5	5.825	36,680	10.218	64,343	16.043	101,023
1960.....	1	4.734	32,314	8.182	55,850	12.916	88,164
	2	5.456	37,243	9.523	65,004	14.979	102,247
	3	6.276	42,840	11.068	75,550	17.344	118,390
	4	7.211	49,222	12.838	87,632	20.049	136,854
	5	8.274	56,478	14.875	101,537	23.149	158,015
1965.....	1	5.082	37,607	8.835	65,379	13.917	102,986
	2	6.288	46,531	11.089	82,059	17.377	128,590
	3	7.761	57,431	13.891	102,793	21.652	160,224
	4	9.562	70,759	17.361	128,471	26.923	199,230
	5	11.752	86,965	21.652	160,225	33.404	247,190

<sup>a</sup> Computed as the projection of the trend line for the years 1930 to 1950.

TABLE 9

*Colombia: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		1.773	19,962	3.708	41,758	5.481	61,720
1950: Computed data <sup>a</sup> .		1.245	14,019	2.795	31,471	4.040	45,490
1955.....	1	1.337	16,794	3.019	37,922	4.356	54,716
	2	1.435	18,025	3.256	40,899	4.691	58,924
	3	1.540	19,344	3.508	44,064	5.048	63,408
	4	1.651	20,738	3.779	47,468	5.430	68,206
	5	1.768	22,208	4.067	51,086	5.835	73,294
1960.....	1	1.437	20,135	3.256	45,623	4.693	65,758
	2	1.656	23,204	3.790	53,105	5.446	76,309
	3	1.905	26,693	4.405	61,723	6.310	88,416
	4	2.189	30,672	5.109	71,587	7.298	102,259
	5	2.511	35,184	5.920	82,951	8.431	118,135
1965.....	1	1.543	24,120	3.516	54,962	5.059	79,082
	2	1.909	29,841	4.413	68,984	6.322	98,825
	3	2.356	36,829	5.529	86,429	7.885	123,258
	4	2.902	45,364	6.909	108,001	9.811	153,365
	5	3.567	55,759	8.617	134,701	12.184	190,460

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 10

*Costa Rica: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		2.109	1,679	2.090	1,663	4.199	3,342
1950: Computed data <sup>a</sup> .		1.730	1,377	3.115	2,480	4.845	3,857
1955 . . . . .	1	1.858	1,655	3.364	2,997	5.222	4,652
	2	1.995	1,778	3.629	3,233	5.624	5,011
	3	2.140	1,907	3.909	3,483	6.049	5,390
	4	2.294	2,044	4.211	3,752	6.505	5,796
	5	2.457	2,189	4.532	4,038	6.989	6,227
1960 . . . . .	1	1.996	1,990	3.629	3,618	5.625	5,608
	2	2.301	2,294	4.224	4,211	6.525	6,505
	3	2.647	2,639	4.909	4,894	7.556	7,533
	4	3.041	3,032	5.694	5,677	8.735	8,709
	5	3.489	3,479	6.598	6,578	10.087	10,057
1965 . . . . .	1	2.143	2,392	3.919	4,374	6.062	6,766
	2	2.652	2,960	4.919	5,490	7.571	8,450
	3	3.273	3,653	6.161	6,876	9.434	10,529
	4	4.033	4,501	7.700	8,593	11.733	13,094
	5	4.956	5,531	9.604	10,718	14.560	16,249

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1949.

TABLE 11

*Cuba: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		7.115	37,532	18.837	99,367	25.952	136,899
1950: Computed data <sup>a</sup> .		4.311	22,740	15.442	81,457	19.753	104,197
1955 . . . . .	1	4.630	26,136	16.677	94,142	21.307	120,278
	2	4.971	28,061	17.990	101,554	22.961	129,615
	3	5.333	30,105	19.380	109,400	24.713	139,505
	4	5.716	32,267	20.878	117,856	26.594	150,123
	5	6.122	34,559	22.468	126,832	28.590	161,391
1960 . . . . .	1	4.975	30,049	17.990	108,660	22.965	138,709
	2	5.734	34,633	20.939	126,472	26.673	161,105
	3	6.596	39,840	24.337	146,995	30.933	186,835
	4	7.579	45,777	28.228	170,497	35.807	216,274
	5	8.695	52,518	32.706	197,544	41.401	250,062
1965 . . . . .	1	5.341	34,519	19.426	125,550	24.767	160,069
	2	6.609	42,714	24.383	157,587	30.992	200,301
	3	8.156	52,712	30.544	197,406	38.700	250,118
	4	10.049	64,947	38.173	246,712	48.222	311,659
	5	12.351	79,825	47.608	307,691	59.959	387,516

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 12

*Dominican Republic: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		0.553	1,168	2.330	4,923	2.883	6,091
1950: Computed data <sup>a</sup> . . . . .		0.736	1,555	2.104	4,446	2.840	6,001
1955 . . . . .	1	0.790	1,878	2.272	5,401	3.062	7,279
	2	0.849	2,018	2.451	5,826	3.300	7,844
	3	0.910	2,163	2.641	6,278	3.551	8,441
	4	0.976	2,320	2.845	6,763	3.821	9,083
	5	1.045	2,484	3.061	7,276	4.106	9,760
1960 . . . . .	1	0.849	2,269	2.451	6,552	3.300	8,821
	2	0.979	2,617	2.853	7,626	3.832	10,243
	3	1.126	3,010	3.316	8,864	4.442	11,874
	4	1.294	3,459	3.846	10,280	5.140	13,739
	5	1.485	3,969	4.456	11,911	5.941	15,880
1965 . . . . .	1	0.912	2,742	2.647	7,960	3.559	10,702
	2	1.128	3,392	3.322	9,989	4.450	13,381
	3	1.393	4,189	4.162	12,515	5.555	16,704
	4	1.716	5,160	5.201	15,639	6.917	20,799
	5	2.109	6,342	6.487	19,506	8.596	25,848

<sup>a</sup> Computed as the projection of the trend line for the years 1936 to 1950.

TABLE 13

*Ecuador: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		1.775	5,679	1.790	5,727	3.565	11,406
1950: Computed data <sup>a</sup> . . . . .		1.083	3,465	1.283	4,104	2.366	7,569
1955 . . . . .	1	1.163	4,287	1.386	5,109	2.549	9,396
	2	1.249	4,604	1.495	5,511	2.744	10,115
	3	1.340	4,939	1.610	5,934	2.950	10,873
	4	1.436	5,293	1.735	6,395	3.171	11,688
	5	1.538	5,669	1.867	6,882	3.405	12,551
1960 . . . . .	1	1.250	5,310	1.495	6,351	2.745	11,661
	2	1.440	6,117	1.740	7,392	3.180	13,509
	3	1.657	7,039	2.022	8,589	3.679	15,628
	4	1.904	8,088	2.345	9,962	4.249	18,050
	5	2.184	9,278	2.717	11,542	4.901	20,820
1965 . . . . .	1	1.342	6,570	1.614	7,902	2.956	14,472
	2	1.660	8,127	2.026	9,919	3.686	18,046
	3	2.049	10,032	2.538	12,426	4.587	22,458
	4	2.524	12,358	3.172	15,530	5.696	27,888
	5	3.103	15,192	3.955	19,364	7.058	34,556

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 14

*El Salvador: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data <sup>a</sup> . . . . .		1.060	1,969	1.024	1,903	2.084	3,872
1950: Computed data <sup>b</sup> . . . . .		0.985	1,830	0.833	1,548	1.818	3,378
1955 . . . . .	1	1.058	2,101	0.900	1,787	1.958	3,888
	2	1.136	2,256	0.970	1,926	2.106	4,182
	3	1.218	2,419	1.1045	2,075	2.263	4,494
	4	1.306	2,594	1.126	2,236	2.432	4,830
	5	1.399	2,778	1.212	2,407	2.611	5,185
1960 . . . . .	1	1.137	2,415	0.970	2,060	2.107	4,475
	2	1.310	2,782	1.130	2,400	2.440	5,182
	3	1.507	3,201	1.313	2,789	2.820	5,990
	4	1.732	3,679	1.523	3,235	3.255	6,914
	5	1.987	4,220	1.764	3,747	3.751	7,967
1965 . . . . .	1	1.220	2,769	1.048	2,379	2.268	5,148
	2	1.510	3,428	1.315	2,985	2.825	6,413
	3	1.864	4,231	1.648	3,741	3.512	7,972
	4	2.296	5,212	2.059	4,674	4.355	9,886
	5	2.822	6,406	2.568	5,829	5.390	12,235

<sup>a</sup> Estimates.<sup>b</sup> Computed as the projection of the trend line for the years 1932 to 1949.

TABLE 15

*Guatemala: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		0.647	1,817	1.433	4,029	2.080	5,846
1950: Computed data <sup>a</sup> . . . . .		0.625	1,756	1.176	3,305	1.801	5,061
1955 . . . . .	1	0.671	2,030	1.270	3,843	1.941	5,873
	2	0.721	2,182	1.370	4,146	2.091	6,328
	3	0.773	2,339	1.476	4,466	2.249	6,805
	4	0.829	2,509	1.590	4,811	2.419	7,320
	5	0.888	2,687	1.711	5,177	2.599	7,864
1960 . . . . .	1	0.721	2,349	1.370	4,463	2.091	6,812
	2	0.831	2,707	1.595	5,197	2.426	7,904
	3	0.956	3,115	1.853	6,037	2.809	9,152
	4	1.099	3,581	2.150	7,005	3.249	10,586
	5	1.261	4,108	2.491	8,116	3.752	12,224
1965 . . . . .	1	0.774	2,715	1.479	5,188	2.253	7,903
	2	0.958	3,361	1.857	6,514	2.815	9,875
	3	1.182	4,146	2.326	8,160	3.508	12,306
	4	1.457	5,111	2.907	10,198	4.364	15,309
	5	1.791	6,283	3.626	12,720	5.417	19,003

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 16

*Haiti: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		0.087	302	0.533	1,842	0.620	2,144
1950: Computed data <sup>a</sup> .		0.081	280	0.522	1,804	0.603	2,084
1955 . . . . .	1	0.087	338	0.564	2,191	0.651	2,529
	2	0.093	361	0.608	2,361	0.701	2,722
	3	0.100	388	0.655	2,544	0.755	2,932
	4	0.107	416	0.706	2,742	0.813	3,158
	5	0.115	447	0.760	2,952	0.875	3,399
1960 . . . . .	1	0.093	406	0.608	2,655	0.701	3,061
	2	0.108	472	0.708	3,091	0.816	3,563
	3	0.124	541	0.823	3,593	0.947	4,134
	4	0.142	620	0.954	4,165	1.096	4,785
	5	0.163	712	1.106	4,829	1.269	5,541
1965 . . . . .	1	0.100	491	0.657	3,224	0.757	3,715
	2	0.124	608	0.824	4,043	0.948	4,651
	3	0.153	751	1.033	5,069	1.186	5,820
	4	0.189	927	1.290	6,330	1.479	7,257
	5	0.232	1,138	1.609	7,895	1.841	9,033

<sup>a</sup> Computed as the projection of the trend line for the years 1944 to 1950.

TABLE 17

*Honduras: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data . . . . .		0.355	545	0.796	1,221	1.151	1,766
1950: Computed data <sup>a</sup> .		0.298	457	0.744	1,141	1.042	1,598
1955 . . . . .	1	0.320	577	0.804	1,450	1.124	2,027
	2	0.344	621	0.867	1,564	1.211	2,185
	3	0.369	666	0.934	1,685	1.303	2,351
	4	0.395	713	1.006	1,815	1.401	2,528
	5	0.423	763	1.083	1,954	1.506	2,717
1960 . . . . .	1	0.344	730	0.867	1,841	1.211	2,571
	2	0.396	841	1.009	2,142	1.405	2,983
	3	0.456	968	1.173	2,490	1.629	3,458
	4	0.524	1,112	1.360	2,887	1.884	3,999
	5	0.601	1,276	1.576	3,346	2.177	4,622
1965 . . . . .	1	0.369	921	0.936	2,337	1.305	3,258
	2	0.457	1,141	1.175	2,934	1.632	4,075
	3	0.564	1,408	1.472	3,676	2.036	5,084
	4	0.695	1,735	1.839	4,592	2.534	6,327
	5	0.854	2,132	2.294	5,728	3.148	7,860

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.



TABLE 18

*Mexico: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		1.573	39,894	5.347	135,663	6.920	175,557
1950: Computed data <sup>a</sup> .		2.620	66,464	5.936	150,585	8.556	217,049
1955.....	1	2.814	79,245	6.411	180,540	9.225	259,785
	2	3.021	85,074	6.915	194,733	9.936	279,807
	3	3.241	91,270	7.450	209,799	10.691	301,069
	4	3.474	97,831	8.025	225,992	11.499	323,823
	5	3.720	104,759	8.637	243,227	12.357	347,986
1960.....	1	3.023	95,778	6.915	219,088	9.938	314,866
	2	3.485	110,415	8.049	255,016	11.534	365,431
	3	4.009	127,017	9.355	296,394	13.364	423,411
	4	4.606	145,932	10.851	343,792	15.457	489,724
	5	5.285	167,445	12.572	398,319	17.857	565,764
1965.....	1	3.246	115,707	7.467	266,169	10.713	381,876
	2	4.016	143,154	9.373	334,110	13.389	477,264
	3	4.957	176,697	11.741	418,520	16.698	595,217
	4	6.107	217,690	14.674	523,069	20.781	740,759
	5	7.506	267,559	18.301	652,357	25.807	919,916

<sup>a</sup> Computed as the projection of the trend line for the years 1934 to 1950.

TABLE 19

*Nicaragua: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		0.795	839	1.000	1,055	1.795	1,894
1950: Computed data <sup>a</sup> .		0.583	615	0.839	885	1.422	1,500
1955.....	1	0.626	684	0.906	990	1.532	1,674
	2	0.672	734	0.977	1,068	1.649	1,802
	3	0.721	788	1.053	1,151	1.774	1,939
	4	0.773	845	1.134	1,239	1.907	2,084
	5	0.828	905	1.221	1,335	2.049	2,240
1960.....	1	0.673	762	0.977	1,106	1.650	1,868
	2	0.775	877	1.138	1,288	1.913	2,165
	3	0.892	1,010	1.322	1,497	2.214	2,507
	4	1.025	1,160	1.534	1,736	2.559	2,896
	5	1.176	1,331	1.777	2,012	2.953	3,343
1965.....	1	0.722	846	1.055	1,236	1.777	2,082
	2	0.894	1,048	1.325	1,553	2.219	2,601
	3	1.103	1,293	1.660	1,946	2.763	3,239
	4	1.359	1,593	2.074	2,431	3.433	4,024
	5	1.670	1,957	2.587	3,032	4.257	4,989

<sup>a</sup> Computed as the projection of the trend line for the years 1931 to 1950.

TABLE 20

*Panama: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		2.943	2,357	5.126	4,106	8.069	6,463
1950: Computed data <sup>a</sup> ..		4.301	3,445	5.726	4,587	10.027	8,032
1955.....	1	4.619	4,074	6.184	5,454	10.803	9,528
	2	4.959	4,374	6.671	5,884	11.630	10,258
	3	5.320	4,692	7.186	6,338	12.506	11,030
	4	5.703	5,030	7.742	6,828	13.445	11,858
	5	6.107	5,386	8.331	7,348	14.438	12,734
1960.....	1	4.963	4,933	6.671	6,631	11.634	11,564
	2	5.720	5,686	7.764	7,717	13.484	13,403
	3	6.581	6,542	9.024	8,970	15.605	15,512
	4	7.561	7,516	10.467	10,404	18.028	17,920
	5	8.675	8,623	12.128	12,055	20.803	20,678
1965.....	1	5.329	5,974	7.203	8,075	12.532	14,049
	2	6.593	7,391	9.041	10,135	15.634	17,526
	3	8.137	9,122	11.326	12,696	19.463	21,818
	4	10.026	11,239	14.155	15,868	24.181	27,107
	5	12.322	13,813	17.653	19,789	29.975	33,602

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1949.

TABLE 21

*Paraguay: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		0.312	438	0.944	1,328	1.256	1,766
1950: Computed data <sup>a</sup> ..		0.225	316	1.348	1,896	1.573	2,212
1955.....	1	0.242	370	1.456	2,228	1.698	2,598
	2	0.259	396	1.570	2,402	1.829	2,798
	3	0.278	425	1.692	2,589	1.970	3,014
	4	0.298	456	1.822	2,788	2.120	3,244
	5	0.320	490	1.961	3,000	2.281	3,490
1960.....	1	0.260	454	1.570	2,743	1.830	3,197
	2	0.299	522	1.828	3,194	2.127	3,716
	3	0.344	601	2.124	3,711	2.468	4,312
	4	0.396	692	2.464	4,305	2.860	4,997
	5	0.454	793	2.855	4,988	3.309	5,781
1965.....	1	0.279	557	1.696	3,385	1.975	3,942
	2	0.345	689	2.128	4,247	2.473	4,936
	3	0.426	850	2.666	5,321	3.092	6,171
	4	0.524	1,046	3.332	6,651	3.856	7,697
	5	0.645	1,287	4.156	8,295	4.801	9,582

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 22

*Peru: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		0.991	8,256	2.492	20,763	3.483	29,019
1950: Computed data <sup>a</sup> ..		1.130	9,413	2.721	22,666	3.851	32,079
1955.....	1	1.214	10,774	2.939	26,084	4.153	36,858
	2	1.303	11,564	3.170	28,134	4.473	39,698
	3	1.398	12,407	3.415	30,308	4.813	42,715
	4	1.498	13,295	3.679	32,651	5.177	45,946
	5	1.605	14,244	3.959	35,136	5.564	49,380
1960.....	1	1.304	12,331	3.170	29,976	4.474	42,307
	2	1.503	14,212	3.690	34,893	5.193	49,105
	3	1.729	16,349	4.288	40,547	6.017	56,896
	4	1.987	18,789	4.974	47,034	6.961	65,823
	5	2.279	21,550	5.763	54,495	8.042	76,045
1965.....	1	1.400	14,106	3.423	34,490	4.823	48,596
	2	1.732	17,452	4.296	43,286	6.028	60,738
	3	2.138	21,542	5.382	54,229	7.520	75,771
	4	2.634	26,540	6.726	67,772	9.360	94,312
	5	3.237	32,616	8.389	84,528	11.626	117,144

<sup>a</sup> Computed as the projection of the trend line for the years 1925 to 1950.

TABLE 23

*Uruguay: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data <sup>a</sup> .....		6.828	16,251	15.921	37,892	22.749	54,143
1950: Computed data <sup>b</sup> ..		6.545	15,577	12.648	30,102	19.193	45,679
1955.....	1	7.029	17,713	13.660	34,423	20.689	52,136
	2	7.546	19,016	14.735	37,132	22.281	56,148
	3	8.096	20,402	15.873	40,000	23.969	60,402
	4	8.679	21,871	17.100	43,092	25.779	64,963
	5	9.294	23,421	18.403	46,376	27.697	69,797
1960.....	1	7.553	20,144	14.735	39,298	22.288	59,442
	2	8.705	23,216	17.151	45,742	25.856	68,958
	3	10.014	26,707	19.933	53,161	29.947	79,868
	4	11.506	30,687	23.121	61,664	34.627	92,351
	5	13.201	35,207	26.738	71,444	39.989	106,651
1965.....	1	8.109	22,900	15.911	44,933	24.020	67,833
	2	10.033	28,333	19.971	56,398	30.004	84,731
	3	12.383	34,970	25.018	70,651	37.401	105,621
	4	15.256	43,083	31.266	88,295	46.522	131,378
	5	18.751	52,953	38.994	110,119	57.745	163,072

<sup>a</sup> Estimates.

<sup>b</sup> Computed as the projection of the trend line for the years 1925 to 1949.

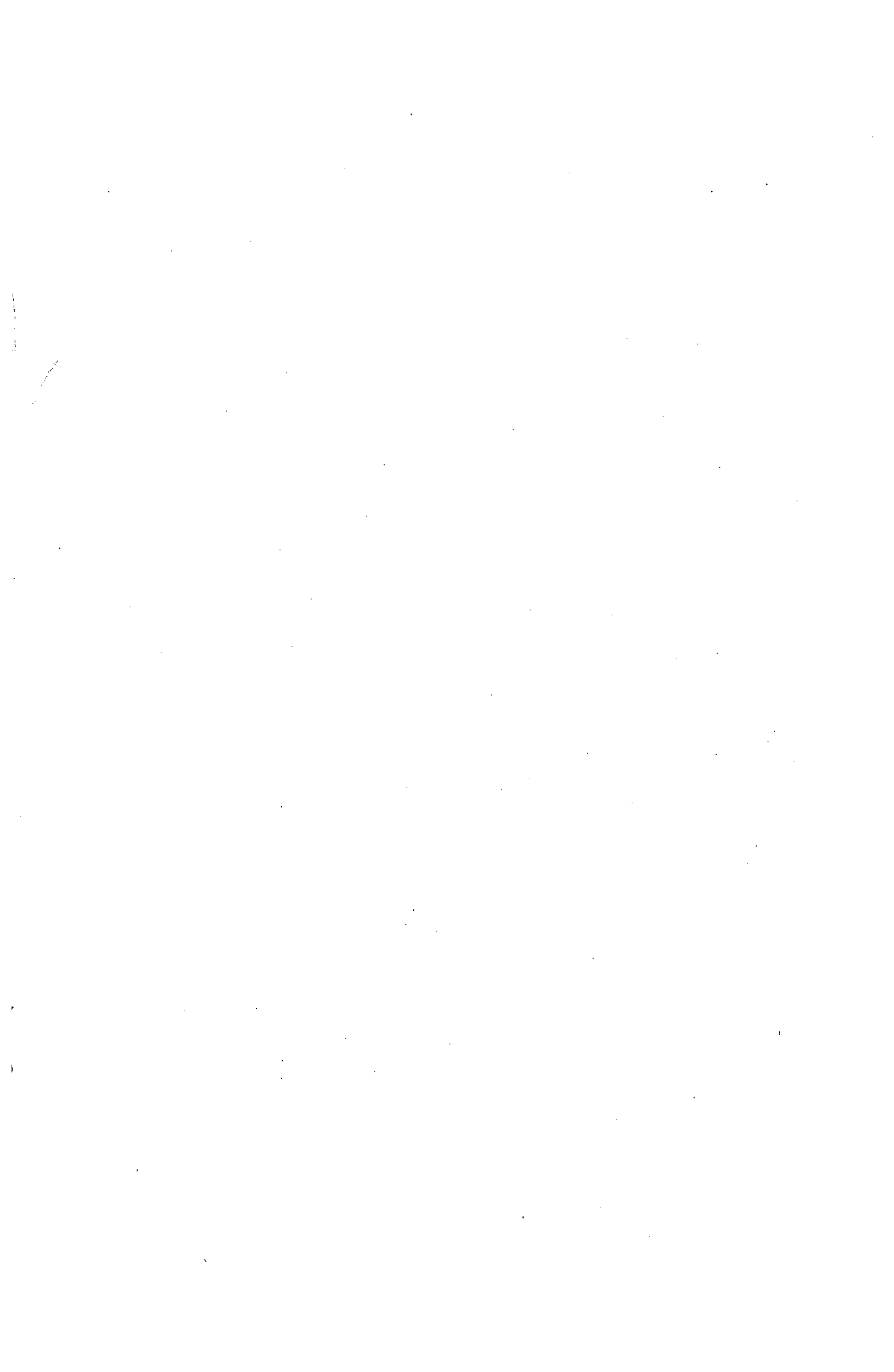
TABLE 24

*Venezuela: Estimates of future consumption of paper and paperboard*

	Rate of increase of per capita income (in %)	Newsprint		Other paper and paperboard		All papers and paperboard	
		Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)	Per capita (kgs.)	Total (tons)
1950: Actual data.....		2.239	10,525	8.484	39,873	10.723	50,398
1950: Computed data*..		2.080	9,776	7.106	33,401	9.186	43,177
1955.....	1	2.234	11,722	7.674	36,068	9.908	47,790
	2	2.398	12,582	8.278	38,907	10.676	51,489
	3	2.573	13,501	8.918	41,915	11.491	55,416
	4	2.758	14,471	9.607	45,153	12.365	59,624
	5	2.954	15,500	10.268	48,260	13.222	63,760
1960.....	1	2.400	14,066	8.278	43,435	10.678	57,501
	2	2.766	16,212	9.636	50,561	12.402	66,772
	3	3.182	18,650	11.199	58,761	14.381	77,411
	4	3.657	21,434	12.990	68,159	16.647	89,593
	5	4.195	24,587	15.051	78,973	19.246	103,560
1965.....	1	2.577	16,870	8.939	58,515	11.516	75,385
	2	3.189	20,875	11.220	73,446	14.409	94,321
	3	3.935	25,759	14.056	92,011	17.991	117,770
	4	4.848	31,735	17.566	114,987	22.414	222,107
	5	5.959	39,008	21.908	143,410	27.867	182,418

\* Computed as the average of 1947-1950 data.







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