CHILE

POTENTIAL PULP AND PAPER EXPORTER

Pulp and Paper Advisory Group for Latin America

(Economic Commission for Latin America, Food and Agriculture Organization, and Technical Assistance Administration)

UNITED NATIONS
Santiago, Chile,
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INTRODUCTION AND ACKNOWLEDGMENTS

The following study deals with the technical and economic possibilities for the establishment of a pulp and paper export industry in Chile as one of the links in a regional development plan to secure future supplies of paper products for Latin America. It was undertaken at the request of the Government of Chile and the Corporación de Fomento de la Producción.

In the preparation of the supporting background material, contained in the Appendices to the report, great assistance was rendered by the Corporación de Fomento. The Advisory Group wishes to express its sincere gratitude for their invaluable help and co-operation to this Organization and its staff in general, and in particular to:

Mr. Luis Adduard, General Manager, and
Mr. Patricio Asenjo, Industrial Division, who
collaborated in the greater part of the study.

Since the general conclusion reached is that conditions in Chile are favourable to the creation of an export industry which would be of great benefit to the country, it is hoped that the report, which is hereby respectfully submitted, may be useful in planning future development.

Arne Sundelin
Chief, Pulp and Paper Advisory
Group to Latin America

NOTE

Throughout the report an exchange rate of 500 Chilean pesos to 1 US dollar is used.

Nevertheless, at the time of going to press, the purchasing power of the peso is equivalent to a exchange rate of 700. The calculations are not materially affected by this, since the increase in th exchange rate corresponds approximately to the rise in the domestic costs during this period (inflatio rate June 1956 to June 1957 has been approximately 37 per cent).

Ton always refers to metric tons, unless otherwise stated.

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PREFACE TO SECOND EDITION

The present text of the report "Chile - Potential Pulp and Paper Exporter" is a practically unchanged version of the first edition published in August 1956. Apart from the correction of errors, only minor changes have been made in the text.

In view of the suggestions and criticism received after publication of the first edition and the changes in conditions which have occurred in the past year, it was considered necessary to make some additional clarifications and comments in order to bring the report up to date. In most cases time has not permitted changes to be made in the main text and the various aspects are therefore dealt with below in the order in which they appear in the report itself.

The international pulp and paper market (Chapter I)

In the past year demand has continued to rise at approximately the rate indicated in the report. The rapid expansion of production capacity, mainly in North America but also in Northern Europe, has gradually brought about a situation with a slight excess of production over consumption. Further capacity increases will be realized at the end of the current year and in 1958 and it is expected that production will continue to outstrip demand for some time to come. This situation will probably be temporary, provided that no major recess in the current economic development takes place, and there are no indications that the long-term trend with increasing supply difficulties for the deficit regions, as outlined in the report, will change.

The report's conclusion that the rate of increase in regional capacity does not keep pace with the rising demand is confirmed. In the case of newsprint the estimated additional capacity of 180,000 tons in 1958 will not be reached as the latest information indicates a net gain of only 145,000 tons, distributed as follows:

Chile	55,000 tons
Colombia	30,000 "
Cuba	30,000 "
Mexico	30,000 "
	145,000 tons

The Argentine project with a capacity of 30,000 tons will be delayed because of the lack of foreign exchange and one of the projects in Mexico (30,000 tons) will not go into production until 1959. On the other hand, it has been announced that a 30,000 ton mill in Cuba will be ready for operation in 1958. As a result it is estimated that the region's import requirements will remain unchanged in 1958 but will then increase by some 100,000 tons in 1960 and 485,000 tons in 1965; this means that they will reach a total of more than 900,000 tons in the last year, unless further expansion of the industry is realized.

A lag in the development rate for the production of other papers and boards similar to that for newsprint is likely to occur as a result of the foreign exchange situation in Argentina. This is especially true for the period up to 1960, in which year the regions import requirements will increase from the present figure of about 200,000 to an estimated 450,000 tons. There is thus ample confirmation of the need for determined efforts to expand production facilities, especially in Argentina, which accounts for about one-third of the region's consumption.

As regards the situation in Chile there will also be a delay in the development programme. The newsprint mill at San Pedro did not start operations until the second quarter of the current year and the pulp mill at Laja (project 2) is not expected to be finished until the middle of 1958. The project of Empresa Nacional de Celulosa S.A. (project 3) is also delayed and cannot be taken into consideration as a supply source before 1960. The plans of Celulosas Chile S.A. (project 4) are, however, to-day more definite with a project for a pulp mill of some 200-250 tons per day which may be completed in 1960/61. As a result, the export surplus of some 100,000 tons of pulp envisaged for the year 1958 will not be realized until 1960 or 1961.

World market prices of pulp and paper have remained fairly stable in the past year with a slight increase for newsprint, other papers and bleached pulp, whereas in the case of unbleached sulphite a slight downward trend has been noted in the second quarter of 1957 as a result of the current surplus situation. There are no signs indicating that major changes will take place in the near future and the slow rise in the price level recorded since the second half of 1953, as a result of increasing production costs, will probably continue at about the same rate.

Pinus radiata – pulpwood supply and cost (Chapter II)

The comments which were received dealt essentially with three aspects - potential yields from the existing plantations, wood transport costs and marketing possibilities for lumber.

As to the question of yields it has been pointed out that,

(a) the site class system used by CORFO in their inventory is unfortunate since less than 2 per cent of the plantation area falls into classes I and II and 98 per cent in the three remaining classes. A class system similar to that currently used in New Zealand with only three classes and a more even distribution between the classes would have been more adequate and facilitated the comparison of yields in the two countries;

(b) some areas of very poor soil and growth near Canteras are included in the inventory. They are not typical and should not have been planted;

(c) in calculating actual volumes, only the trees with a diameter of more than 5 inches at breast height were included.

The classification system used and the fact that unsuitable areas are included in the inventory do not affect the yields from existing plantations but may give a misleading picture of the future potential. On the other hand, the exclusion of small size trees, results in a conservative estimate of the yields, which thus are somewhat higher than indicated in the report.

The calculations of economic yields from the plantations suggested that in the case of plantations belonging to site classes IV and V a policy should be adopted with short rotation periods and clear cutting at the age of maximum economic return. As a result, it was recommended that those areas should be set aside for the production of pulp-wood only and that no thinning or pruning of these stands should be undertaken. It has been pointed out that such a policy may increase the damage from insects, fungi and fire. Obviously, the recommendation should therefore be provisional, i.e. such sylvicultural measures should be undertaken as to reduce those risks but *not* with a view to producing sawtimber since the stumpage value of the trees which are allowed to grow into sawtimber dimensions in these site classes will be much too high.

Regarding transport costs for pulpwood it seems likely that the calculations in the report are somewhat optimistic for two reasons; under present road conditions the assumed average driving speed of 30 kms per hour is probably too high and the estimated cost of road building may be on the low side. It has been suggested that an average trucking speed with load of 20 kms per hour would be a more realistic figure. On the other hand, the time allowance for loading and unloading is ample, provided modern equipment and methods are used. The combined effect of these factors may result in transport costs which are somewhat higher than estimated but the increase would not be large enough to have any significant influence on the price of wood delivered at the factory. In this context it should also be kept in mind that the stumpage values indicated in the report, are on the high side as they are calculated with a 10 per cent profit on plantation investments. This is demonstrated by the fact that the current price for pulpwood is 1,400 pesos per m^3 at roadside which gives an estimated net stumpage value of about 600 pesos as compared with a calculated weighted average of 900 pesos in the report.

The most controversial point in the report is the estimate of potential markets for Insignis pine lumber which is generally considered too pessimistic. Available data on local consumption and the export trends do not support a more optimistic view at present. It has been claimed, however, that the market and demand for this lumber could be considerably expanded by an improvement of the quality through better grading, sorting, *et cetera*. Further measures which may raise the domestic consumption include the eventual adoption of a housing development programme in the country based on an increased utilization of wood.

None of these measures is, however, likely to have any significant influence on the market in the period before 1960 as a quality improvement of the lumber, such as would be required by the export

market, would also depend on sylvicultural measures which could only have a long-range effect. In 1965, the sawtimber availability will outstrip, by three times, the demand as estimated in the report -a margin which must be considered large enough to cover the possible increases in requirements. The conclusion is therefore that the calculated potential availability of pulpwood in the year 1965 -about 135 million cubic feet- is not likely to be affected by an increase in the demand for sawtimber. It is expected, however, that this question will be further analysed at the end of this year by a special study of a FAO expert on the marketing of lumber.

Other raw materials and problems (Chapter III)

No additional information has been received as regards supply of chemicals and fuels. Prices have increased during the year -for fuel oil as a result of the Suez crisis and for coal and domestically produced chemicals because of the general inflation in the country. (See also chapter V, Investment and production costs).

The prospects for an improvement in the electric energy supply situation are today better than last year as a result of the recently authorized increase of the rates. It may thus be expected that the installation of new generating capacity will be encouraged. Also, Chile has recently received a loan from the International Bank for the development of hydro-electric resources. These changes in the situation over that of last year have been introduced in annex V, which has been modified accordingly. The need for additional measures to secure a satisfactory development should, however, be stressed -in particular, an amendment of the law governing the rates and which would allow a larger re-investment of profits.

The fresh water supply and effluent disposal problems -both deciding factors in the locating of new mills- have not been further investigated and the need for reliable information about those problems should again be stressed.

The transport problem (Chapter IV)

It has not been possible to obtain additional information about developments in the transport sector. As pointed out in the report, an improvement in the existing conditions is necessary to secure a rapid expansion of the industry. An analysis of the transport problems inside the plantation area and for the shipment of finished products is therefore required in order to assess the industrial development prospects.

The transport situation, together with the problems of water supply and contamination -apart from wood availability- are the main factors to be considered in selecting potential mill sites. To help the Government in assessing these locational problems, both for immediate and future developments, FAO has assigned to the country an expert in this field, who is at present working in close collaboration with the Corporación de Fomento. His study will be finished at the end of this year and will no doubt be of great value as a follow-up of the present report.

Investment and production costs (Chapter V)

In the year since the publication of the first edition of this report the cost of pulp and paper machinery has increased by some 10 to 15 per cent, depending on the country of origin. During the same period construction costs in local currency have increased by 25 to 30 per cent; nevertheless as the dollar exchange rate has meanwhile increased by about 30 per cent the construction cost in terms of dollars has in fact remained unchanged over the year. As the foreign exchange part accounts for some 70 per cent of the total investment it may thus be estimated that the capital requirements indicated in the study will have increased by some 7 to 10 per cent as of today.

It has been pointed out that some of the investment figures indicated for the separate mill sections are out of line and should be corrected. This refers particularly to the costs for the electrolytic plants and the steam and power stations, which are both estimated on the low side for the small mill

units but are too high for the larger plants. If corrected, these figures would tend to increase the price differences between mills of different capacities, but would not be large enough to have any significant influence on the production costs as calculated in the report. Undoubtedly, the estimates of investments in other mill sections should also in some cases be corrected, but it is nevertheless believed that the aggregate capital requirements, with the proper price adjustments indicated above, are accurate enough for the purpose of estimating production costs.

Raw material costs have increased over the year but the price movements have not been consistent; thus, while the prices of coal and fuel oil have been approximately doubled the cost of saltcake has remained virtually unchanged. It may be estimated that the net effect of the price adjustments is a 30 per cent rise in the cost of raw materials calculated in local currency, i.e. the price level has remained approximately unchanged in terms of dollars. The same also applies to operating costs and overheads; labour wages and salaries have increased by some 30 to 32 per cent (local currency) while repair materials and plant supplies may have increased by 10 to 15 per cent (in dollars).

Up-to-date information on prices of various raw materials, wages, et cetera, has been obtained from one of the groups currently engaged in projecting a new pulp mill. It has been considered of interest that this information from an independent source should be made available to readers and it is therefore, included as an additional annex to the report (see annex X).

Since capital charges account for approximately 40 to 50 per cent of the total production costs it may be estimated that these will have increased by some 3 to 5 per cent as a result of the 7 to 10 per cent rise in capital requirements.

The combined effect of the price movements over the year on production costs has been estimated at approximately 5 per cent. In medium-sized mills this increase corresponds to about 4 dollars for unbleached pulp, 5 dollars for bleached pulp and newsprint and some 8 to 10 dollars for papers -a rise in production costs which corresponds approximately to the increases over the year in the international prices of these products.

Economic evaluation of the projects and an over-all assessment (Chapter VI)

In the year that has passed since the publication of the first edition of this report no significant changes have taken place which warrant a re-assessment of the development possibilities for a pulp and paper industry based on the wood from the Insignis pine plantations nor of the economic prospects for this industry. On the other hand, only limited progress has been made towards the implementation of a development programme. The various recommendations made in the report with a view to encouraging industrial development should therefore once again be stressed, in particular those which refer to the attraction of foreign capital, without which a rapid expansion cannot be achieved.

AIM AND SCOPE OF THE STUDY

The aim of the following report is to establish, in general terms, the technical and economic possibilities for the development of a pulp and paper export industry in Chile. It must be emphasized that the study is of a general character, and cannot be used for the final appraisal of specific mill projects, which must be evaluated according to their individual merits. Such evaluation is a long and costly process, requiring detailed investigation of alternative mill sites, etc., and is thus outside the scope of the present report.

As regards development prospects, it must first be asked whether a market for pulp and paper produced in Chile already exists or whether it could be developed in the near future and what its size is likely to be. To answer this question, a special analysis has been made of developments in the different regions of the world during the post-war period (1948-55). It includes forecasts of future demand, based partly on previous estimates from different sources, which have, however, been revised in the light of later developments, and partly on a new technique which slightly deviates from standard methods. The market study is included in annex I to the report and is briefly summarized in chapter I of the main text.

It was clear even at a preliminary stage that of the country's potential fibrous resources the plantations of Pinus radiata in the southern part of Central Chile offered by far the best prospects, not only for technological reasons -the prevalence of a single species with long fibres- but also from an economic point of view. Furthermore, the amount of wood which these plantations will produce in the future is large enough to support a greater industrial capacity than is likely to be established in Chile within the next 10 years. Discussion has therefore been confined to pulp and paper production based on this raw material, and does not take into account the potential resources of the natural forests in the south of the country.

The fibrous raw material situation is analysed in detail in annex II, which is divided into three parts, dealing respectively with the forest inventory, the probable cost of pulpwood and prospective future yields. This annex is summarized in chapter II.

Since the availability of pulpwood depends on what percentage of the total yield from the plantations will be diverted to the production of sawn goods, annex III contains a short review of the marketing possibilities for lumber from Pinus radiata.

Chapter III, which deals mainly with the availability and cost of chemicals and fuels, includes a paragraph on the problem of fresh water supply, since, in many cases, this is likely to present difficulties and limit the choice of alternative mill sites.

The greatest obstacle to a large-scale development of the pulp and paper industry is the country's transport situation, to which some general consideration has been given in chapter IV and annex VI. Needless to say, this report cannot indicate ways or means of solving the problem, a task which must be undertaken in a broader context; it merely serves to indicate the magnitude of the problem and to add the warning that detailed investigations are necessary for each project and mill site.

Chapter V summarizes the calculations of investment and production costs for sixteen mill projects of different capacity, and producing different qualities of pulp and paper. The estimates have been made for the following purposes:

(a) to determine the minimum economic mill unit for each product;

(b) to indicate the capital requirements for a new project; and

(c) to serve as a basis for the economic evaluation of individual projects, as well as for the overall assessment of development prospects and their economic implications, contained in chapter VI, which evaluates such possibilities, both from the private investors' and from the national viewpoint.

In order to preserve a logical sequence in the main text, it has been kept intentionally short, and side issues have as a rule been avoided. In few cases only has reference been made to details in the annexes, which should be considered as separate, and, in most cases, enlarged chapters containing the supporting data.

CHAPTER I

THE INTERNATIONAL PULP AND PAPER MARKET

1. During the last decades, the world market for pulp and paper has perhaps experienced more violent and frequent fluctuations, both in the balance of supply and demand and in the price level, than any other. There are two main reasons for this instability. First, the consumption of paper and board is a sensitive indicator of a country's cultural, economic and industrial activities; and, secondly, while international trade in these commodities is but marginal in relation to total production and consumption in Europe and North America, these marginal quantities account for a large share of consumption in the deficit regions. As a result, small variations in the domestic markets of Europe and North America have far-reaching consequences on the international paper trade.

2. Two other factors further aggravate the short-term price fluctuations; when the world economy is expanding and marginal export availabilities are small, ocean freight tariffs tend to increase; and, at the same time, importer countries, for fear of supply difficulties and further price increases, often make speculative stock purchases, which give additional momentum to the price movement.

3. Far more dangerous and disquieting for such importer countries than the short-term price fluctuations on the world pulp and paper market is the uncertainty of supply over the long-term. This problem has in recent years commanded increasing attention from both national and international bodies, especially the United Nations and its specialized agencies, which have emphasized in several studies the threat inherent in the long-term supply question.

4. The present study amply confirms the seriousness of this problem. In fact, the estimates of future demand, revised in the light of recent developments on the international market, indicate that consumption will probably rise faster than was predicted in earlier forecasts. More energetic efforts must therefore be made to develop regional resources in the deficit areas with a view to avoiding a depressed paper consumption, incommensurate with cultural and economic standards. The situation in the different regions, as predicted in annex I, is briefly reviewed below.

1. North America

5. During the period 1948-55, newsprint consumption increased by a little less than 1.3 million tons from below 5 million tons in 1948 to over 6.2 million in 1955- which represented an annual increment of slightly under 3 per cent. In the same period production expanded by almost 2 million tons and export availabilities from 50 thousand tons to 750 thousand tons per year. In 1955-65 demand is expected to grow more slowly than in 1948-54, at a rate of 2.7 per cent as against the historical rate of 3.3 per cent annually. Total consumption is estimated at 6.8, 7.1 and 8.1 million tons for the years 1958, 1960 and 1965, respectively. By 1958, current plans for the expansion of the industry will have raised annual production by more than 1 million tons, which means that the exportable surplus may amount to some 1.2 million tons in the same year.

6. Production and consumption of paper and board other than newsprint has fluctuated considerably in the post-war period, bearing out the contention that paper consumption is a sensitive index of a country's economic situation. From 1948 to 1955, the volume of yearly demand rose by almost 5.5 million tons, or an annual increment of about 3.6 per cent, reaching 25.4 million tons. Production has approximately balanced consumption, leaving a net export availability of some 225 thousand tons as an average for the year 1948-54. The demand forecast indicates that consumption will increase by some 3.5 per cent annually, attaining 27.75, 29.9 and 36 million tons in the years 1958, 1960 and 1965, respectively. Existing plans for the development of the industry will not meet the expected expansion of demand, and the present net export availability will probably disappear in 1958.

7. Before the war North America imported a net quantity of more than 1 million tons of woodpulp annually from Europe. In the period 1948-50 this dependence on imports was reduced to an average of 450 thousand tons, and by 1955 it had been converted into an exportable surplus of some 750 thousand. Unfortunately, no data on future expansion plans were available, but it seems likely that North America

will maintain or even increase its present net exports during the next few years. On the other hand, the long-term trend will undoubtedly take the form of a decline in export availabilities, mainly as a result of inadequate wood supplies, but also because the North American industry will probably be reluctant to make substantial additions to its production capacity for the sake of exports to deficit regions where from time to time dollar shortages may cause changes in the import policy.

8. The situation in North America may be summarized as follows: a) it is likely that the export availability of newsprint in the region will expand considerably in the next few years and approximately balance the growing deficits in the other regions; b) production of other papers and boards will cover the internal demand but net exports will probably disappear; c) the present export availability of wood pulp is likely to be maintained. The long-term trend, however, indicates that North America -as the only surplus region- will not be in a position to cover the increasing deficits in the other regions.

2. Europe 1/

9. As a result of the changes in Europe's economy during and immediately after the war, production and consumption of newsprint declined sharply from the pre-war level -production 2.6 and consumption 2.4 million tons- and not until the year 1954 did the market regain its 1937 tonnages. Since the population has increased by some 10 per cent as from this year, it follows that per capita consumption is still depressed, and is likely to rise at a faster rate than would normally be expected from the increase in per capita income. The demand forecast shows an annual increment in total consumption of 6 per cent for the period 1955-1965 as against a historical rate of 11 per cent in the years 1948-55. Consumption is thus estimated to rise from 2.64 million tons in 1955 to 3.45 in 1958 3.85 in 1960 and 4.7 million tons in 1965. Present expansion plans, as quoted in different sources, indicate that by the year 1958 production will increase by some 550 thousand tons per annum as compared to an estimated consumption increase of 810 thousand tons. The 1955 export surplus of 170 thousand tons is thus likely to become a net import requirement of some 100 thousand tons, an estimate which for several reasons may be on the low side.

10. Production and consumption of papers and boards, other than newsprint, have more than doubled in the 7-year period 1948-54. Production increased from 4.84 to 10.64 and consumption from 4.35 to 9.80 million tons, while the export availability increased during the same period from about half a million tons to a little more than 800 thousand. Demand is estimated to rise by 55 per cent between 1955 and 1965 which corresponds to an annual increment of 4.5 per cent as compared to more than 12 per cent in the years 1948-54; thus a considerable slow-down in the consumption increase rate is foreseen. It is, nevertheless, higher than previous forecasts made by the United Nations and other bodies which -as demonstrated by developments in the 1950-55 period- underestimated the increase in consumption. As a result, a more pessimistic view must be taken than previously expressed on Europe's possibilities of satisfying her own demand and at the same time maintaining the present export level. No reliable data are available on the industrial expansion, but estimates indicate that the forest increment in Scandinavia may support an additional pulping capacity of some 1.5 million tons. Assuming that an additional quantity of half a million tons could be produced in the rest of Europe, the total increase of 2 million tons would be sufficient to produce about 600 thousand tons of newsprint and some 2 million tons of other papers and boards. If this capacity increase actually takes place within the next five years, by 1960 Europe's present export surplus of about 800 thousand tons of papers and boards (except newsprint) would still become a net import requirement in excess of half a million tons, an estimate which presupposes that the net export of pulp is maintained at the 1954 level of 200 thousand tons per year.

11. Annual exports of woodpulp from Europe decreased by more than 1 million tons from 1937 to 1948, and in the post-war years the amount has remained relatively stable at some 700 to 900 thousand tons, while imports from North America have increased by more than 300 thousand tons. Net exports have, as a result, decreased from a pre-war level of more than 1.6 million tons to only 200 thousand tons in 1955. An interesting aspect of Europe's pulp and paper exports is the change in proportion which has taken place between the two items; thus, while pulp accounted for almost 65 per cent of the net exports in 1937-1938, it had decreased to only 20 per cent in 1954. There is every reason to believe that the tendency towards integration of pulp with paper production, which is the background for this change in exports, will continue, and the export surplus of pulp will gradually disappear.

1/ *All figures exclude Eastern Europe and the U.S.S.R.*

12. To sum up the European supply and demand situation; it seems likely that, by 1960, the present net export surplus of 170 thousand tons of newsprint will change to a net import requirement of some 100 thousand tons, the surplus of other papers and boards, 800 thousand tons, will disappear and Europe will depend on imports from North America for half a million tons of her supply if pulp exports are to be maintained at the present level. Developments after 1960 are difficult to assess but there is little doubt that Europe may have serious difficulties in satisfying a demand for paper products commensurate with the economic and cultural level in the region.

3. Latin America

13. Annual consumption of all papers and boards in the region is today slightly over 1.5 million tons, of which newsprint accounts for a little over 500 thousand. Some 450 thousand tons of newsprint and about 200 thousand tons of other papers and boards are imported, corresponding to 43 per cent of the total consumption. In addition, import requirements of pulp amount to approximately half a million tons per year -more than 50 per cent of the total requirements of the local industry. Demand is expected to rise sharply; newsprint consumption is estimated at 775 thousand tons in 1960 and 1.5 million tons in 1965, other papers and boards at 1.63 and 2.24 million tons, respectively, i.e. a combined annual increment of 8 per cent as compared to about 3 per cent in the period 1948-54. This increase in consumption rate is mainly accounted for by an expected rise in demand in Argentina where consumption has been highly depressed.

14. Additional capacity, planned and likely to be constructed before 1960, does not exceed 500 thousand tons per annum, which means that the present deficit in domestic supply of some 650 thousand tons will increase to 850 thousand in 1960 and not less than 1.8 million tons in 1965, of which newsprint will account for 550 and 930 thousand tons respectively. Since it is unlikely that these additional quantities will be available from North America and Europe, or that Latin America can afford to spend foreign exchange on paper imports, mainly in dollars, amounting to some 330 million dollars (1955 prices) per year by 1965, the unavoidable conclusion is drawn that unless the regional capacity is expanded at a much faster rate than is at present envisaged, Latin America will suffer a high degree of deferred consumption, detrimental to both economic and cultural development.

15. Assuming that imports of pulp and paper could be maintained at the present level and that local paper production is expanded to satisfy the balance in demand, the requirements of pulp, mechanical and chemical, would increase over the 1955 level by 560 thousand and 1.5 million tons in the years 1960 and 1965, respectively -approximately half of each quality. Aggregate expansion plans for the industry in 1954 comprised 190 and 580 thousand tons of mechanical and chemical pulp, including general objectives which had not yet been studied as to feasibility. Should these plans be implemented to their full extent, Latin America would by 1960 have reduced the import dependency to some 200 thousand tons, a quantity which -due to the expected rise in demand between 1960 and 1965- would again increase to an aggregate of more than 1 million tons in the latter year. As it is unlikely that all the projects will be realized, the deficits quoted here are probably on the low side. In addition to the supply difficulties which this quantity is likely to impose, Latin America's heavy dependency on the marginal markets of Europe and North America (before the war one third of the combined exports to deficit regions, two thirds in the post-war years) obviously places this region in a precarious situation during periods of scarce supply, and strong efforts should be made to reduce the risk by developing local production facilities.

4. Chile

16. Since the present report deals with the development prospects in Chile, special mention should be made of the consumption trends and expansion plans in this country. In the post-war period consumption of newsprint as well as of other papers and boards has remained practically unchanged, except for year to year variations. One of the explanations of this fact probably resides in foreign exchange restrictions applied to these items and, as a result, the country has today a depressed consumption in relation to per capita income. Consumption of newsprint is slightly over 20 thousand tons, and other papers and boards 40 thousand, which correspond to a per capita consumption of 3.7 and 6.2 kilogrammes per year. Future demand is estimated to rise to 39 and 50 thousand tons of newsprint in 1960 and 1965 respectively,

and to 61 and 77 thousand tons respectively of other papers and boards. Except for a quantity of some 10 thousand tons of imported newsprint the supply is met by local production, which, however, depends on imports of chemical pulp. Expansion plans for the industry include three mills, at present under construction, a newsprint mill with a rated capacity of about 50 thousand tons, a kraft pulp mill with an annual capacity of some 70 thousand tons and a small sulphate pulp mill with an estimated annual production of some 7 thousand tons. In addition there is a project under serious consideration for a pulp mill with an annual capacity of some 70 to 90 thousand tons. Taking those projects into consideration, by 1960 Chile will have an export surplus of about 10 thousand tons of newsprint and some 95 thousand tons of chemical pulp, an estimate which presupposes that the existing production capacity for newsprint is converted to the production of other papers. As will be seen later in the report, however, the potential prospects are far in excess of the development plans.

5. The other deficit regions

17. No special study of the situation in the other deficit regions has been made for this report, and the demand forecast below is taken from a report on the world situation prepared by the United Nations in 1953 2/. According to this report the total average consumption in the years 1950-52 was close to 1.8 million tons of papers and boards of which about 480 thousand tons were newsprint; these figures exclude Japan and Mainland China. The tacit assumption was that these two countries will be able to meet their own rising needs. Of the total consumption some 1.2 million tons i.e. about two thirds were imported. Demand was expected to increase in the period 1950-52 to 1960-62 by 68 per cent for newsprint and 59 per cent for other papers and boards, to 800 thousand tons and 2.1 million tons, respectively. Development plans fell short of expected consumption increase by a little over 100 thousand tons of newsprint and some 225 thousand tons of other papers and boards. Subsequent development in the region suggests that the assessment made above has been too optimistic; in 1954 production of newsprint had risen by only 30 thousand and of other papers and boards by 100 thousand tons. It is therefore likely that the competing claims from these regions on the export availabilities from North America and Europe will be stronger than indicated above.

6. Conclusions

18. The following main conclusions regarding the future world market in pulp and paper are drawn from the regional assessments in the preceeding paragraphs and from annex I;

a. It seems probable that the supply and demand of newsprint in the next three years will be approximately balanced. Beginning in 1958 or 59, a gradual tightening of the market will take place unless the present rate of production increase in the deficit regions is accelerated considerably. The situation will be further aggravated in the 1960-65 period, and if determined efforts are not made to secure regional supplies, consumption is likely to be highly depressed in the deficit areas.

b. The supply and demand situation for other papers and boards is more disturbing since there are indications that a world deficit situation may develop already within the next few years, again provided that regional capacity is not greatly increased. Tentatively it is estimated that there will be a world deficit of close to 1 million tons per year in 1958-59.

c. The pulp market is likely to experience more or less the same development as is the case for papers and boards other than newsprint; i.e. a deficit situation will arise during the next few years unless regional resources are created.

d. Europe will in a relatively short time change from a net exporter to deficit area, and North America alone remain as the net exporter to other regions. Consequently it may be expected that an increasing share of imports to the deficit regions will have to be liquidated in dollars, as a situation where Europe has to purchase pulp and paper from North America in order to maintain her exports to deficit areas is unlikely to continue permanently.

e. Summing up for the purpose of this report: a prospective market for pulp and paper produced in Chile already exists and is likely to expand rapidly in the coming decade.

2/ World Pulp and Paper Resources and Prospects. (World Survey) UN/FAO publication. New York 1954.

CHAPTER II

PINUS RADIATA - PULPWOOD SUPPLY AND COST

1. Location

19. The main stands of Pinus radiata plantations are found in the seven provinces of Maule, Linares, Ñuble, Bío-Bío, Concepción, Arauco and Malleco in the southern area of central Chile (see map I). These provinces lie in a central valley which runs north and south and is flanked by the Andes on one side and the Cordillera de la Costa on the other. It is on the latter, which only in a few places rises above 1,000 metres and which was once covered by native forests, that most of the plantations have been established. Other important stands are found on some alluvial terraces in the central valley.

2. Area and yield

20. The forest inventory prepared by Corporación de Fomento in 1953 shows that the area under plantation in that year amounted to about 175 thousand hectares, of which more than one third is in the province of Concepción. Considerable plantation work has been carried out in the following years and it is estimated that in 1956 the total area well exceeds 200 thousand hectares. All figures and calculations of future yields given below and in the appendices refer, however, to the plantations existing in 1953 and are therefore on the conservative side. Further, in calculating the volumes of wood only trees with a diameter at breast height of 6 inches with bark are included.

21. The volume of standing timber, calculated according to these criteria, was 9.8 million cubic metres without bark. (All figures of volumes and yields are given in solid cubic metres without bark). Of this total volume almost two thirds are contained in plantations of 10-15 years of age, and more than one third in the age group of 13-15 years. This is important to bear in mind since, as will be seen later, the age of minimum cost for the wood varies from 16 to 20 years and is 16 years for most of the plantations. Consequently, the main part of the plantations is rapidly approaching the age of maximum economic return, after which age the stumpage value of the wood will increase.

22. In the Forest Inventory the plantations have been grouped in five different categories (site classes), the classification being based on the average height at 20 years of the dominant and co-dominant trees of the stand, i.e. on the growth rate which, in turn, depends on soil conditions, climate, etc. 1/. The growth rate varies considerably between the site classes: from a maximum average annual increment of 9 cubic metres per hectare for Site V to more than 60 cubic metres for Site I. From the percentage distribution of the site classes -about 80 per cent of sites IV and V and less than 5 per cent of sites I and II- the average growth (to the year of maximum yield) for all plantations has been determined at 18.2 cubic metres per hectare and year, almost 8 times as high as in the coniferous forests of Scandinavia. (annex II, section A).

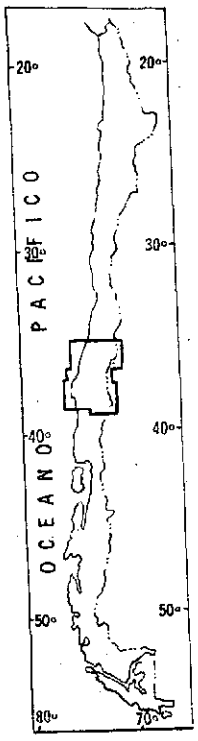
3. Stumpage value

23. To establish the probable cost of pulpwood, a calculation has been made of the stumpage values of Pinus radiata in the different site classes and at various ages. The estimate is based on the present plantation and maintenance costs and assumes that the forest owner will receive 10 per cent compound interest on his capital investment. Since the capital grows at an increasing rate each year, whereas the increment in wood volume declines after a certain age, it follows that the value of standing timber will reach a minimum point. (See figure II-1). The age when this point is reached is determined for each site class by the increment curve and the rate of interest. With 10 per cent interest, as used in the present study, the age of minimum cost is considerably lower than the age of maximum annual yield; for

1/ *For a comparison with the classification used for the Pinus radiata plantations in New Zealand see 'Preface to 2nd edition'.*

CENTRO-SUR DE CHILE: PLANTACIONES DE PINUS RADIATA
SOUTHERN PART OF CENTRAL CHILE: PINUS RADIATA PLANTATIONS
(1953)

MAPA 1
MAP. I



PINUS RADIATA

REFORESTABLE — 100% | 50%

CAMINOS — ROADS

FERROCARRIL — RAIL ROADS

ESCALA: 1 = 1.250.000

0 5 10 20 30 50 100 Km.

FUENTE: CORPORACION DE FOMENTO DE LA PRODUCCION

instance in the case of site class V, which accounts for more than 40 per cent of the total plantation area, the minimum cost will be obtained at 16 years against a final cutting at 22 years to reach maximum yield. The weighted average yield from all site classes, determined at the ages of minimum cost, is 15 cubic metres per hectare and year, against 18 when calculated at the age of maximum yield.

24. The stumpage value estimated on the basis outlined in the preceding paragraph, varies from 1 dollar per cubic metre for the combined site class I and II to 3 dollars for site V, with a weighted average of 1.79 dollars; this value is about one-fifth to one-sixth of the stumpage price of spruce and pine in Scandinavia in 1955. This low value of the standing timber, which is due to the very high growth rate of Pinus radiata in Chile, constitutes the main reason why, (as will be seen later in the report), pulp and paper can be produced in the country at prices which are competitive on the international market.

4. Cost at mill site

The aggregate cost of pulpwood delivered to a mill site comprises, apart from the stumpage price, the cost of extraction to road side, transport to the mill, and the overheads. The extraction cost, which has been estimated on the basis of actual operations, is approximately 1.60 dollars per cubic metre. Transport cost and overheads naturally vary with the size of operations and the location of the mill in relation to the plantations; for a hypothetical mill in the province of Nuble producing 250 tons of pulp per day they have been estimated at 1.60 dollars. Thus the total cost of pulpwood delivered mill site will be approximately 5 dollars per cubic metre, which is approximately one third of the cost in Scandinavia.

5. Management and future yields

25. An analysis of local consumption trends and export availabilities for sawnwoods from Pinus radiata (annex III) indicates that only a small fraction of the total availability of sawtimber, as determined in the Forest Inventory, could be marketed. In most cases thinning and pruning operations which are undertaken in order to produce more or better sawtimber is a waste of money, and it is therefore recommended that, as a general policy, plantations belonging to site classes IV and V should be reserved mainly for the production of pulpwood and clearcut at the ages of minimum stumpage value. As a consequence, it is also recommended that the planned training programme and credit facilities for better sylvicultural management of the plantations should be revised.

26. If the plantations are managed in the way described in the previous paragraph, the annual yield of pulpwood will gradually increase from about 1.3 million cubic metres in 1956 to more than 3.7 million in 1965. In addition, there is today an accumulated quantity of some 3.4 million cubic metres available from plantations which have already passed the age of minimum cost. The average quantity produced by plantations existing in 1953 is calculated at a minimum of 2.8 million cubic metres per year during the period 1956-69 (see figure II-VI) -a quantity which is sufficient for a production of some 600 thousand tons of pulp or 850 thousand of newsprint per year. There is therefore no doubt that, judged by the raw material supply, a considerable expansion of the industry over and above the present plans can take place, and should take place in the near future before the plantations pass the age of minimum stumpage value. In fact, an expansion of the pulp and paper industry seems to be the only solution by which the value of the plantations -estimated at some 60 million dollars at the present cost of planting- could be saved.

CHAPTER III

OTHER RAW MATERIALS AND PROBLEMS

1. Chemicals and fuels (annex IV)

27. In the production of pulp and paper and for ancillary processes (steam and power generation, production of caustic soda and chlorine, etcetera), various chemicals and fuels are required, the availability of which as to quality and volume should be ensured within reasonable price limits. The base chemicals for the pulping operation are:

in the sulphate process; salt cake (sodium sulphate) or common salt and sulphur and limestone, and

in the sulphite process; sulphur (or pyrites) and limestone.

These chemicals are available in Chile in sufficient quantities and with the requisites mentioned above. They are, however, not available in the pine plantation area and the regular supply does therefore involve a transport problem which must be carefully studied for each particular mill site. (See chapter IV).

28. Chile has indigenous resources of coal and the production capacity is in excess of current demand. The mines are mainly located in the coastal zone, the two most important being Lota and Coronel about 30 kilometres from the town of Concepción, and thus in the vicinity of the plantation centre. The quality is inferior, but acceptable for industrial use. Only minor quantities of oil are produced in the country and requirements are mainly imported.

29. A mill producing unbleached sulphate pulp is practically self-supporting in energy which is produced in sufficient quantity in the chemical recovery system by burning the organic material in the waste liquor. In the case of bleached pulp, various grades of paper and newsprint, however, energy must be supplied from outside, either as fuel, or electric energy or both. If fuel only is supplied, i.e. the mill produces its own electric energy, the required quantities are considerable for some of the products. Thus, about 650 kilogrammes of coal are required per ton of product in a mill producing bleached kraft papers and supplying its own needs of caustic soda and chlorine, i.e. an annual quantity of some 45,000 tons for a 200 tons per day mill unit. Here again, availability and price do not pose any problems, whereas the transport situation at present may cause difficulties for a large scale development of the industry.

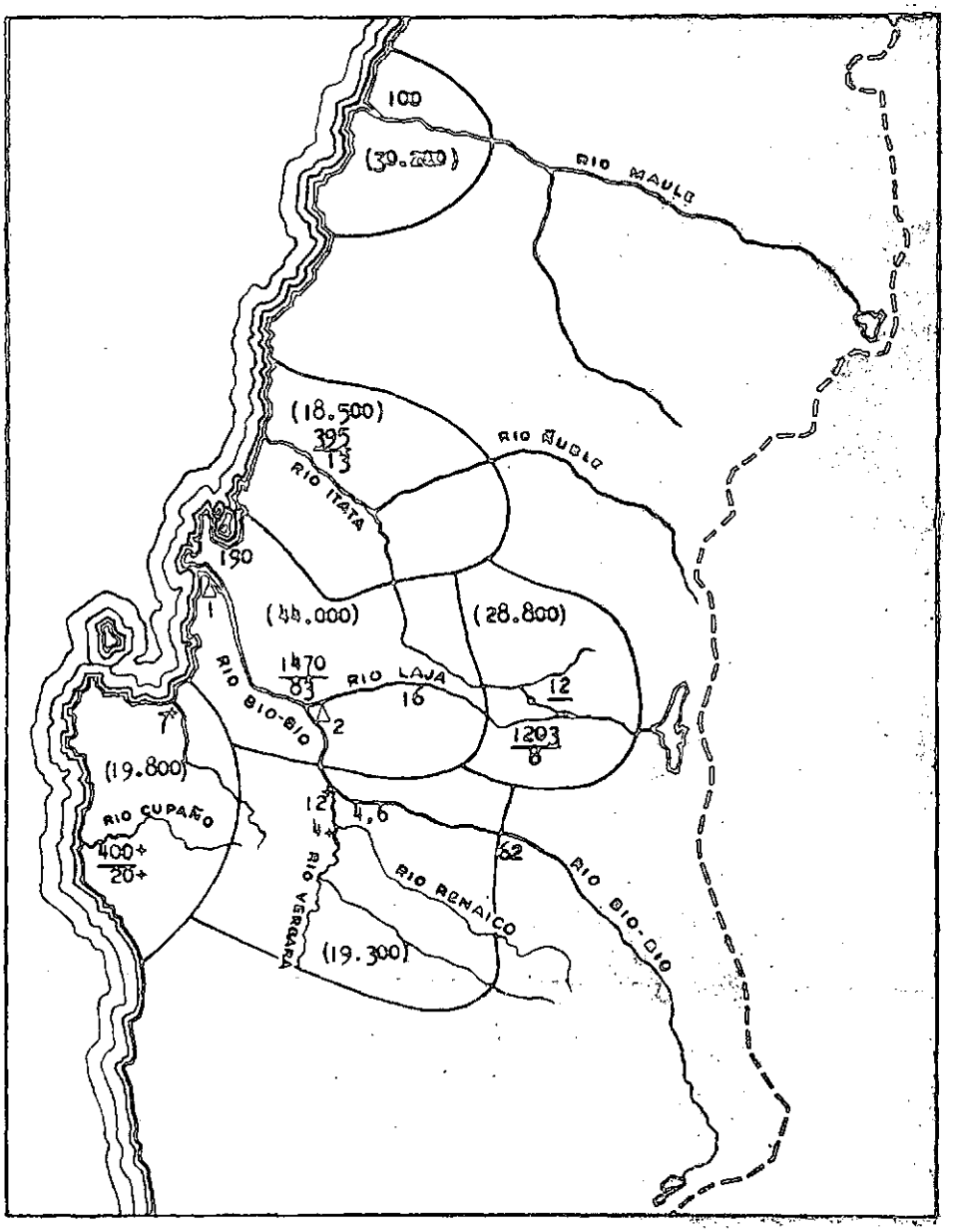
2. Electric energy. (annex V)

30. The situation as regards electric energy supply in the country today is far from satisfactory and demand is greatly in excess of existing supply possibilities; the estimated deficit in 1955 was more than 200 thousand kilowatts. The reason for the lag in capacity increase is two-fold: the law regulating the tariffs at a level of insufficient return on investments, and the scarcity of capital. Indications are that the situation will be considerably eased in the next few years as the tariff laws have recently been amended by Congress and capital could now possibly be obtained from the funds established through the Agricultural Surplus Agreement with the United States or by loans from the International Bank for Reconstruction and Development. Apart from the development planned by ENDESA (Empresa Nacional de Electricidad S.A.) which calls for an increase in generating capacity of 579 thousand kilowatts by 1964, further expansion is likely to take place in the private sector, mainly through the activities of the Compañía Chilena de Electricidad (subsidiary of the American and Foreign Power Company), who recently announced their decision to build a thermo-electric plant with a capacity of 120 thousand kilowatts, to be finished in 1959.

31. Since a pulp and paper mill, and particularly a newsprint mill, is a large consumer of electric energy -for instance, a newsprint mill with a daily capacity of 300 tons needs an electrical input of

FUENTES DE AGUA DULCE EN LA ZONA DEL PINUS RADIATA

FRESH WATER SUPPLY SOURCES IN THE PINUS RADIATA ZONE



EL GASTO MÁXIMO, m^3/SEG SE INDICA CON CIFRAS SUBRAYADAS; 20

EL GASTO MÍNIMO, m^3/SEG SE INDICA CON CIFRAS SIN SUBRAYAR; 7

LA SUPERFICIE FORESTAL EN 1953, HECTÁRES, SE INDICA CON CIFRAS ENTRE PARÉNTESIS; (18.500)

Δ FÁBRICAS EN CONSTRUCCIÓN EN 1956 : Δ_1 - 160 TON POR DÍA, PAPEL DE DIARIO

Δ_2 - 200 TON POR DÍA, PASTA SULFATO

\+ ESTIMACIÓN A BASE DE UNA SOLA OBSERVACIÓN

MAXIMUM FLOW, m^3/SEC, INDICATED BY UNDERLINED FIGURE; 20

MINIMUM FLOW, m^3/SEC, INDICATED BY PLAIN FIGURE; 7

FOREST AREA IN 1953, HECTARES, INDICATED BY FIGURE IN BRACKETS; (18.500)

Δ MILLS UNDER CONSTRUCTION 1956 : Δ_1 - 160 TON PER DAY NEWSPRINT

Δ_2 - 200 TON PER DAY SULFATE PULP

\+ ESTIMATED FROM ONE SINGLE OBSERVATION

some 23 thousand kilowatts- the investment in a thermo-electric plant is considerable but, on the other hand, the scale of operation is large enough to ensure a reasonable cost.

In view of the uncertainty of future supplies from outside, it therefore seems prudent that new mill projects should as far as possible take into consideration the development of their own electricity supply sources. In all the hypothetical projects calculated in this study provisions have thus been made for self-sufficiency in electric energy.

3. Fresh water supply and effluent disposal. (annex IV, tables IV-3 and IV-4.)

32. One of the pre-requisites for the establishment of a pulp and paper industry is the continuous access to abundant quantities of fresh water both for the production itself and for ancillary processes, such as steam generation. Some idea of the large volumes required may be given by stating that the fresh water consumption in a mill of 300 tons daily capacity producing kraft papers from its own pulp is of the order of 4,500 cubic metres per hour. The water must also meet certain specifications as to purity, differing for the various types of products, the most obnoxious contaminants being manganese and iron.

33. A problem which is equally important is the question of effluent disposal. For mills located inland there is seldom any alternative to the use of a river for this purpose and as these usually flow through inhabited areas and are used for watering cattle, washing, irrigation and so on the problem may often become serious. In many countries restrictive legislation determines the amount and quality of the effluents that may be discharged. Such laws also exist in Chile but are inadequate and do not include special regulations for pulp mills. It would thus be extremely unwise to select a mill site without first giving serious consideration to the disposal problem, or without frank consultations with the Government or such official departments as are connected with the question of river pollution.

34. If the flow of the river is large enough, the mill effluents will be sufficiently diluted to permit discharge (except when the water is used for drinking) and the minimum flow required for a sulphate pulp mill of 300 tons daily capacity is then about 20-30 cubic metres per second. Map II indicates the main fresh water supply sources in the *Pinus radiata* zone. From the figures of minimum flow indicated on the map, it will be seen that only in a few cases are the above requirements met. The conclusion is, therefore, that great care must be taken when selecting inland mill sites to ensure that the effluent disposal could be solved in a satisfactory way.

35. It is recommended that the whole problem of river pollution as a result of a pulp and paper industry development should be reviewed by the competent authorities.

CHAPTER IV

THE TRANSPORT PROBLEM (Annex VI)

36. One of the main problems in connexion with an expansion of the pulp and paper industry in the country is the lack of good transport facilities, both for the supply of pulpwood and other raw materials for the production, as well as for shipment of finished goods. The magnitude of the problem is indicated by the fact that the total tonnage to be moved daily to and from a pulp mill with a daily capacity of 250 tons is of the order of 1,500 tons and, since regular daily transport of the same tonnage is impossible to achieve, the transport system must be developed to cope with peak loads which may be considerably higher.

1. Pulpwood transport

37. Because of the relatively short average transport distances for pulpwood it is probable that the transport in most cases will be by trucks. However, in the area of the pine plantations only about 30 per cent of existing roads are suitable for traffic in all weather. Moreover, many of these roads are not in a condition to permit heavy and intense traffic. It is therefore vital to a large scale development of the industry that a good road network is constructed connecting the plantation centres with the best prospective mill sites. This road system should be developed not only to serve the existing plantations, which are relatively scattered, but should principally be planned for a future concentration of new plantations in the vicinity of possible mill locations. Such planning may be based on the method of linear programming to obtain minimum transport cost and investment.

38. Although the existing road network is insufficient and in bad condition, it is believed that the problem of pulpwood transport could be solved individually for most of the prospective mill sites since average trucking distances will be short -for a pulp mill of 250 tons daily capacity, of the order of 30-40 kilometres- and therefore costs, even under adverse conditions, not prohibitive. Considerable improvement of the public road system is also to be expected in the near future and particularly in this sector of the country as a result of the implementation of the "Agriculture and Transport Development Plan for Chile" which will be partly financed by the International Bank for Reconstruction and Development.

2. Transport of finished products

39. For an inland mill site the transport distance to port for finished goods, and to the mill for some raw materials will, as a rule, be longer than in the case of pulpwood, and rail transport with the existing freight tariffs will be cheaper than by truck. The railway situation in the plantation area is, however, somewhat similar to that of roads, the restricted load capacity being mainly due to shortage of rolling stock. In addition, some of the lines serving the plantation centre deviate from the standard gauge of the principal north-south line and re-loading of cars at the junctions will therefore be necessary. A development plan, calling for an investment of 62 million dollars and 6 billion pesos, has been worked out by the Empresa de Ferrocarriles del Estado, the implementation of which will be partly financed by the International Bank as a link in the "Agriculture and Transport Development Plan". The situation is thus likely to improve considerably within the next few years. However, for the purpose of this report transport of finished products is assumed to be made by truck and the estimated costs are thus likely to be on the conservative side.

3. The port situation

40. From the location point of view, Talcahuano would be the most suitable port for the export of pulp and paper. It lacks, however, facilities for docking vessels of deep draught and the loading of ocean freighters would, at present, depend on the use of lighters. This system is expensive and it must be considered as a pre-requisite for a development of the industry that this port should be expanded and modernized, especially since the alternative ports of Valparaiso and San Antonio cannot handle additional tonnages and would also incur much heavier freight charges. Plans to improve the Talcahuano port are under way and will probably be carried out in the next few years, thus solving the shipping problem.

CHAPTER V

INVESTMENT AND PRODUCTION COSTS (Annex VII)

1. *Investments and capital requirements*

41. Investment and production costs have been calculated for sixteen mill projects of different capacities, and producing different qualities of pulp and paper, to serve as a basis for the assessment of the economic prospects for an export industry in Chile. The estimates include four project sizes, 50, 100, 200 and 300 tons per day for unbleached and bleached pulp production; two mill sizes, 50 and 100 tons daily for unbleached and bleached kraft papers, and four newsprint mills, 100, 200, 300 and 400 tons per day. The investment estimates are based on current (May 1956) prices of pulp and paper production machinery in Europe and the United States and local construction costs in Chile. The projects are, except in the case of newsprint, calculated for complete self-sufficiency in steam and power, as well as caustic soda and chlorine in the case of the bleached qualities. Apart from the investment in the mill itself, off-site investments have also been estimated (housing and community facilities for the personnel) as well as investments in forest and transport departments (trucks, and housing for transport workers and administrative staff) since, in most cases, such facilities do not exist in the area and must be developed as part of a mill project.

42. In the total investments must also be included the capital costs during the construction period, the amount of which depends on the time required before the mill is in full operation and the interest and other expenses charged to the capital. For the purpose of this report it has been assumed that the construction period will be three years and the charges 8 per cent. Finally, to arrive at the total capital requirement, working capital should be added to the aggregate investment. It has been estimated as equal to the cost of 4 months production (exclusive of interest on capital investment), plus the value of spares required for mill operation and pulpwood transport.

43. It should be noted that in the estimates of investments as well as production costs import duties on production machinery (at present approximately 25 per cent of the c.i.f. value) have not been taken into account, since it is recommended that Customs franchise for this particular kind of machinery should be one of the measures adopted by the State to encourage a rapid development of an industry with high foreign exchange earning capacity. Should the customs duties remain, they would add approximately 12 to 13 per cent to the total capital requirements listed in the following paragraphs.

2. *Pulp mills*

44. The mills producing unbleached pulp are based on the sulphate process and include complete and modern equipment for recovery and burning of the waste liquor. Bleached qualities are assumed to be produced by the sulphur-soda process to utilize the caustic soda produced simultaneously with the chlorine required for bleaching. This means, however, only minor changes in the equipment in comparison to the sulphate process, and for the purpose of this report it may be assumed that the investment will be the same in both cases. Investments and capital requirements are as follows:

UNBLEACHED PULP

(Thousands of dollars)

Mill capacity, tons/day:	50	100	200	300
Mill investment	6,200	8,420	11,250	15,300
Forest Dept. trucks	85	180	420	700
Transport Dept. trucks	45	92	187	255
Housing and community	715	908	1,263	1,700
Capital cost during constr.	1,205	1,635	2,225	3,035
Total investment	8,250	11,235	15,345	20,990
Working capital	780	1,190	1,910	2,755
Capital requirement	9,030	12,425	17,255	23,745
of which foreign exchange	6,212	8,757	12,046	16,570

Corresponding figures of total investment and capital requirements for mills producing bleached pulp are as follows:

Mill capacity, tons/day:	50	100	200	300
Total investment	10,250	13,665	18,730	25,140
Capital requirement	11,235	15,140	21,105	28,500

45. Investments as well as capital requirements are straight line functions of the mill capacity with deviations in aggregate investments from the straight line of less than plus or minus 3 per cent. It is thus believed that within the capacity limits of 50 to 300 tons per day the straight line relationship could be used for estimates of investment and capital needs at intermediate mill sizes 1/. The figures for mills producing unbleached pulp bring out two important facts which are valid also for integrated and newsprint mills; the heavy capital costs during construction time, which amount to almost 15 per cent of the total investment and the large proportion, 70 per cent of the capital requirement which is in foreign exchange.

1/ *On this subject, see also: Pulp and Paper Prospects in Latin America, United Nations publication, Sales No. 1955, II.G.4.*

3. Integrated mills

46. Two sizes, 50 and 100 tons daily capacity, have been calculated for integrated mills producing unbleached and bleached kraft papers from a 100 per cent chemical pulp furnish. On the assumption that the straight line relationship between investment and capacity is valid also in this case, projections to larger mill sizes, 200 and 300 tons daily, have been made. Total investments and capital requirements are as follows, (in thousands of dollars).

Mill capacity, tons/day	50	100	200	300
Unbleached papers:				
Total investment	12,140	17,130	27,100	37,100
Capital requirement	13,315	18,950	30,200	41,500
Bleached papers:				
Total investment	14,410	20,170	31,700	43,210
Capital requirement	15,820	22,345	35,400	48,400

4. Newsprint mills

47. Four mill sizes, 100, 200, 300 and 400 tons per day have been calculated. The projects include a sulphite pulping section for the production of the necessary quantity of chemical pulp (20 per cent of the furnish), the assumption being that young trees of Pinus radiata, which have not yet developed any heartwood, could be pulped by this process. If not, the sulphate process with semi-bleaching must be used, which, however, cannot be established economically on a small scale.

Investment and capital requirements are;

Mill capacity, tons/day	100	200	300	400
Total investment	12,755	19,660	28,045	35,160
Capital requirement	14,230	22,155	31,710	39,860

As in the case of pulp mills the investment and capital requirements are straight line functions of the mill capacity. Further, the percentage share of capital costs during construction, and foreign exchange requirements in total investments and capital needs are almost the same; i.e. 15 and 70 per cent respectively.

Production costs. (annex VIII)

48. Production cost estimates have been prepared for all the mill projects and are recorded numerically and graphically in tables VIII-19 to 24, figs. VIII-I to V. They include depreciation of investments calculated according to the sinking fund method with estimated life of 10 and 15 years for mill and

off-site investments respectively, and a compound interest rate equal to the current return on securities of 8 per cent per annum. Since the useful life of the assets is much longer, the estimates are conservative. The daily production costs are also straight line functions of the mill size (figures VIII-I to V) with deviations for the single points of less than plus or minus 1.5 per cent. Unit costs are accordingly hyperbolical functions of the capacity and show a steep fall with a capacity increase in the small mills and a gradual levelling off towards an assymptotic value for the larger mill sizes. It is thus important that a mill should be planned with a large enough capacity to take advantage of the main decline in unit cost in order to have maximum competitive power in the world market. For this reason it is recommended that the pulpmills in Chile should not be built with a capacity less than some 250 tons and newsprint mills not smaller than 300 tons per day.

49. The production costs in dollars per ton are summarized below

Mill size, tons/day:	50	100	200	500	400	Estimated sales value from mill
Unbleached pulp	126.69	96.30	77.16	73.49		115.05
Bleached pulp	156.95	118.26	95.92	90.72		144.45
Unbl. kraft papers	186.93	145.64	125.00	119.00		177.53
Bl. kraft papers	223.60	174.07	145.00	135.00		245.13
Newsprint		117.35	98.55	95.39	92.17	130.51

The share of depreciation (including interest) in the aggregate production costs is approximately 54 per cent for mill capacities of 50 tons per day and declines with increasing sizes to slightly less than 40 per cent. For the purpose of comparison estimated sales values from mills in Chile (see annex IX app. IX-A) are included in the table. As will be seen, the margins between these values and production costs are considerable in the case of larger mills, a question which is further dealt with in the following chapter.

50. As would be expected from the high depreciation charges, existing import duties on the production machinery have a considerable effect on production costs, which at the existing tariff rate will increase by 6-7 per cent. The importance of customs franchise as an incentive for the development of the industry is thus further stressed.

CHAPTER VI

ECONOMIC EVALUATION OF THE PROJECTS AND AN OVER-ALL ASSESSMENT

51. The economic evaluation of the projects has been made from two different aspects;

i) The private investors' viewpoint, which presupposes a maximum return on the invested capital at a minimum risk, and

ii) the national viewpoint, according to which a maximum earning of foreign exchange should be obtained from available capital and raw material resources.

The system used for the assessment is in the first case the venture profit method, venture profit being defined as the excess profit over and above the minimum acceptable return on capital after taxation. The minimum acceptable profit should yield a net asset sufficient to cover amortization charges and leave a net profit of 8 per cent on the capital 1/. In the second case net foreign exchange earning capacity is measured in terms of recovery time, which is the period in which the foreign exchange share of the investment is recovered by exchange earnings.

52. In each of the two cases limitations in capital or raw material supply will affect the relative attractiveness of one operation over the other. This is only to be expected and reflects the general fact that capital limitations will favour the production of intermediate and less refined products, whereas in the case of raw material restrictions maximum profits will be obtained from the more refined products.

53. Since it is common practice to finance the purchase of production machinery through deferred payments, the projects have, in addition, been evaluated by their capacity to liquidate such payments. This is measured by the number of years in which the foreign exchange share of the investment can be repaid by the gross annual earnings after taxation.

54. It is impossible within the scope of this summary to give a comprehensive narrative of the economic evaluations made in annex IX and its appendices which contain more complete information. In the following paragraph examples will be given illustrating some of the assessments from the investors and the country's viewpoints, in each case assuming that there is an upper limit on capital or pulpwood availability.

1. Evaluation on profit and deferred payment basis – the investors' viewpoint

55. Assuming that a total capital of 25 million dollars (including working capital) is available, mills of the following sizes could be built which would give annual venture profits as recorded below:

1/ In this study minimum acceptable profit covers also depreciation of off-site investments which, as rule, are recoverable in case of the project's failure. The assessment is thus conservative.

Order of attractiveness	Product	Approx. mill size tons per day	Annual venture profit; thousands of dollars
1	Unbleached pulp	400	4,700
2	Bleached pulp	300	4,450
3	Bleached papers	145	3,225
4	Unbleached papers	180	2,350
5	Newsprint	270	2,330

Besides showing the high venture profits which will be obtained from pulp and paper production in Chile -almost 20 per cent of total capital in the case of unbleached kraft pulp and slightly less than 10 per cent for newsprint- the figures also illustrate the point made previously, that capital limitation will favour the production of less refined products, unbleached pulp being the most attractive. In this context it should, however, be remembered that the mills producing kraft papers and newsprint are of smaller sizes than recommended.

56. The foreign exchange share in the total capital requirements is about 70 per cent for all the mills, and is thus some 17.5 million dollars in the previous example. At this level the repayment periods (by gross annual earnings after taxation) fall into two distinct groups. The first group comprises unbleached and bleached pulp, which have a repayment period of about 2.6 years, and the second group consists of unbleached and bleached papers and newsprint with a repayment time of between 3.3 and 3.9 years (figure IX - VI). To these periods must of course be added that part of the project construction time during which foreign exchange is required, and which may be estimated at about 2 years. Judged by their capacity to liquidate deferred payments in the shortest possible time, the different products thus maintain the same order of attractiveness as in the case of capital limitation.

2. Limitations in wood supply

57. When the project size is determined by pulpwood availability and not by capital restrictions, the maximum venture profits which may be obtained from the different operations change their order of attractiveness, as demonstrated in the table below showing the venture profit per cubic metre (solid volume) of wood at an annual supply level of 400 thousand cubic metres.

Order of attractiveness	Product	Venture profit, dollars per m3.	Percentage of profit for bl. papers
1	Bleached papers	14.00	100
2	Unbleached papers	8.38	60
3	Newsprint	8.25	59
4	Bleached pulp	6.88	49
5	Unbleached pulp	6.38	46

3. *Assessment of foreign exchange earning capacity - the national viewpoint*

58. The economic benefit for the country as a whole, which may be obtained from the alternative investment possibilities, is measured in the case of capital limitation in terms of net foreign exchange recovery time 2/, or the period in which the foreign exchange share of the capital requirement is recovered by the exchange earnings from the exports of the products. This time is listed below for projects requiring 17.5 million dollars in foreign exchange.

Order of attractiveness	Product	Foreign exchange recovery time; years
1	Unbleached pulp	1.51
2	Bleached pulp	1.58
3	Bleached papers	2.27
4	Newsprint	2.33
5	Unbleached papers	2.57

The figures emphasize the unusually short time in which the foreign exchange requirements to establish the mill are recovered, varying from approximately one and a half years for unbleached and bleached pulp to about two and a half years in the case of newsprint and kraft paper. A comparison with the table in paragraph 55 shows that the order of attractiveness for the different operations is the same as in the case of venture profits from projects with capital limitation, except in the case of newsprint and kraft papers, for which the order of attractiveness is reversed.

59. A similar reversal in the order of attractiveness for newsprint and kraft paper production, when judged from the private and the country's viewpoint, occurs in the case of wood supply limitations.

60. Since capital availability in the less industrially developed countries is generally the limiting factor when a new industry is created, a natural sequence is to start with projects for unbleached and bleached pulp and later -when pulpwood supply may set a limit to further expansion of individual mills as well as of the industry as a whole- to integrate paper or newsprint sections with the pulp mills by re-investing profits. Needless to say, marketing possibilities for the different products may change this sequence or make it advisable to diversify the production regardless of the prospective profits or foreign exchange earnings. It should further be pointed out that many cases may arise when pulpwood supply would be the limiting factor from the outset, for instance when the forest stands within economic transport distance from the mill are limited, or when the Company has only small plantations of its own. The last point is important, since it is definitely recommended that any large size mill should control at least about half of its pulpwood supply to avoid market speculations and interruptions of production because of shortage of wood.

4. *Over-all assessment of the economic prospects*

61. The importance to the economy of Chile of a pulp and paper industry based on the Pinus radiata plantation is shown by stating that the annual foreign exchange net earnings from the industry would amount to some 60-85 million dollars, depending on the products exported. These figures refer to the first 10 years of the industry's life after which time, when the assets are fully depreciated, the earnings will

2/ Net foreign exchange earning is the f.o.b. value of the product minus depreciation of foreign exchange investment and items in the production cost which incur exchange payment, such as spares and maintenance materials.

rise by some 25 per cent. As an illustration, it may be mentioned that a development programme including annual productions of the following quantities and products, which no doubt could be marketed in Latin America, would result in net exchange earnings as follows:

Product	Quantity (Thousands of tons)	Net exchange earnings	
		First 10 years	After 10 years
		(millions of dollars)	
Newsprint	300	29	37
Kraft papers	100	13	16
Unbleached pulp	200	19	22
Bleached pulp	50	6	7
Total		67	82

A comparison with the present commercial gross exchange earnings in the country -in 1955 about 490.2 million dollars corresponding to an estimated net earning of some 426.8 millions- further illustrates the scale and importance of this industry in the country's economy.

The capital requirements to establish the industry are large -for the development programme outlined above some 170 million dollars is needed, of which about 50 millions is in local currency- and Chile will have to rely on foreign financing to carry out a programme of this size in a reasonably short time. It is believed, however, that if the Government adopts an encouraging policy, and when the economic possibilities of an industry of this kind in Chile are known, such financing may be obtained. Some of the measures which should be undertaken by the Government to create an incentive for foreign and local investment in this field are summarized in the following general recommendations.

Chapter VII

RECOMMENDATIONS

1. *General recommendations*

1. The Government should, as a link in the economic development plan for the country, adopt a policy and take measures to create incentives for establishing in the shortest possible time, a large-scale pulp and paper industry, based on the existing plantations of Pinus radiata. This measure should be undertaken for two main reasons; to improve the trade balance, since net foreign exchange earnings would rise by some 15-20 per cent, and to recover the value represented by the existing plantations -some 60 million dollars- an asset which can only be saved in total by the establishment of this industry.

2. Since a development aiming at full utilization of the output from the plantations will require some 120 million dollars of foreign exchange and since it is unlikely that the public or private sector in the country could provide this amount, the participation of foreign capital -either on an equity basis or through direct investments- is vital to secure a rapid expansion of the industrial capacity. In formulating its policy the Government should therefore clearly emphasize that the primary aim is to encourage private enterprise and foreign capital as the only present means for a successful development of a large-scale industry. This does not in any way preclude State participation in single projects, which may even be necessary to incite such development.

3. Neither direct nor indirect foreign investments are, however, likely to take place unless the investor is assured that favourable conditions exist in respect to profit remittances, capital withdrawal etc. If a generous policy towards foreign capital in general, does not already exist, or will not soon be adopted, it is recommended that maximum possible concessions should be granted to this particular industry immediately.

4. It is recommended that the present import duties on machinery -about 25 per cent of the c.i.f. value- should be lowered or preferably completely abolished for the production equipment in this industry, during a specified period, since their impact on production costs is considerable, as a rule about 7 per cent of the total cost. This measure would thus undoubtedly encourage investments and would also give the investor a certain security that the State is actively interested in the development.

5. The commercial policy of the country should be correlated with the development of the industry and, as soon as definite dates are known when new capacities will start operations, these export availabilities should be taken into account in trade negotiations with the deficit countries. Trade agreements should if possible be made on a long-term basis, especially with the main importers e.g. Argentina and, in particular, for bulk products such as newsprint and unbleached kraft pulp.

6. A pulp and paper industry of the size which could be established in Chile requires a large number of professional employees and skilled workmen trained in this specific field. In the initial phase of development foreign technicians and specialists would have to be brought into the country to train local personnel. Although the main training would take place in the industry itself, and would be the responsibility of the individual companies, it must rest upon the State to provide adequate basic education in the universities and technical schools, and through special courses. It is therefore recommended that the education programme related to this particular subject should be revised and enlarged.

2. *Specific recommendations*

(a) Forestry problems

7. Since only a fraction of the total potential availability of Pinus radiata sawtimber could be marketed, it is recommended that the planned training programme and credit facilities for better sylvicultural management of the plantations should be revised, taking into account that plantations with low growth rates should, as a general policy, be reserved for the production of pulpwood alone, and clearcut at the ages of minimum stumpage value. Thinning and pruning of these plantations, is, as a rule, a waste of money and should be discouraged.

8. It is recommended that the future plantation programme should be co-ordinated in order to obtain, as far as possible, large and concentrated stands in the vicinity of the most suitable mill locations, to reduce extraction and transport costs. Since plantation work is likely to remain mostly in private hands, co-ordination could best be achieved by proper information and propaganda.

9. A moderate size pulp or paper mill is a large consumer of pulpwood, and since this represents a considerable proportion of aggregate production costs, it is vital that the industry should exercise control over its supply requirements, both as to quantity and price. It is therefore recommended that any large size mill should have its own plantations, sufficient to cover some 50 per cent of its pulpwood needs, in order to prevent market speculations and interruptions of production because of wood shortage or excessive prices.

(b) River pollution

10. Restrictive legislation regarding disposal of effluents in the rivers already exists in the country (Código de aguas), but it is inadequate and does not include regulations strictly applicable to water contamination by pulp and paper mills, which is a serious problem. Great care must therefore be taken, especially when selecting inland mill sites, to ensure that the disposal problem could be solved in a satisfactory way, and frank consultations with such official departments as are connected with the stream pollution problem are necessary. It is recommended that the whole problem of river pollution as a result of a pulp and paper industry development should be reviewed by the competent authorities and clearly defined regulations established to help the industry in its location problem.

(c) Transport problem

11. One of the main problems in connexion with an expansion of the pulp and paper industry is the lack of good transport facilities, both for the supply of pulpwood and other raw materials, and for shipment of finished goods. Responsibility for the development of such facilities must rest upon the public sector, especially since foreign investments on a large scale are not likely to be made without an assurance that the transport problem will be solved satisfactorily. This applies not only to the public road system in the plantation area, but also to railways and, especially, to the port situation. Talcahuano seems to be the best prospective port for the export of pulp and paper and it must be considered as a pre-requisite for the development of the industry that this port should be expanded and modernized. It is recommended that the whole transport problem in connexion with the industrial development in the area should be reviewed by the competent authorities.

(d) Community and housing facilities

12. The public authorities should be responsible for the development of basic community facilities such as schools, hospitals, communications, water supply, drainage etc. It is recommended that such facilities should be provided generously and without delay, to facilitate labour movement and to assist the industry in the problem of acquiring the necessary personnel.

13. Although the provision of housing for employees and workmen in most cases would have to be the responsibility of the private enterprise, it is recommended that the State should make available long-term loans at low cost for such housing, as a measure to ease the financing problem of the industry.

(e) Technical matters

14. In the development of the industry advantage should be taken of the latest improvements in processing techniques and machinery design (e.g. continuous cooking systems) to achieve a maximum competitive power. However, since a large scale pulp and paper mill calls for a very heavy investment, a cautious or even conservative view must be taken to safeguard against technical failures, and only such processes and machinery as are already in successful commercial operation should be considered. Informed and objective advice on the technical planning of the mills is essential to ensure their viability, and it is recommended that well-known consulting firms of high integrity should be employed. Their planning and advice may seem expensive, but there is no doubt that the absence of highly qualified technical assistance will prove to be much more costly.

3. Final recommendation

Since the Pinus radiata plantations constitute one of the most important raw material resources for the production of pulp and paper in Latin America, the utilization of which would make a large contribution towards solving the future supply problem for these products in the region and be of great economic benefit to Chile, it is recommended that the Government should take energetic measures to ensure that the development of the industry will take place rapidly. To achieve a maximum of efficiency, the development programme should be co-ordinated in all its aspects, and the official department or organization in charge of this co-ordination should be given adequate funds to carry out its work forcefully.

ANNEX I

THE MARKET SITUATION FOR PULP AND PAPER

A. STRUCTURE OF THE INTERNATIONAL MARKET

1. *Short-term fluctuations in prices and balance of supply and demand*

During the last decades the international market in paper, board and pulp has experienced more violent and frequent changes both in the supply and demand balance and the price level than perhaps any other world market. There are two main reasons for this instability. Firstly, the consumption of paper and board is one of the most sensitive indicators of a country's cultural, economic and industrial activity; second, the inter-regional trade in these commodities is only marginal in relation to aggregate production and consumption in the large industrial regions (Europe and North America) where export availabilities represent but a small proportion of total production.

The first point is illustrated in figure I-I which shows the correlation between the industrial production index and total consumption of paper and board in the United States during the period 1920-52. It is clear that a close relationship exists between paper consumption and over-all industrial activity in the country.

The second feature is demonstrated in the following tables I-1 and I-2, which show the production and consumption of paper and pulp by regions.

Table I-1

PRODUCTION AND CONSUMPTION OF PAPER AND BOARD BY REGIONS, 1954

(Millions of tons)

Region	Production	Consumption	Net export as a percentage of production	Imports as a percentage of consumption
Europe	13.36	12.27	8.2	-
North America	29.71	28.85	2.9	-
Latin America	0.94	1.50	-	37
Asia	2.20	2.66	-	21
Rest of the world a/	0.50	1.10	-	55

Source: FAO, Yearbook of Forest Products Statistics, 1955.

a/ Excluding the Soviet Union, Eastern Europe and mainland China.

Table I-2

PRODUCTION AND CONSUMPTION OF WOODPULP a/ BY REGIONS, 1954

(Millions of tons)

Region	Production	Consumption	Net export as a percentage of production	Imports as a percentage of consumption
Europe	11.72	11.46	2.2	-
North America	25.13	24.66	1.9	-
Latin America	0.35	0.78	-	55
Asia	1.71	1.86	-	8
Rest of the world b/	0.37	0.46		24

Sources: FAO, Yearbook of Forest Products Statistics, 1955; Woodpulp Statistics 1955, United States Pulp Producers Association.

a/ Also includes other fibre pulps.

b/ Excluding the Soviet Union, Eastern Europe and mainland China.

Tables I-1 and I-2 show that, whereas net exports of paper in 1954 amounted to 8.2 per cent of total production in Europe and 2.9 per cent in North America, corresponding figures for pulp exports stood at only 2.2 and 1.9 per cent, respectively. Besides showing how marginal are the surplus quantities from the industrial regions, the tables also emphasize the importance of these export availabilities to total needs in the regions which are less developed industrially. Latin America, for instance, depends upon imports of paper and pulp corresponding to 37 and 55 per cent, respectively, of the total consumption.

It should also be noted that export availabilities will become even more marginal in the future. It has thus been estimated that by 1960-62 consumption of paper and board will have increased in North America by 25-30 per cent and in Europe by some 40 per cent over the 1950-52 levels, whereas no appreciable rise in total exports is envisaged 1/.

From what has been said above, it is easy to understand that even slight changes in the internal European and North American supply/demand relationship has had and will have -at least in the near future- grave repercussions on the international market. This has been clearly demonstrated in the post-war years, a period when pulp and paper prices have fluctuated extremely sharply, and when small buyers have had to pay exorbitant prices in times of scarce supply 2/.

Two additional factors further aggravate the short-term price fluctuations. When the world economy is expanding and the marginal export availabilities are small, ocean freight rates tend to increase and at the same time the importers -from fear of supply difficulties and further price increases- often make speculative stock purchases; both give additional momentum to the price movement. During a slack

1/ *See World Pulp and Paper Resources and Prospects, (World Survey), op.cit. As will be seen later in this report, actual consumption figures for 1954 and 55 indicate an appreciably steeper rise in consumption than was envisaged in the 'World Survey'.*

2/ *It seems probable that the situation during this period was aggravated by the post-war adjustment of economies and trade and by the outbreak of the Korean war and some authorities claim that the market will now experience less violent changes. True or not, this does not nullify the validity of the general conclusion, namely, that small changes in the domestic markets of Europe and North America will have far-reaching consequences on the international paper trade.*

economic cycle, the situation is reversed. Figure I-II, which shows the annual fluctuation in prices of newsprint and kraft pulp imported into Chile, amply illustrates the short-term price movements.

However difficult and inconvenient periodic interruptions of supply and rapid price fluctuations of an essential commodity such as paper may be, an importing country can always lessen their effects by such means as the maintenance of large stocks and the adoption of a compensatory price policy in order to stabilize the domestic price level. Such a policy, while easing a temporary situation in the internal market would not affect long-term supply problems, and would also be contingent upon a rigid state control of imports and prices. Its effect on the international market -unless jointly adopted by the main importing countries- would also be insignificant.

2. The problem of supply over the long term

Far more dangerous and disturbing for importing countries than the above-mentioned short-term fluctuations is the uncertainty of supply over the long term. This problem has in recent years commanded growing attention from both national and international bodies, in particular the United Nations and its specialized agencies.

The following are some important conclusions contained in studies which have been carried out or sponsored by the United Nations 3/.

The *World Survey* concludes that "Pulp and paper production in Europe and North America will continue to grow" and that "new investment is likely to be principally guided by the trend in domestic demand in those regions". Also, "it seems unlikely, for several reasons, that the margin available for export to other regions will rise substantially in the long term". Further:

"But though the surplus available for export in the old production centres will fluctuate, conceivably rising above present levels from time to time, clearly two-thirds of humanity cannot be content to have their supplies of an essential commodity interrupted by periodical fluctuations. And in any case a long-term increase in the exportable surplus commensurate with the rising needs of the deficit regions does not seem likely".

Tables I-3 and I-4 below give a summary of world consumption of pulp and paper in 1950-52 and of estimates of demand in 1960-62, as predicted in the previously cited report.

3/ *For further information, see World Pulp and Paper Resources and Prospects, op.cit.; and Pulp and Paper Prospects in Latin America, op.cit.*

Table I-3

ESTIMATED INCREASE IN DEMAND FOR PAPER AND BOARD, 1950-52 TO 1960-62, BY REGION AND BY CATEGORY a/

(Millions of tons)

Region	Paper and board consumption		Absolute increase	Percentage increase
	Average 1950-52	Estimated 1960-62		
Europe	11.82	16.38	4.56	38
USSR	(1.92)	(3.00)	(1.08)	56
North America	28.57	36.83	8.26	29
Latin America	1.45	2.54	1.09	75
Near and Middle East	0.10	0.15	0.05	50
Far East	1.92	4.05	2.13	110
Oceania	0.67	1.00	0.33	48
Africa	0.45	0.71	0.26	56
World	46.90	64.66	17.76	38
Category				
Newsprint	9.41	12.90	3.49	37
Other printing and writing paper	8.75	11.29	2.54	29
Other paper	11.43	16.03	4.60	40
Board	17.31	24.44	7.13	41
	46.90	64.66	17.76	38

Source: Food and Agriculture Organization, World Survey, op.cit., table I-7.

a/ For a comparison with demand forecasts made later in the current report it should be observed that;
1) the figures quoted in the above table include also building board consumption, which has been omitted from the revised demand figures, and 2) figures for Europe given in this report include Eastern Europe (unless otherwise stated).

Table I-4

ESTIMATED PULP REQUIREMENTS IN 1960-62

(Millions of tons)

Region	Wood pulp needed to satisfy domestic consumption of pulp products		Increase
	Average 1950-52	Estimated 1960-62	
Europe	9.3	12.3	3.0
North America	22.1	28.1	6.0
USSR	(1.8)	(2.8)	(1.0)
Latin America	1.27	2.23	0.96
Near and Middle East	0.10	0.15	0.05
Far East	1.53	3.40	1.87
Oceania	0.63	0.95	0.32
Africa	0.38	0.60	0.22
World	37.1	50.5	13.4

Source: Food and Agriculture Organization, World Survey, op.cit., table I-9.

These tables show that the anticipated increase in demand during the current decade is almost 18 million tons of paper (38 per cent of the 1950-52 consumption) and 13.4 million tons of pulp (about 27 per cent of the 1950-52 level). The lowest rates of increase are those envisaged for Europe and North America, but in absolute quantities these regions account for about 70 per cent of the total.

Market development in the years 1954 and 1955 indicates that the above demand forecasts are on the low side. This unexpected increase in demand has made it necessary to revise the demand forecast for the main regions of the world, and particularly for Latin America, in order to appraise the current and future marketing possibilities for pulp and paper produced in Chile.

B. A FORECAST OF FUTURE DEMAND AND THE SITUATION IN THE DIFFERENT REGIONS OF THE WORLD

1. Methods used in forecasting demand

Three different methods have been used in forecasting future demand;

Method A: the historical projection method. This method is a simple forecast based on the historical development trend, usually for the 7-year period 1948-54, assuming that consumption will rise by an equal percentage each year. As a rule the first 3-year period has been chosen as a base period with 1949 as the base year to avoid errors resulting from year-to-year changes in stocks. From the base year future demand has been calculated by projection of the mathematically fitted curve (the least square method) obtained from the base year consumption and the apparent consumption figures for the following years. The method is crude and in such cases where data are available to permit the use of either of the following methods, it has been used only for purposes of comparison.

Method B: the historical correlation method. This method is based on the observation that paper and board consumption is closely related to the per capita income in a country: i.e. a given increase in per capita income will result in a defined increase in per capita consumption of paper products 4/. This is especially true in the case of newsprint, where consumption is closely related to net disposable income on a per capita basis.

The correlation between consumption and income is determined from historical data of the two entities. Since the elasticity coefficient will change (diminish) with an increase in income this must be taken into consideration if the forecast is made for a long time. In most of the forecasts made here historical data for the period from 1948 to 1954 have been used. Per capita income figures are the Gross National Products (GNP) per capita, calculated at constant prices 5/.

To determine the total consumption level in a country or region by the historical correlation method it is necessary to have estimates of future income as well as population. For some countries estimates of income are available but as a rule income levels will have to be determined either from historical trends or by some other means of forecasting economic development.

Method C: the general correlation method. When data are not available to determine the elasticity coefficient this may be estimated by comparison with other countries having a similar per capita income level. The procedure to assess future demand is then the same as in Method B. To facilitate such comparisons the elasticity coefficients for a) newsprint and b) all other papers and boards, have been calculated for a number of countries with different income levels and are recorded in tables I-5 and figures I-III and I-IV.

4/ For a given country the correlation shows a straight-line relationship between the logarithms for per capita income and consumption; i.e.

$$\log y = k \cdot \log x + C,$$ *where y is consumption per capita, x the income per capita, C a constant and k the elasticity coefficient.*

The correlation equation is valid only for comparatively small changes in per capita income, since the elasticity coefficient will vary with x as demonstrated later.

5/ It should be noted that, in order to determine the elasticity coefficient alone, it is unnecessary to use actual income figures at constant prices. Index figures for per capita income (at constant prices), which are more readily available, will serve the same purpose, as demonstrated by the following equations:

1) $\log y_1 = k \cdot \log x_1 + C$
2) $\log y_2 = k \cdot \log x_2 + C$

Elimination of C between the two equations gives:

3) $\log \frac{y_1}{y_2} = k \cdot \log \frac{x_1}{x_2}$

Thus, index figures for both income and paper consumption can be used to determine the elasticity coefficient

Table I-5

VARIATION OF ELASTICITY COEFFICIENTS FOR PAPER CONSUMPTION WITH GROSS NATIONAL PRODUCT PER CAPITA

Country	Period	GNP per capita (1950 dollars)	Elasticity coefficients		
			Newsprint	All other paper grades	
				Importing countries	Exporting countries
United States	1948-55	1,942	0.36		0.88
United States	1929-38	1,115	0.76		(0.83)
Canada	1948-54	1,020	0.73		1.15
Sweden	1949-54	760	0.97		1.67
Venezuela	1948-54	656		0.85	
Norway	1949-54	604			1.91
W. Germany	1949-54	418	1.45	1.28	
Finland	1948-54	387			2.27
Europe excl. United Kingdom and France	1949-54	356	1.62	1.54	
Latin America, excl. Argentina	1948-55	222	2.21	1.48	
Mexico	1948-54	208		1.77	
India	1948-54	62	3.37		

The following conclusions may be drawn from the table and figures I-III and I-IV.

The elasticity coefficient decreases with an increase in per capita income, more sharply for newsprint than for other papers and boards. Although definite conclusions cannot be drawn from these limited data, they indicate that the coefficient may be approximately a straight line function of the logarithm of the income. See figures I-III and I-IV. The coefficients may thus be represented by the general formula:

$$\text{Equ. (1)} \quad k = \frac{d\,(\log y)}{d\,(\log x)} = p \log x + C_1$$

where k is the elasticity coefficient, y consumption per capita, x per capita income and p and C constants.

In the case of "other papers and boards", there seems to be a distinct difference between the coefficients for importing and exporting countries, with higher values for the latter group of countries. This probably reflects the fact that paper products are usually cheap in comparison to the general price level in exporting countries.

The constants p and C in the equation above have been calculated and are as follows:

		p	C_1
Newsprint	-	1.79	6.23
Other papers and boards			
importing countries	-	1.52	5.24
exporting countries	-	2.10	7.68
average	-	1.81	6.46

If the differential equation 1) is solved for log y the following expression for paper consumption as a function of per capita income is obtained:

$$\text{Equ. (2)} \qquad \log y = p \frac{(\log x)^2}{2} + C_1 \log x + C_2$$

Since p has a negative value it follows that log y and consequently the per capita consumption will reach a maximum point or "saturation value", above which the total paper consumption in a country will rise only at the same rate as the population increase. The "saturation value", which is reflected in the constant C_2, varies from one country to another and depends apparently on a number of factors, among them primarily the existing relation of paper consumption to income.

It seems probable that the saturation level may also vary by the time depending on changes in the consumption pattern, for instance by the introduction of new paper products on the market or by new uses of existing products. These changes are, however, by their nature, unpredictable.

In figures I-V and I-VI, consumption is recorded as a function of per capita income. In the case of newsprint (figure I-VI), the consumption curve has been calculated from the United States consumption level in the period 1948-55, while for other papers and boards three functions, corresponding to the consumption levels in the United States, Europe and Latin America are recorded. The United States curve is calculated using the constants p and C_1 for exporting countries, the curve for Europe with the average values for importing and exporting countries, while for Latin America the constants for importing countries have been used.

From figure I-VI it will be seen that the saturation level, as calculated from equation 2 and with the United States consumption level as basis for the projection, is about 37 kilogrammes per head annually, a consumption figure which had almost been reached in that country in the year 1956. It should also be noted that the consumption -income curve corresponds remarkably well to the historical development in the United States; the consumption figure for the period 1929-38 being slightly below the line, which may indicate that the consumption pattern has remained relatively unchanged. Since, however, there are signs which show that the consumption of newsprint in the United States in the early nineteen-fifties was deflated owing to the impact of television on newspaper advertising lineage (see section on North America) it is likely that the consumption curve is also depressed and will tend to show too small consumption figures. Forecasts of the future demand in the United States have therefore assumed that the elasticity coefficient has not yet reached the zero value.

For other papers and boards (figure I-VI), it should again be noted that the consumption curve corresponds well to the historical development in the United States. The consumption curve for Europe in its lower part (up to an income of about 2,000 dollars per head and year) is almost parallel to the U.S. curve. It indicates higher consumption figures than for United States at the same income level, which probably is accounted for by the historical change in the consumption pattern due to technical development. The curve for Latin America is, at the present income level of about 220 dollars, also higher than the curve for the United States, but the projection to higher incomes is considerably lower. This is probably an indication of the fact that in the under-developed regions the consumption of some paper products is still limited to specific uses and sections of the population. When the industrial development of these areas proceeds, it is likely that the consumption-income relationship for paper will approach, or may even exceed, the historical data for the United States.

2. *The situation in North America*

(a) Newsprint

(i) Development in the post-war period

During the post-war period from 1948 to 1955, newsprint production, consumption and export availabilities have shown the following development:

Table I-6

NEWSPRINT PRODUCTION, CONSUMPTION AND EXPORT AVAILABILITY IN NORTH AMERICA
1948-55

(Millions of tons)

Year	Production			Consumption a/			Export availability
	United States	Canada	Total	United States	Canada	Total	
1948	0.795	4.210	5.005	4.681	0.278	4.959	0.046
1949	0.833	4.706	5.539	5.010	0.304	5.314	0.225
1950	0.921	4.830	5.751	5.320	0.322	5.642	0.109
1951	1.020	5.004	6.024	5.474	0.326	5.800	0.224
1952	1.041	5.159	6.200	5.485	0.335	5.820	0.380
1953	0.083	5.190	6.173	5.549	0.361	5.910	0.263
1954	1.099	5.429	6.528	5.498	0.382	5.880	0.648
1955	1.361	5.606	6.967	5.866	0.350	6.216	0.751
(1956)	1.466	5.874	7.340	6.176	0.451	6.627	0.713

Source: U.S.; Newsprint Production and Supply, U.S. Dept. of Commerce, Febr. 14, 1956. 1955; Pulp, Paper and Board Industry Report, March 1956, Canada; 1948-50, FAO Yearbook of Forest Product Statistics. 1955, Newsprint Data 1953 and 1955, News - print Association of Canada, Montreal, Canada.

Note: Figures for 1956 were taken from Pulp, Paper Board Industry Report , March 1957 (U.S.A) and Pulp and Paper Magazine of Canada , Convention Number, 1957 (Canada)

a/ Consumption in U.S. adjusted for year-end changes in stocks.

The table shows that from 1948 to 55 total production in North America increased by almost 2 million tons, of which 1.4 million in Canada, and consumption by a little less than 1.3 million tons. The heavy dependence of the United States on imports is notable, net import requirements having risen from about 3.9 million tons in 1948 to 4.6 million tons in 1955, practically all of which is covered by Canadian exports. Of interest also is the stagnation of consumption in the United States during the period 1950-54, which has been partly attributed to a decrease in newspaper advertising in favour of television. The increase in advertising lineage (and consequently newsprint consumption) which has taken place in 1955 indicates that the impact of television has now lessened. As a result of this development it may be expected that demand forecasts based on the consumption trend from 1948-55 will tend to be on the low side.

Net export availability in North America has increased from less than 50,000 tons in 1948 to more than 700,000 tons in 1955, thereby surpassing the pre-war (1937) figure of about 460,000 tons. An analysis of the actual export figures is made in appendix I-A of which the following table I-7 gives a summary.

Table I-7

EXPORT AND IMPORT OF NEWSPRINT IN NORTH AMERICA 1937-55

(Thousands of tons)

Year	Export to Europe	Export to Latin America	Export to other regions	Total export	Import from Europe	Export surplus
1937	330	395		725	267	458
1948	71	167	162	400	236	164
1949	118	145	174	437	218	219
1950	31	115	80	233	146	87
1951	99	151	121	371	179	192
1952	153	212	162	527	163	364
1953	159	171	128	458	148	310
1954	307	244	168	719	115	604
1955	388	250	208	846	113	733
(1956)				851	272	579 a/

Source: Newsprint Production and Supply, U.S. Dept. of Commerce, Febr. 14, 1956; Pulp Paper and Board Industry Report, March 1956 and 1957; F.A.O. Yearbook of Forest Products Statistics; Newsprint Data 1953, 1955 and 1956, Newsprint Association of Canada, Montreal, Canada.

a/ The fall in export surplus in 1956 is mainly due to a rebuilding of stocks by more than 200,000 tons.

It should be noted that the 1955 actual export figure exceeds the export availability by 95,000 tons, indicating that a withdrawal from stocks of this quantity had taken place during the year.

Actual exports have more than doubled in the period from 1948 to 1955, during the last year exceeding the pre-war volume of 725,000 tons by more than 100,000 tons. The largest increase is noted for Europe, which raised imports from North America from about 70,000 tons in 1948 to almost 390,000 in 1955, a quantity which is about 60,000 tons higher than in 1937. The increase is expected to continue in the future, a question which will be further examined in the section dealing with Europe. Exports to other regions (incl. Latin America) have also increased but less spectacularly than to Europe -from 330,000 tons in 1948 to 460,000 in 1955, a gain of about 40 per cent.

Imports from Europe, all of which are shipped to the United States, have naturally decreased during the 1948-55 period parallel with the increasing exports from North America to Europe. In 1948, North America had a net import of 165,000 tons from Europe, which in 1955 turned into a net export of 275,000 tons -a change in the trade balance of not less than 440,000 tons in a period of seven years.

(ii) Forecast of future demand

In a recently published study 6/ by the Forest Products Division of the United States Department of Commerce, a forecast was made of future demand for newsprint in the United States for the period up to 1965. The forecast is based on the correlation between consumption and net disposable income per capita

6/ Newsprint Production and Supply. U.S. Department of Commerce, February 14, 1956.

during the period 1949 to 1955 and the projections of disposable income and population made by the Joint Committee on the Economic Report 7/. According to this study, the estimate of future consumption would be: 1956, 6.17 million tons; 1957, 6.17 million; 1958, 6.31 million; 1960, 6.58 million; and 1965, 7.48 million tons.

In the present report two estimates of future consumption have been made: one using the historical consumption trend (method A described above) and the other based on the correlation between newsprint consumption and the per capita gross national product with projections of income and population from historical developments in the periods 1948-54 and 1946-54 respectively. Consideration has been taken of the fact that the elasticity coefficient is likely to diminish gradually during the period of forecast.

A comparison of the three demand forecasts is made in table I-8.

Table I-8

UNITED STATES: COMPARISON OF DEMAND FORECASTS FOR NEWSPRINT

(Thousands of tons)

Year	Method A	Method B	Report of U.S.Dept. Commerce	Value accepted for this report
1956	6,080	6,011	6,170 a/	6,100 a/
1957	6,252	6,168	6,170	6,200
1958	6,428	6,325	6,310	6,325
1960	6,796	6,644	6,580	6,650
1965	7,810	7,468	7,480	7,500

a/ Includes 91,000 tons for replacing stocks.

The correspondence between the different forecasts is very good. As may be seen from table I-8, the consumption estimates accepted for the purpose of this report are approximately the same as those reached by using Method B, but with the exception that about 90,000 tons have been added to the 1956 figure to allow for the replacement of stocks, which were dangerously low at the end of 1955.

For Canada, estimates of future demand have also been made according to both Methods A and B. A summary of the forecasts is given in table I-9 below.

Table I-9

CANADA: COMPARISON OF DEMAND FORECASTS FOR NEWSPRINT

(Thousands of tons)

Year	Method A	Method B	Accepted value
1956	408	406	425 a/
1957	426	422	425
1958	444	439	440
1960	485	474	480
1965	602	570	600

a/ Includes replacing stocks with 20,000 tons.

7/ *Total disposable income (1954 dollars) in 1965 estimated at 383,000 millions. Total population in 1965 estimated at 190 million.*

Compilation of figures from tables I-7 and I-8 gives the following summary (table I-10) of future demand for newsprint in North America.

Table I-10

NORTH AMERICA: ESTIMATE OF NEWSPRINT DEMAND, 1955-65

(Thousands of tons)

Year	United States	Canada	Total
1955	5,866	350	6,216
1956	6,100	425	6,525
1957	6,200	425	6,625
1958	6,325	440	6,765
1960	6,650	480	7,130
1965	7,500	600	8,100

The demand figure for 1965 shows a 30 per cent increase over 1955 actual consumption, or 2.7 per cent annually as against 3.3 per cent for the period 1948-54.

(iii) Forecast of future production

In the previously-mentioned report on newsprint prepared by the U.S. Dept. of Commerce, estimates have been made of future production capacity and actual production in the United States for the period 1956-59. A similar forecast for the Canadian industry is made in *Newsprint data 1955* by the Newsprint Association of Canada. The estimates are summarized in the following table I-11.

Table I-11

NORTH AMERICA: ESTIMATE OF NEWSPRINT CAPACITY AND PRODUCTION 1955-58

(Thousands of tons)

Year	Estimated capacity			Estimated production		
	United States	Canada	Total	United States	Canada	Total
1955	1,400	5,500	6,900	1,361	5,606	6,967
1956	1,525	5,640	7,165	1,480	5,800	7,280
1957	1,700	5,965	7,665	1,590	5,970	7,560
1958	1,815	6,270	8,085	1,725	6,270	7,995

Sources: Newsprint Production and Supply, U.S. Dept. of Commerce, Febr. 1956; Newsprint Data 1955, Newsprint Association of Canada.

The summary shows that annual newsprint capacity is estimated to increase by about 1.2 million tons during the period from 1955 to 1958, while actual production is assumed to rise by a little over one million tons per year. A comparison with the demand forecast in table I-10, indicates that export availabilities in North America may rise to about 1.2 million tons in 1958, a gain over the 1955 figure of approximately 500,000 tons. This increase is impressive, but the analysis of probable developments in other regions of the world made in the following sections shows that the gain may be insufficient to cover expected deficits.

(b) Other papers and boards

(i) Post-war developments

During the period 1948-55, the production, consumption and export availabilities of papers and boards except newsprint showed the following development in North America:

Table I-12

NORTH AMERICA: PRODUCTION, CONSUMPTION AND EXPORT AVAILABILITY OF ALL PAPERS AND BOARDS EXCEPT NEWSPRINT, 1948-55

(Thousands of tons)

	Production			Consumption			Export availability
	United States	Canada	Total	United States	Canada	Total	
1948	19,093	1,122	20,215	18,927	1,008	19,935	280
1949	16,847	1,080	17,927	16,750	0,996	17,746	181
1950	19,979	1,211	21,190	19,869	1,150	21,019	171
1951	21,339	1,341	22,680	21,090	1,256	22,346	334
1952	19,922 a/	1,201	21,123	19,697 a/	1,173	20,870	253
1953	21,865	1,457	23,322	21,746	1,422	23,168	154
1954	21,734	1,300	23,034	21,487	1,295	22,782	256
1955	24,303	1,500	25,803	23,912	1,460	25,372	431
(1956)	25,469	1,657	27,126	25,107	1,612	26,719	407

Sources: 1948-54; FAO, Yearbooks of Forest Products Statistics
1955 United States, Pulp, Paper and Board, Industry Report, March 1956, U.S. Department of Commerce.
1954-55 Canada, Pulp and Paper Magazine of Canada, Convention Issue, 1956.

Figures for 1956 were taken from Pulp, Paper and Board Industry Report 1957, Pulp and Paper Magazine of Canada. Convention Number 1957 and United States Exports of Domestic and Foreign Merchandise, May 1957.

a/ Value from Wood Pulp Statistics 1955, U.S. Pulp Producers Association.

As may be seen from this table, paper production and consumption in the United States fluctuated sharply in the period 1948-55 bearing out the fact that paper consumption is a sensitive indicator of industrial and economic activity in a country. The increase in U.S. consumption during 1948-55 was about 5 million tons (more than 25 per cent), 2.5 million tons of which were in 1955, almost 50 per cent of the total increase. Development of production as well as consumption in Canada has been more stable, showing an aggregate increase in demand of about 450 thousand tons in the seven-year period, a rise of 45 per cent. The export availability has fluctuated during the period 1948-54 between 150 and 334 thousand tons with an average of 230 thousand, and jumped in 1955 to 430 thousand tons.

As might be expected from the relative stability in the export availability, North American inter-regional trade has remained fairly constant over the period studied, which is demonstrated in the following table I-13.

Table I-13

NORTH AMERICA: EXPORT AND IMPORT OF PAPERS AND BOARDS OTHERS THAN NEWSPRINT, 1948-55

(Thousands of tons)

Year	Total export	Export to other regions	Total import	Import from other regions	Export surplus
1948	509	371	229	91	280
1949	330	234	149	53	181
1950	310	205	139	34	171
1951	530	390	196	56	334
1952	450	322	164	36	286
1953	391	250	237	96	154
1954	486	359	232	105	254

Sources: Total Exports: FAO Yearbook of Forest Products Statistics.
Exports to other regions: Total exports minus trade figures between U.S.A. and Canada obtained from U.S. Trade Statistics.

(ii) Forecast of demand.

Estimates of future demand have been made separately for United States and Canada according to Methods A and B. In using Method B it has been assumed that the correlation coefficient will diminish during the period of forecast.

Since correlation with GNP is not so close for other papers and boards as for newsprint and the fluctuations in consumption are more pronounced, the correspondence between the two sets of estimates is not so good as in the case of newsprint. It is believed that a closer correlation, and hence a more reliable forecast, could be obtained if industrial output per capita is used instead of GNP. A further improvement would probably result from a breakdown of the paper and board group into "writing and printing papers" and "industrial papers and boards". Time has, however, not permitted such analysis to be made.

Demand forecasts are recorded in the comparative summary given in table I-14 below.

Table I-14

NORTH AMERICA: COMPARATIVE FORECASTS OF DEMAND FOR ALL PAPERS AND BOARDS, EXCEPT NEWSPRINT, 1955-65

(Thousands of tons)

Year	United States			Canada			Total
	Method A	Method B	Accepted value	Method A	Method B	Accepted value	
1955a/	-	-	23,912	-	-	1,460	25,372
1956	24,140	24,108	24,125	1,670	1,523	1,560	25,685
1957	25,070	25,056	25,100	1,780	1,607	1,650	26,750
1958	26,040	26.004	26,025	1,900	1,694	1,725	27,750
1960	28,080	27,980	28,000	2,167	1,882	1,900	29,900
1965	33,940	33,376	33,500	3,011	2,437	2,500	36,000

a/ Actual consumption figures are quoted for 1955.

The table shows that paper and board consumption (excluding newsprint) is expected to increase by 18 per cent in the period from 1955 to 1960 and by 42 per cent in the ten-year period 1955-65. This increase corresponds to an average annual increment in demand of about 3.5 per cent as compared to about 3.6 per cent for the period 1948 to 1955.

(iii) Future production capacity

United States production capacity for papers and boards, except newsprint, at the end of 1955 and 1958 has been estimated as follows from information published in the March 1956 Pulp, Paper and Board Industry Report issued by the U.S. Department of Commerce;

Table I-15

UNITED STATES: PRODUCTION CAPACITY FOR PAPERS AND BOARDS, 1955-58

(Thousands of tons)

	1955	1958
Newsprint	1,400	1,815
Other papers and boards	25,000	26,835
Total capacity	26,400	28,650

The recorded capacity is estimated for the end of the years and it is therefore unlikely that actual production in 1958 could exceed 96 per cent of the rated capacity, as in 1955 the production averaged 95.6 per cent and in January 1956 the paper production was 99 per cent and the paperboard production 100 per cent of the rated capacity.

Thus the United States' production of other papers and boards in 1958 may be estimated at about 25.750 million tons, as compared to an estimated demand of about 26 million. The comparison indicates that the present net export surplus of about 400 thousand tons per year may change into a net import surplus of about 250 thousand tons in the three year period unless production capacity is raised at a faster rate than is at present envisaged. This increase is fairly probable since the paper industry of the United States will undoubtedly respond quickly to a tightening of the home market, but it seems unlikely that the increase will be sufficient to cover the expected demand and at the same time to maintain the present level of exports.

For the purpose of this report, it is assumed that production capacity in the United States will increase by an additional 300 thousand tons over and above the forecast made by the United States Department of Commerce. Rated production capacity for "other papers and boards" in the year 1958 is thus estimated at 27.135 million tons and actual production in the same year -assuming an average operating rate of 96 per cent- at 26.050 million tons, which leaves a small export surplus of about 25,000 tons. When accepting this figure, it should be borne in mind that the forecast of demand is based on the assumption that economic development in the country will continue at the average rate experienced in the period 1948-55, 3.1 per cent annual increase in gross national product per capita -and that a change of plus or minus one per cent in this development rate will result in a total consumption change of about plus or minus 400 thousand tons.

Unfortunately no information was available about development plans in Canada. Certain conclusions may, however, be drawn from an analysis of the trade balance between Canada and other regions. From table I-13, and United States foreign trade statistics, the following summary table has been compiled;

Table I-16

CANADA: BALANCE OF TRADE IN PAPER AND BOARD, EXCEPT NEWSPRINT, 1948-54

(Thousands of tons)

Year	Export to United States	Import from United States	Net export to United States	Total export surplus	Net export to other regions
1948	112	25	87	114	27
1949	67	29	38	84	46
1950	72	33	39	61	22
1951	95	45	50	85	35
1952	81	47	34	28	-6
1953	80	61	19	35	16
1954	52	74	-22	7	29

Sources: Trade figures USA-Canada from U.S. Trade Statistics.

Table I-16 shows that Canadian trade with the United States in these paper items has changed from a net surplus of 87,000 tons in 1948 into a net import of 22,000 tons in 1954. During the same period the net export to other regions has remained fairly stable, except for 1952, and averaged about 30 thousand tons per annum. It is assumed here that Canada will expand production facilities in the three-year period 1956-58 sufficiently to maintain net exports to other regions and to balance the trade with the United States.

The North American balance of supply and demand for papers and boards others than newsprint in the years 1955 and 1958 may thus be summarized as follows:

Table I-17

NORTH AMERICA: BALANCE OF SUPPLY AND DEMAND FOR OTHER PAPERS AND BOARDS, 1955 AND 1958

(Thousands of tons)

Year	Production			Consumption			Export availability total
	United States	Canada	Total	United States	Canada	Total	
1955	24,303	1,500	25,083	23,912	1,460	25,372	431
1958	26,050	1,755	27,805	26,025	1,725	27,750	55

The demand and supply forecasts for papers and boards others than newsprint in North America, made above, indicate that net export availability in the region will decrease from an annual tonnage of 430 thousand in 1955 to some 50 thousand in 1958.

(c) Pulp

(i) Developments in the post-war period

Production, consumption and net export availability of all grades of woodpulp have been as follows during the period 1948-55: (For detailed figures on export, see appendix I-B).

Table I-18

NORTH AMERICA: PRODUCTION, CONSUMPTION AND EXPORT AVAILABILITY OF ALL GRADES OF WOODPULP 1948-55 a/

(Thousands of tons)

Year	Production		Consumption		Export availability		
	United States	Canada	United States	Canada	U.S.	United States	Total
1948	11,002	6,903	12,967	5,302	-1,965	1,601	-364
1949	10,528	7,055	12,348	5,675	-1,820	1,380	-440
1950	12,623	7,606	14,769	5,964	-2,146	1,642	-504
1951	14,133	8,348	15,950	6,346	-1,817	2,002	185
1952	13,930	8,036	15,378	6,327	-1,448	1,709	261
1953	14,864	8,121	16,755	6,392	-1,891	1,729	-162
1954	15,554	8,616	17,005	6,685	-1,451	1,931	480
1955	17,713	9,050	19,064	6,950	-1,351	2,100	749
(1956)	19,014	9,573	20,549	7,404	-1,535	2,169	634

Sources: 1948-54 production and consumption; Wood Pulp Statistics 1955, U.S. Pulp Producers Association.
1955-56 United States; Pulp, Paper and Board Industry Report, U.S. Dept. of Commerce, March 1956, March 1957.
1955-56 Canada; Pulp and Paper Magazine of Canada, Convention Issue for the years 1956 and 1957.

a/ Consumption figures for U.S.A. include changes in stocks. The table includes also dissolving grades but not exploded or defibrated pulps used in the production of building boards.

Thus in the eight-year period 1948-55 production of woodpulp in North America has increased from 17.9 million tons per annum to 26.8 millions -a rise of 50 per cent- whereas consumption increased from 18.3 millions to 26.0 millions or 42 per cent. Before the war (1937) North America imported a net quantity of more than 1 million tons. In the period 1948-50 the import dependency had been reduced to an average of little less than 450 thousand tons and in 1955 it had changed into an export surplus of about 750 thousand tons. Of the total net change 1948-55 in the trade balance with other regions -1.185 million tons- United States accounted for 626 thousand tons and Canada for 559 thousand tons

An analysis of the supply balance for dissolving pulp alone shows the following development in the period 1948-55:

Table I-19

NORTH AMERICA: PRODUCTION, CONSUMPTION AND EXPORT AVAILABILITY OF DISSOLVING GRADE WOODPULP, 1948-55

(Thousands of tons)

Year	Production			Consumption a/			Export availability		
	United States	Canada	Total	United States	Canada	Total	United States	Canada	Total
1948	381	310	691	579	32	611	-198	278	80
1949	340	239	579	456	21	477	-116	218	102
1950	435	305	740	625	42	667	-190	263	73
1951	559	371	930	741	43	784	-182	328	146
1952	641	348	989	784	43	827	-143	305	162
1953	615	391	1,006	814	45	859	-199	346	147
1954	690	387	1,077	751	54	805	-61	333	272
1955	893	354	1,247	886	56	942	7	298	305
(1956)	854	374	1,228	818	61	879	36	313	349

Sources: Production: USA, 1948, Wood Pulp Statistics 1956; 1949-56, Pulp, Paper and Board Industry Report, March 1957; Canada, 1948-55, Wood Pulp Statistics 1956, Pulp and Paper Magazine of Canada, Convention Number, 1957.
Consumption: USA, 1948-52, Wood Pulp, etc. op.cit; 1953/56, Pulp, Paper and Board etc., op.cit. Canada, 1948-55, Wood Pulp etc. op.cit.; 1956, Pulp and Paper Magazine, etc. op. cit.

a/ From 1953 to 1956 the consumption figures for U.S.A. were adjusted for changes in stoc

Consumption of dissolving grade woodpulp in North America has thus increased by 54 per cent and production by 80 per cent in the period 1948-55. Most of the production increase has taken place in the United States, which today is practically self sufficient. The region as a whole has increased its export availability by more than 200 thousand tons resulting in a net surplus in 1955 of 300 thousand tons.

3. *The situation in Europe* 1/

(a) Newsprint

Production, consumption and export availability of newsprint in Europe have been as follows during the post-war period. For details on trade see also appendix I-A.

1/ *Unless otherwise stated figures for Europe exclude Bulgaria, Czechoslovakia, Eastern Germany, Hungary, Poland, Rumania and the Soviet Union.*

Table I-20

EUROPE: NEWSPRINT PRODUCTION CONSUMPTION AND EXPORT AVAILABILITY 1948-55

(Thousands of tons)

Year	Production			Consumption			Export availability
	Sweden Norway Finland	Rest of Europe	Total	United Kingdom	Rest of Europe	Total	
1948	744	931	1,675	413	861	1,274	401
1949	868	1,175	2,043	602	978	1,580	463
1950	905	1,405	2,310	590	1,200	1,790	520
1951	893	1,437	2,330	612	1,108	1,720	610
1952	929	1,371	2,300	737	1,247	1,984	316
1953	934	1,596	2,530	724	1,381	2,105	425
1954	935	1,715	2,650	826	1,594	2,420	230
1955	1,055	1,785	2,840	929	1,741	2,670	170
(1956)	1,176	1,884	3,060	1,035	1,779	2,814	246

Sources: FAO, Yearbook of Forest Products Statistics, 1950 and 1951 Newsprint Data 1953 and 1955, Newsprint Association of Canada; UNESCO, Newsprint Trends 1928-51 Figures for 1956 (estimates) were taken from Newsprint Data 1956.

During the eight-year period 1948-55, production has increased by more than 1.1 million and consumption by 1.4 million tons. As a result the export availability has decreased from almost 500 thousand tons in the three-year period 1948-50 to less than 200 thousand in 1955.

A comparison with the 1937 figures -production 2.6 and consumption 2.4 million tons- shows, that not until the year 1954 did the market attain its pre-war level in total tonnages. Since the population has increased by 10 per cent during the same period, it follows that the per capita consumption is still depressed, and is likely to increase at a faster rate than would normally be expected from the increase in per capita income.

Table I-20 emphasizes the large share (37 per cent) of total production which comes from Sweden, Finland and Norway. On the consumption side it should be noted that the United Kingdom accounts for 35 per cent of the aggregate demand.

(i) Forecast of demand

Separate demand forecasts have been made for the United Kingdom and for the rest of Europe. Both forecasts are based on a combination of the historical projection and the general correlation methods (Methods A and C); i.e. the per capita consumption is assumed to grow at the 1949-54 rate until it reaches the level indicated by the ideal consumption-income curves shown in figures I-V and I-VI. From that point the consumption is assumed to follow the curve.

Table I-21 gives the demand forecasts in total tonnages. As a comparison the demand forecast made by the U.S. Dept. of Commerce is included 8/.

8/ *Newsprint Production and Supply, op.cit.*

Table I-21

EUROPE: NEWSPRINT DEMAND FORECASTS 1955-1965

(Thousands of tons)

Year	United Kingdom	Rest of Europe	Total consumption	United States Dept. Commerce
1955	930	1,710	2,640	2,667
1956	950	1,905	2,855	2,867
1957	980	2,170	3,150	3,266
1958	1,010	2,440	3,450	3,638
1960	1,075	2,775	3,850	-
1965	1,200	3,500	4,700	-

The demand for newsprint is thus estimated to increase by about 80 per cent in the 10-year period from 1955 to 1965, which corresponds to an annual increase of 6 per cent as compared to about 11 per cent in the period 1948 to 55.

The difference between the forecast made in this study and by the U.S. Dept. of Commerce isaccounted for by a difference in the estimate of consumption in Great Britain. For the year 1958 the United States Dept. of Commerce predicts a consumption in this country of 1.360 million tons; i.e. 250 thousand tons higher than the present estimate. In a footnote to the report on Newsprint Production and Supply *(loc.cit.)* it is stated that Sir Eric Bowater, head of the Bowater Organization, at a meeting of the Board of Directors on 18 March, 1954, predicted "that the demand for newsprint in the United Kingdom could soon reach 2,240,000 short tons" (2 million metric tons), which estimate was "based on circulation increases and a return to the number of pages prevalent in pre-war years". It is not clear whether the figure quoted includes consumption in the British Commonwealth; in any case it is far in excess of both the demand forecasts shown in Table 21. It is therefore likely that consumption will be considerably higher than the estimate made in the present study and may exceed the figure quoted by some 200 or 300 thousand tons by 1958.

(ii) Forecast of future production and balance of supply

Present expansion plans, as quoted in different sources, indicate that by the year 1958 modernization of existing mills and new mills will add an additional annual capacity of 580 thousand tons. Counting with an average operating rate of 95 per cent the production increase over the year 1955 will thus be 550 thousand tons as compared to an increase in consumption of 810 thousand tons. The 1955 export surplus of 170 thousand tons is thus likely to change into a net import requirement of about 100 thousand tons, an estimate which probably is on the low side.

As will be seen later the long-term problem is far more dangerous and may lead to serious supply difficulties in Europe, and as a consequence also in the other deficit regions of the world.

(b) Other papers and boards

(i) Production and consumption in the post-war period

In the period 1948 the production, consumption and export availability in Europe of all papers and boards except newsprint were as follows:

Table I-22

EUROPE: PRODUCTION, CONSUMPTION AND EXPORT AVAILABILITY OF ALL PAPERS AND BOARDS EXCEPT NEWSPRINT, 1948-54

(Thousands of tons)

Year	Production	Consumption	Export availability
1948	4,840	4,350	490
1949	6,630	6,010	620
1950	7,620	7,080	540
1951	9,084	8,394	690
1952	7,849	7,309	540
1953	9,057	8,357	700
1954	10,641	9,811	830
(1955)	11,718	10,924	794

Sources: FAO, Yearbooks of Forest Products Statistics and other sources.

Table 22 shows that both production and consumption have more than doubled in the 7-year period, while export availability shows a smaller increase; from about 500 thousand tons in 1948 to a little over 800 thousand in 1954.

(ii) Forecast of future demand

As in the case of newsprint future demand has been estimated by using a combination of the Methods A and C; historical projection up to the point of "ideal" consumption and general correlation for the rest of the period. Table I-23 shows the forecast for the period 1955-65.

Table I-23

EUROPE: FORECAST OF DEMAND FOR ALL PAPERS AND BOARDS, EXCEPT NEWSPRINT, 1955-65

(Thousands of tons)

Year	Total consumption	Year	Total consumption
1955	10,245	1958	11,985
1956	10,710	1960	13,165
1957	11,340	1965	15,920

Total increase in consumption is thus estimated at about 5.7 million tons in the 10-year period, corresponding to a 55 per cent rise from the 1955 level or 4.5 per cent per annum, compared to about 12.3 per cent in the period 1948-54. A considerable slow-down in the rate of increase is thus foreseen. It is, however, considerably higher than the previous forecasts made by the United Nations. For instance, in the *World Survey* (op.cit.) the increase in European consumption of other papers and boards in the period 1950/52 to 1960/62 is estimated to be 36 per cent, or 3 per cent per annum. Development in the period 1950 to 55 indicates, however, that this rate represents an under-estimate and as a result a more pessimistic view must be taken than expressed in the *World Survey*, on Europe's possibilities to satisfy her own demand and at the same time maintain the present export level.

Unfortunately no reliable data are available regarding expansion plans for the industry producing other papers and boards than newsprint, and the actual level of future export availability is therefore difficult to assess. Figures have been mentioned in various sources indicating that with the present forests increment, the pulp capacity could be increased by an additional 1 million tons in Finland and about 0.5 million tons in Sweden. Assuming that an additional quantity of 0.5 million tons could be produced in the rest of Europe (excluding Eastern Europe and the U.S.S.R.) the total capacity increase of 2 million tons would be sufficient to produce about 600 thousand tons of newsprint and an additional 2 million tons of other papers and boards. If the required capital is available and this expansion actually takes place within the next five years, by 1960 Europe's present export surplus of about 800 thousand tons would change into a net import requirement of more than 500 thousand tons. This estimate presupposes that the present net export of pulp, about 200 thousand tons per annum, is maintained.

(c) Woodpulp 9/

Exports of woodpulp from Europe have been as follows in 1937 and the post-war period: (for detailed figures on distribution, see appendix I-B).

Year	Export to: a/ North America	Latin America	Others	Total	Import from North America	Net export
1937	1,404	206	283	1,893	139	1,654
1948	439	145	103	687	192	495
1949	504	238	113	855	358	697
1950	537	319	110	966	146	820
1951	395	326	113	834	369	465
1952	374	186	74	634	328	306
1953	463	242	167	872	289	583
1954	333	320	124	777	520	257
(1955)	320	327	132	779	689	90

Sources: FAO; Yearbooks of Forest Products Statistics.
Wood Pulp Statistics 1951, 1953 and 1956; U.S. Pulp Producers Association.

a/ Figures refer to Sweden, Finland, Norway Austria and Western Germany. Export from other countries is negligible.

9/ *Figures refer to the whole of Europe.*

The table shows that the annual export of woodpulp from Europe has decreased by more than 1 million tons from 1937 to 1948. In the post-war years the tonnage has remained relatively stable at about 700 to 900 thousand tons. Net export, however, has decreased in the same years by about 500 thousand tons and the resulting balance between total and net exports has been covered by imports from North America which in 1954 exceeded half a million tons.

An interesting aspect of Europe's export of pulp and paper is the change in proportion between the two items which may be seen from the following table I-25.

Table I-25

EUROPE: CHANGE IN NET EXPORT OF PULP AND PAPER, 1937 TO 1954

(Pre-war figures include Eastern Europe)

	1937-38		1950-52		1953		1954		(1955)	
	Mill. tons	Per cent	Mill. ton	Per cent	Mill. tons	Per cent	Mill. tons	Per cent	Mill. tons	Per cent
Wood pulp	1.36	63.5	0.53	33	0.58	34	0.26	20	0.09	8
Paper and board	0.78	36.5	1.07	67	1.14	66	1.05	80	1.04	92
Total	2.14		1.60		1.72		1.31		1.13	

Aside from the large decrease of 800 thousand tons in net exports the table shows that whereas pulp export was almost two thirds in the pre-war years, it is today only about 20 per cent of the total net exports. There is every reason to believe that the tendency towards integration of pulp with paper production, which is the background for the change in exports, will continue and, as a result, the export availability of pulp will gradually disappear.

To sum up the European supply and demand situation in 1960, as estimated in this study: it seems likely that the present export availability of 170 thousand tons of newsprint will change into a net import requirement of 100 thousand tons, the export availability of other papers and boards, about 800 thousand tons, will disappear and Europe will have to depend on imports of about 500 thousand tons if pulp exports are maintained at their present level.

Developments after the year 1960 are naturally difficult to assess, but indications are that Europe may have serious difficulties to satisfy a demand of pulp and paper commensurate with the economic and cultural level in the region.

4. Latin America

(a) Newsprint

During the period 1948-55 consumption, production and net import requirements of newsprint have been the following: (for detailed figures see appendix I-C).

Table I-26

LATIN AMERICA: CONSUMPTION, PRODUCTION AND IMPORT REQUIREMENT OF NEWSPRINT 1948-55

(Thousands of tons)

Year	Consumption			Production			Net import requirement
	Argentina	Rest of Latin America	Total	Argentina	Rest of Latin America	Total	
1948	121	243	364	...	32	32	332
1949	117	246	363	...	39	39	324
1950	104	267	371	3	46	49	322
1951	112	289	401	3	45	48	353
1952	93	331	424	1	51	52	372
1953	37	332	369	8	46	54	315
1954	62	361	423	18	39	57	365
(1955)	111	377	488	22	43	65	423

Sources: See appendix I-C.

Newsprint consumption in Argentina fluctuated sharply during the period, because import and consumption restrictions existed, whereas the consumption in all other Latin American countries has increased at a remarkably steady rate of some 7.6 per cent per annum. Aggregate consumption in the region today stands at more than 500 thousand tons, of which only about 65 thousand are locally produced. Latin America is thus currently dependent on imports of newsprint from North America and Europe for almost 90 per cent of total requirements.

Imports have increased about 40 per cent during the 7-year period and are likely to rise further in the future as will be seen below unless regional production facilities are expanded more rapidly than is at present envisaged.

(i) Estimate of future demand

Because of the substantial fluctuations in Argentina's consumption during recent years, separate demand forecasts have been made for this country and the rest of Latin America. The prospects for Argentina are taken from a special study of the country made by the Pulp and Paper Advisory Group and are based on the assumption that the Net Geographic Product per capita will increase by 3 per cent annually from the year 1955. For all the other countries, the estimate is made according to the historic correlation method (Method B), since there is a close relationship between paper consumption and GNP per capita in those countries (see figure I-VII).

Annual demand figures based on the forecast are as shown in table I-27.

Consumption is thus anticipated to increase by more than 100 per cent in the coming decade, which corresponds to an annual increment of about 8 per cent as compared to an average for the whole of Latin America of 5.4 per cent in the last seven years. The increase in the annual increment is entirely accounted for by an expected rise in Argentina's consumption as a result of the political changes that took place during 1955.

The report by the United States Dept. of Commerce 10/ predicts a total consumption for the whole of Latin America of 635 thousand tons in the year 1958, i.e. slightly lower than the present estimate.

10/ *Newsprint Production and Supply, op.cit.*

Table I-27

LATIN AMERICA: FORECAST OF NEWSPRINT DEMAND 1955 TO 1965

(Thousands of tons)

Year	Argentina	Rest of Latin America	Total
1955	123a/	405 b/	528
1956	131	443	574
1957	139	480	619
1958	148	520	668
1960	167	615	782
1965	227	940	1,167

a/ Projected figure from the period 1948-52, base year 1950.
b/ Proyected figure from the period 1948-54, base year 1951.

Comparing the present estimate with the demand forecast established by the United Nations in 1954 11/ -which gives two sets of estimates, Forecast A based on a conservative assessment of economic growth in the area and Forecast B assuming a more favourable development, it will be seen that the former actually exceeds even the Forecast B for Latin America as a whole, but that demand in Argentina alone will rise more slowly. (see table I-28).

Table I-28

LATIN AMERICA: COMPARISON OF NEWSPRINT DEMAND FORECASTS

(Thousands of tons)

Year	Argentina		Rest of Latin America		Total	
	Present estimate	United Nations Forecast B	Present estimate	United Nations Forecast B	Present estimate	United Nations
1960	167	205	615	521	775	726
1965	227	277	940	708	1,150	985

(ii) Future balance of supply and demand

Present plans for an expansion of the newsprint industry in the region include the following projects which may be in operation by 1960:

Argentina	30,000 tons	
Chile	55,000 "	(in operation 1957)
Colombia	30,000 "	(plans still uncertain)
Mexico	65,000 "	(2 mills)
Total	180,000 "	

11/ *Pulp and Paper Prospects in Latin America,* op.cit.

Assuming that these projects are all realized and that the industry will operate at 95 per cent of the rated capacity, an additional domestic supply of 170,000 tons per annum will be available by 1960. Together with the production from existing mills in the region -about 65,000 tons- Latin America could then supply some 235,000 tons of the total requirements of 775,000 tons. Unless additional capacity is installed in the region, the dependence upon imports is thus likely to rise by some 100,000 tons by the year 1960 and by no less than 480,000 tons in 1965, when total imports would amount to more than 900,000 tons.

Since it is unlikely that these additional quantities will be available from North America and Europe or that Latin America can afford to spend foreign exchange on her newsprint imports, mainly in dollars, amounting to some 140 million dollars (1955 prices excl. freights) per year by 1965, it may be concluded that a vigorous effort must be made to develop regional capacity in order to avoid a lower consumption than corresponds to the cultural and economic level of the region.

(b) Other papers and boards

For the post-war period, the following consumption, production and net import requirements of paper and boards other than newsprint are recorded. (For detailed figures see appendix I-D).

Table I-29

. LATIN AMERICA: CONSUMPTION, PRODUCTION AND IMPORT REQUIREMENT OF PAPERS AND BOARDS, EXCEPT NEWSPRINT, 1948-54

(Thousands of tons)

Year	Consumption			Producción			Net import requirement
	Argentina	Rest of Latin America	Total	Argentina	Rest of Latin America	Total	
1948	264	554	818	177	397	574	244
1949	283	565	848	178	406	584	264
1950	302	639	941	208	465	673	268
1951	314	695	1,009	228	511	739	270
1952	269	714	983	199	548	747	236
1953	172	762	934	167	570	737	197
1954	225	829	1,054	210	637	847	207
(1955)	299	895	1,194	262	709	971	223

Sources: See appendix I-D.

As in the case of newsprint, the statistics are separated for Argentina and all other Latin American countries. They show that consumption in Argentina declined during the period, while in the other countries a steady increase of about 7 per cent annually took place. The drop in Argentina's consumption was almost entirely due to import restrictions which have not been offset by a corresponding increase in domestic production. Elsewhere in Latin America, expansion of local production has almost covered the rise in consumption; net imports have risen only 30,000 tons from about 160 thousand to 190 thousand tons. This is not surprising, since many Latin American countries maintain import restrictions on these paper and board grades. It is thus difficult to assess whether the supply increase has actually been sufficient to cover the demand or if present consumption is depressed. It seems reasonable to assume

that the last is the case and that consumption would have increased at a faster rate if the restrictions were lifted or local production were sufficient to cover the demand.

(i) Estimate of future demand

Once again separate estimates of future demand have been made for Argentina and the rest of Latin America. As in the case of newsprint, the forecast for Argentina is based on the assumption that per capita income in the country will increase by 3 per cent after 1955. For the rest of Latin America, the demand has been estimated by the historic correlation method (Method B). (See table I-30

Table I-30

LATIN AMERICA: ESTIMATE OF FUTURE DEMAND FOR PAPER AND BOARD, EXCEPT NEWSPRINT, 1955-65

(Thousands of tons)

Year	Argentina	Rest of Latin America	Total
1955	323 a/	874 b/	1,197
1956	345	935	1,280
1957	369	995	1,364
1958	394	1,060	1,454
1960	449	1,205	1,654
1965	627	1,660	2,287

a/ Projected figure from the period 1948-52, base year 1950.
b/ " " " " " 1948-54 " " 1951.

The table shows that the demand in the whole of Latin America is expected to increase by almost 90 per cent during the 10-year period, representing an annual increment of 6.5 per cent as against 4.3 per cent for the period 1948-54. The increase is entirely accounted for by a rise in Argentina's consumption, since in the 1948-54 period the increment in all the other countries together was about 7 per cent per year.

A comparison with the demand forecast made in 1954 by the United Nations 12/ shows that the present estimate falls approximately in the middle between the two forecasts A and B. An analysis of the demand estimates for each country reveals that the present estimate for Argentina corresponds to Forecast A whereas for the other countries the estimate comes close to Forecast B, as demonstrated in table I-31.

12/ *Pulp and Paper Prospects in Latin America, op.cit.*

Table I-31

LATIN AMERICA: COMPARISON OF DEMAND FORECASTS FOR PAPERS AND BOARDS OTHER THAN NEWSPRINT 1955-65

(Thousands of tons)

Year	Argentina		Rest of Latin America		Total	
	Present estimate	United Nations Forecast A	Present estimate	United Nations Forecast B	Present estimate	United Nations A and B
1960	449	450	1,205	1,258	1,654	1,708
1965	627	556	1,660	1,771	2,287	2,327

(ii) Future balance of supply and demand

There are no complete data available on the current expansion plans for the industry. The figures of capacity increase quoted below are those contained in the United Nations survey carried out in 1954 13/. In this survey a number of projects for expanding the capacity of existing mills, as well as for the establishment of new industries, are given. The list includes:

a) New mills and extensions completed since 1950.
b) New mills and extensions where construction had already begun in 1954.
c) Projects which in 1954 had not yet passed the stage of preliminary planning.
d) General goals which had not yet been translated into specific projects; for instance the Argentine 5-year plan.

According to these estimates the planned capacity increase amounts to 465 thousand tons which, if the programme is fully implemented, would bring the total capacity in the region up to 1,275 thousand tons per year. However, even when the programme is realized to its full extent, Latin America will still have a deficit increase of more than 150 thousand tons in 1960 and not less than 750 thousand tons in 1965. Judged by the development in the period 1950-55, considerable doubt must also be expressed as to the possibility to realize a capacity expansion of more than 450 thousand tons by the year 1960 and it is therefore likely that the total deficit for this year will be considerably higher than 350 thousand tons. Consequently, unless the regional capacity is expanded at a much faster rate than is at present envisaged, Latin America must either raise imports of paper and board substantially or must suffer a high degree of deferred demand. This situation must already be faced now, since a period of approximately 3 to 4 years is generally required for a new project to pass from its original planning stage to full production.

(c) Pulp

Reliable data on imports and regional production of different grades of pulp are not available. For the purpose of this report only the data on import requirements are essential and are recorded in table I-32, which summarizes the exports of all grades of pulp from North America and Europe to Latin America. For detailed figures see appendix I-E.

13/ *Pulp and Paper Prospects in Latin America, op.cit.*

Table I-32

EXPORTS OF ALL GRADES a/ OF PULP FROM NORTH AMERICA AND EUROPE TO LATIN AMERICA, 1937 AND 1948-54

(Thousands of tons)

Year	Exports to		Total
	Argentina	Rest of Latin America	
1937	43	169	212
1948	45	132	177
1949	70	180	250
1950	70	279	349
1951	129	269	398
1952	86	187	273
1953	36	261	297
1954	167	323	490
(1955)	192	303	495

Source: Wood Pulp Statistics, 1951, 1953, 1955 and 1956, U.S. Pulp Producers Association.

a/ Includes dissolving pulp.

The table brings out two important facts:

(a) Local production of pulp in Latin America has not kept pace with the increase in paper and board production and, as a result, imports have more than doubled in the seven-year period 1948-54.

(b) Because of the marginal availability of pulp from Europe and North America and speculative stock purchases, imports show great year-to-year changes. This is particularly the case in Argentina, where the absence of a consequent import policy has further aggravated the situation.

It is of interest to note the large and increasing share which Latin America has obtained of total pulp exports from Europe and North America to deficit regions. (See table I-33).

Table I-33 shows that before the war Latin America imported one third of the combined exports from Europe and North America to deficit regions, a share which has increased to two thirds in the post-war years. This heavy dependency on the marginal markets of Europe and North America obviously places Latin America in a most precarious position during periods of short supply; vigorous efforts should therefore be made to reduce this risk by developing regional production facilities.

Table I-33

DISTRIBUTION OF PULP EXPORTS FROM NORTH AMERICA AND EUROPE TO DEFICIT REGIONS

Year	Total exports to deficit regions, (1,000 tons)	Exports to Latin America (1,000 tons)	Latin America, as a percentage of total
1937	611	212	34.5
1948	330	177	53.5
1949	511	258	50.5
1950	474	349	73.5
1951	589	398	67.5
1952	408	273	67.0
1953	551	297	54.0
1954	731	490	67.0
(1955)	741	497	67.0

(i) Estimate of future demand

Assuming that imports of papers and boards could be maintained at the present level and that regional production capacity is expanded sufficiently to cover the expected balance in requirements, the future demand of chemical and mechanical pulp would be approximately as recorded in table I-34.

Table I-34

LATIN AMERICA: ESTIMATE OF FUTURE DEMAND OF PULP FOR REGIONAL PAPER AND BOARD PRODUCTION

(Thousands of tons)

Year	Balance between present import and expected demand for paper and board		Estimated quantity of pulp to cover balance in paper and board supply		Total
	Newsprint	All others	Mechanical pulp	Chemical pulp	
1956	151	1,057	225	650	875
1957	196	1,141	275	705	980
1958	245	1,231	325	770	1,095
1960	359	1,431	445	905	1,350
1965	744	2,064	845	1,345	2,190

This table emphasizes the rapid increase in demand for paper pulp which may be expected should regional paper and board production be expanded to cover the rising consumption. According to the United Nations' survey in 1954 14/, existing pulp capacity in the year 1950 stood at 120 thousand tons of mechanical and 200 thousand tons of chemical pulp. Aggregate expansion plans for the industry in the year 1954 included 190 and 580 thousand tons of mechanical and chemical pulp, respectively. Should these expansion plans, which also include general goals that had not been studied as to feasibility, in fact be implemented to their full extent, Latin America will have reduced the 1954 import dependency of about 500 thousand to 200 thousand tons in 1960. The sharp upswing in demand which is expected to take place between 1960 and 1965 would, however, again raise the deficit during the end of the period to about 470 thousand mechanical and 540 thousand tons of chemical pulp; i.e. an aggregate of more than one million tons. But, since it is unlikely that all the projects will be realized, the deficits quoted above are probably on the low side, especially for the year 1960.

(d) The situation in Chile

Paper and board production, imports and apparent consumption in Chile have shown the following trends in the post-war period:

Table I-35

CHILE: PAPER AND BOARD PRODUCTION, IMPORTS AND APPARENT CONSUMPTION, 1948-54

(Thousands of tons)

Year	Newsprint				Other papers and boards			
	Prod.	Import	Consumption		Prod.a/	Import	Consumption	
				(kgs/cap)				(kgs/cap)
1948	6.1	14.7	20.8	3.55	37.6	0.6	38.2	6.53
1949	8.0	14.0	22.0	3.69	36.1	0.8	36.9	6.18
1950	11.0	19.0	30.0	4.95	33.9	1.0	34.9	5.75
1951	12.4	12.6	25.0	4.04	36.0	0.6	36.6	5.92
1952	11.7	9.9	21.6	3.43	45.0	0.5	45.5	7.22
1953	9.4	13.2	22.6	3.52	42.0	0.4	42.4	6.59
1954	12.4	11.3	23.7	3.67	39.6	0.5	40.2	6.23
(1955)	11.5	14.2	25.7	3.80	41.3	0.8	42.1	6.23

Sources: National statistics and private sources.

a/ The production of boards, etc. from waste papers, approx. 8,000 tons per year, is excluded.

It will be seen from the table that the consumption of newsprint as well as other papers and boards except for year to year variations, has remained practically unchanged during the post-war period. One of the explanations for this fact probably resides in the restrictions on foreign exchange allocated to imports of these items. As a result, Chile has today a depressed consumption in relation to per capita income.

14/ *Pulp and Paper Prospects in Latin America, op.cit.*

(i) Development plans

Three mills are at present under construction, two of them belonging to the Compañía Manufacturera de Papeles y Cartones S.A. and financed with a 20 million dollars loan from the International Bank for Reconstruction and Development.

1. A newsprint mill with a rated annual capacity of about 50,000 tons at San Pedro, near the mouth of the Bio-Bio river. The mill started production in April 1957.

2. A sulphate pulp mill with an annual capacity of 70,000 tons in Laja, near the junction of the rivers Laja and Bio-Bio. Part of the production will be bleached and the mill will probably start operations at the end of 1957.

3. A small sulphate pulp mill with an initial capacity of about 20 tons per day, which is estimated to be increased to 50 tons after one year, is at present being erected in the province of Ñuble (Trupán). The mill is expected to start operations in the middle of 1957.

4. A project is at present being studied by the Empresa Nacional de Celulosa S.A. a company with a share capital of 4,000 million pesos, formed by the Corporación de Fomento, the Corporación Nacional de Inversiones de Previsión, the Caja de Empleados Públicos y Periodistas and the Servicio de Seguro Social. A tentative mill site has been selected near Huépil on the river Itata, close to the canal joining the rivers Laja and Itata. Present plans call for the establishment of a sulphate pulp mill with a daily capacity of about 200-250 tons, partly producing bleached qualities.

The Company has its own plantations with a total area of some 15,000 hectares which -if managed according to the recommendations made in Appendix 26- will yield an annual average of about 175 thousand cubic metres of pulpwood in the period from 1958 to 1973, a quantity sufficient to cover about 50 per cent of the requirements in the mill. Additional plantations exist in close vicinity to the site, and estimates indicate that the average transport distance would not exceed 30 kilometres for the total pulpwood requirements.

5. A new company -Celulosas Chile S.A.- is at present under formation with a proposed share capital of 3,000 million pesos. The Company is studying the possibilities to install a pulpmill in co-operation with a foreign pulp and paper producer, but no data are available about the size of the project.

(ii) Estimate of future demand

A separate demand forecast for paper and board consumption in Chile has been made and is included in appendix I-F, of which the following table I-36 is a summary:

Table I-36

CHILE: DEMAND FORECAST FOR PAPERS AND BOARDS, 1956-65

Year	Newsprint		Other papers and boards		Total	
	1,000 tons	Kgs per capita	1,000 tons	kgs per capita	1,000 tons	kgs per capita
1956	31.3	4.53	50.4	7.30	81.7	11.83
1957	33.3	4.74	53.4	7.59	86.7	12.33
1958	34.9	4.88	55.7	7.58	90.6	12.66
1960	38.8	5.22	61.4	8.26	100.2	13.48
1965	49.5	6.07	76.7	9.40	126.2	15.47

According to the estimate, total consumption of newsprint and other papers and boards is expected to increase by 60 and 50 per cent, respectively, during the 10-year period. The estimate is probably on the conservative side.

A comparison of the demand forecast with the present production figures and the development plans (projects 1-3) shows that in 1960 Chile will have an export surplus of about 11,000 tons of newsprint and some 90,000 tons of chemical pulp. The estimate presupposes that the present production capacity for newsprint is converted to the production of other papers.

(iii) Rayon pulp

Since a project to establish a pulp mill with integrated capacity for the production of rayon pulp has been under discussion, special comment should be made on the production and marketing problems for this particular product.

Rayon pulp -or more generally dissolving pulp- is technically the most difficult item to produce and requires great experience and knowledge of the production process in order to obtain an acceptable product. A wide variety of grades are available on the market, each of which is subject to rigid specifications and quality control, since, in many cases, even slight changes in the quality may result in great economic loss to the customer because of interruptions in the production or complete discard of large tonnages of end products, which do not come up to standard. As a result, the ties between producer and consumer are strong and the latter is always extremely reluctant to change to a new supply source, even at a price incentive.

The total consumption of dissolving pulp in Latin America is today about 60 thousand tons per year, of which Chile accounts for about 5 thousand. The main consuming countries are Argentina, Brazil and Mexico where production facilities with an annual capacity -when producing dissolving grades only- of some 100 thousand tons are at present under construction (45,000 in Mexico, 20,000 in Brazil and 30,000 in Argentina).

Since it is most unlikely that a stable export market in other regions, principally Europe and North America, could be developed, the marketing possibilities for dissolving pulp produced in Chile are very uncertain and it is the definite recommendation of the Advisory Group that production should not be contemplated in the country at present.

5. The other deficit regions

The following summary is based on an analysis of future demand and supply of pulp and paper in the Far East, Near and Middle East, Africa and Oceania made in the *World Survey (op.cit.)*. The forecast is made for the year 1960-62 and excludes Japan and mainland China, the tacit assumption being that these two countries will be able to meet their own rising needs.

"In Japan both paper production and consumption are rising extremely rapidly. Both her pulp and paper industries face very difficult raw material problems, so serious that Japan cannot be counted upon to make any substantial contribution towards reducing the deficit in the rest of the region. In China, too, paper consumption is rising rapidly, and the indications are that domestic supplies will require to be supplemented by imports for some time to come". *(Pulp and Paper Prospects in Latin America, op.cit. pp. 49/50)*.

Table I-37

FUTURE SUPPLY AND DEMAND SITUATION FOR PAPERS AND BOARDS
IN OTHER DEFICIT REGIONS
(Thousands of tons)

Region	1950-52			1960-62		
	Production	Import	Consumption	Production	Import	Consumption
Far East, excl. China and Japan	190	375	565	582	448	1,030
Near and Middle East	27	74	101	95	55	150
Africa	90	360	450	218	492	710
Oceania	287	388	675	466	534	1,000
Total	594	1,197	1,791	1,361	1,529	2,890
Of which:						
Newsprint	51	428	479	270	474	804
Others	543	769	1,312	1,091	955	2,086

Source: World Pulp and Paper Resources and Prospects, op.cit.

The table shows that consumption is expected to rise by 68 per cent for newsprint and 59 per cent for other papers and boards. Production increase -estimated on the assumption that all projects under consideration will be realized- is not sufficient to cover the rising needs, resulting in deficit increases of a little over 100 thousand tons of newsprint and about 225 thousand tons of other papers and boards. Subsequent developments in the region suggest that the assessment has been too optimistic; in 1954 the production of newsprint had risen by only 30 thousand tons and of other papers and boards by 100 thousand tons. It is therefore likely that the competing claims from these regions on the export availability from North America and Europe will be much stronger than that indicated above. For the purpose of this report it is thus assumed that the import requirements recorded in table I-37 for the period 1960-62 will already be attained in 1958-59.

C. CONCLUSIONS

The following main conclusions regarding the future world market in pulp and paper are drawn from the regional assessments in this report:

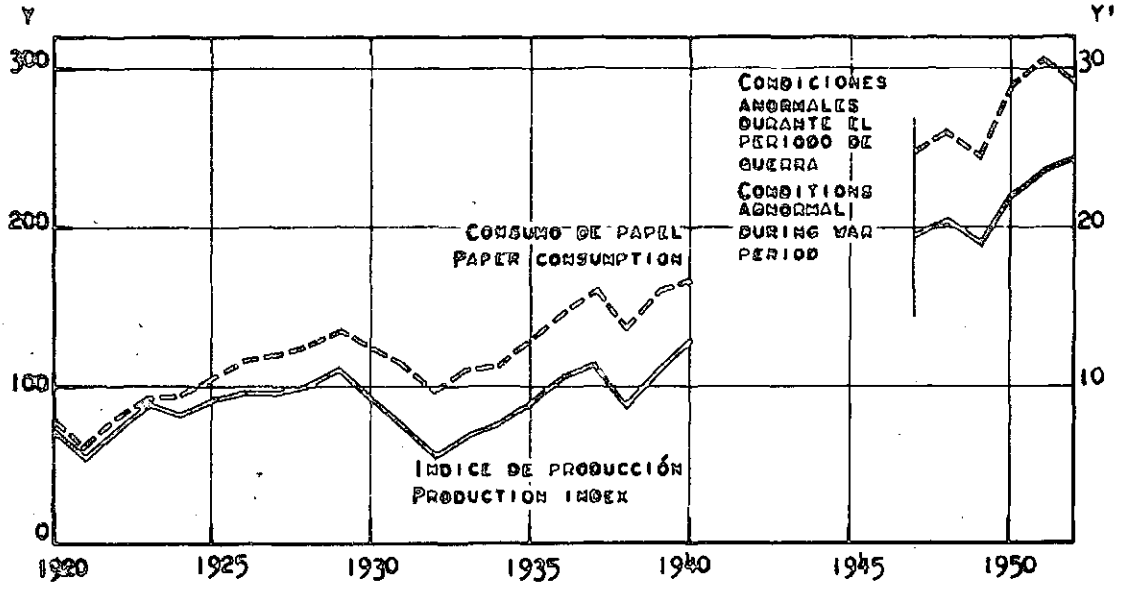
1. It seems probable that the supply and demand of newsprint in the next three years will be approximately balanced. Beginning in 1958 or 59, a gradual tightening of the market will take place unless the present rate of production increase in the deficit regions is accelerated considerably. The situation will be further aggravated in the 1960-65 period, and if determined efforts are not made to secure regional supplies, consumption is likely to be highly depressed in the deficit areas.
2. The supply and demand situation for other papers and boards is more disturbing since there are indications that a world deficit situation may develop already within the next few years, again provided that regional capacity is not greatly increased. Tentatively it is estimated that there will be a world deficit of close to 1 million tons per year in 1958-59.
3. The pulp market is likely to experience more or less the same development as is the case for papers and boards other than newsprint; i.e. a deficit situation will arise during the next few years unless regional resources are created.
4. Europe will in a relatively short time change from a net exporter to a deficit area, and North America alone remain as the net exporter to other regions. Consequently it may be expected that an increasing share of imports to the deficit regions will have to be liquidated in dollars, as it is unlikely that a situation will continue permanently whereby Europe has to purchase pulp and paper from North America in order to maintain her exports to deficit areas.
5. Summing up for the purpose of this report: a prospective market for pulp and paper produced in Chile already exists and is likely to expand rapidly in the coming decade.

FIGURA I - I

FIGURE I - I

CORRELACION ENTRE LA PRODUCCION INDUSTRIAL Y EL CONSUMO DE PAPEL EN LOS ESTADOS UNIDOS

CORRELATION BETWEEN INDUSTRIAL PRODUCTION AND PAPER CONSUMPTION IN THE UNITED STATES



Y - INDICE DE PRODUCCIÓN INDUSTRIAL
MANUFACTURING PRODUCTION INDEX

Y' - CONSUMO TOTAL DE PAPEL, MILL. DE TON
TOTAL PAPER CONSUMPTION, MILL. TONS

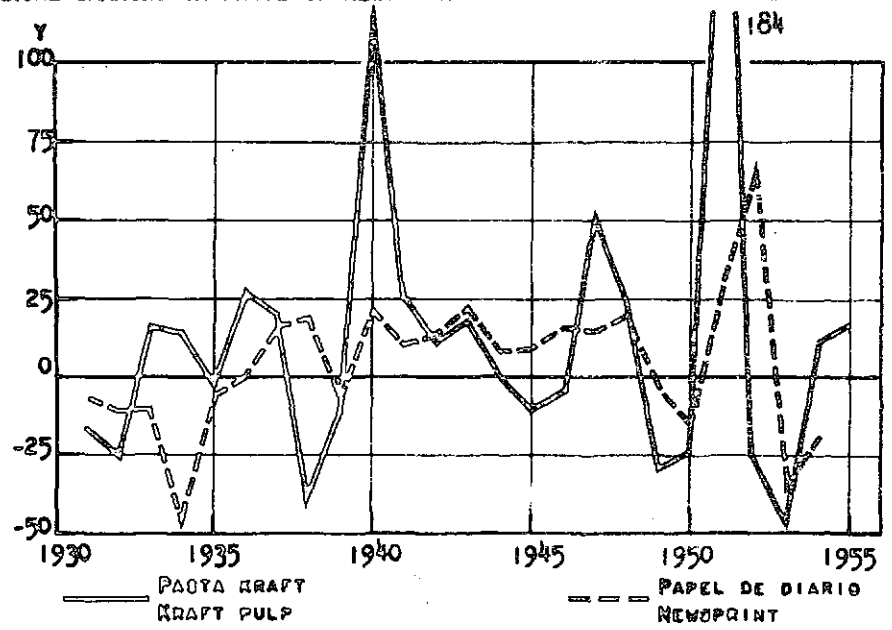
FUENTE: HISTORICAL STATISTICS OF THE US 1789-1945
SOURCE: STATISTICAL ABSTRACTS OF THE US 1954
WOOD PULP STATISTICS 1953

FIGURA I - II

FIGURE I - II

VARIACIONES ANUALES DEL PRECIO DEL PAPEL DE DIARIO Y DE LA PASTA KRAFT IMPORTADOS POR CHILE

ANNUAL CHANGES IN PRICE OF NEWSPRINT AND KRAFT PULP IMPORTED TO CHILE



Y - POR CIENTO DE CAMBIO SOBRE EL AÑO ANTERIOR
PER CENT CHANGE OVER PREVIOUS YEAR

FIGURA I - III
FIGURE I - III

RELACION ENTRE EL COEFICIENTE DE ELASTICIDAD (k) PARA EL PAPEL DE DIARIO Y EL PRODUCTO BRUTO NACIONAL POR HABITANTE (x)

RELATIONSHIP BETWEEN ELASTICITY COEFFICIENT (k) FOR NEWSPRINT AND GROSS NATIONAL PRODUCT PER CAPITA (x)

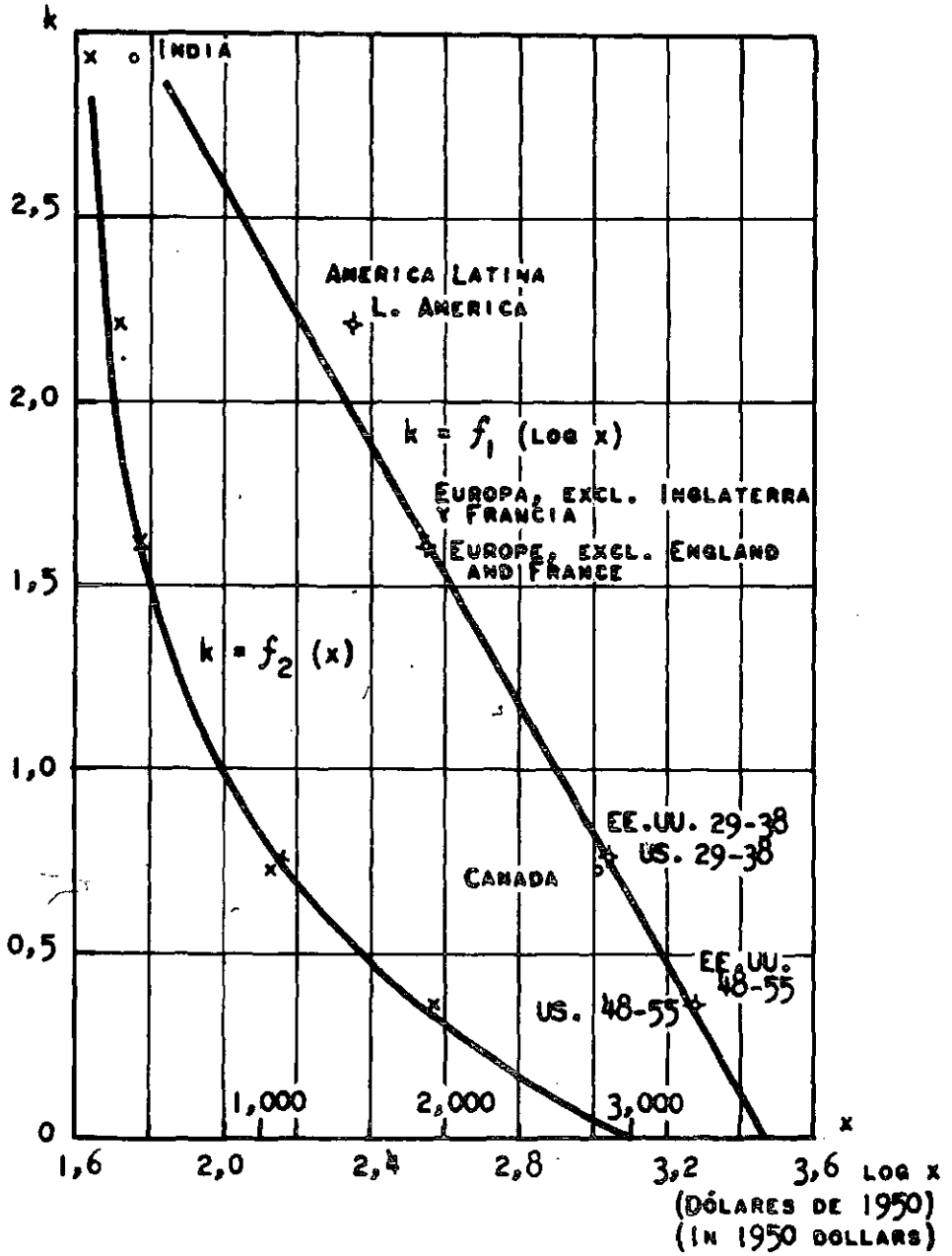


FIGURA I - IV
FIGURE I - IV

VARIACION DEL COEFICIENTE DE ELASTICIDAD PARA TODOS LOS PAPELES Y CARTONES, EXCEPTO PAPEL DE DIARIO, CON EL INGRESO POR HABITANTE

VARIATION OF ELASTICITY COEFFICIENT FOR ALL PAPERS AND BOARDS, EXCEPT NEWSPRINT, WITH PER CAPITA INCOME

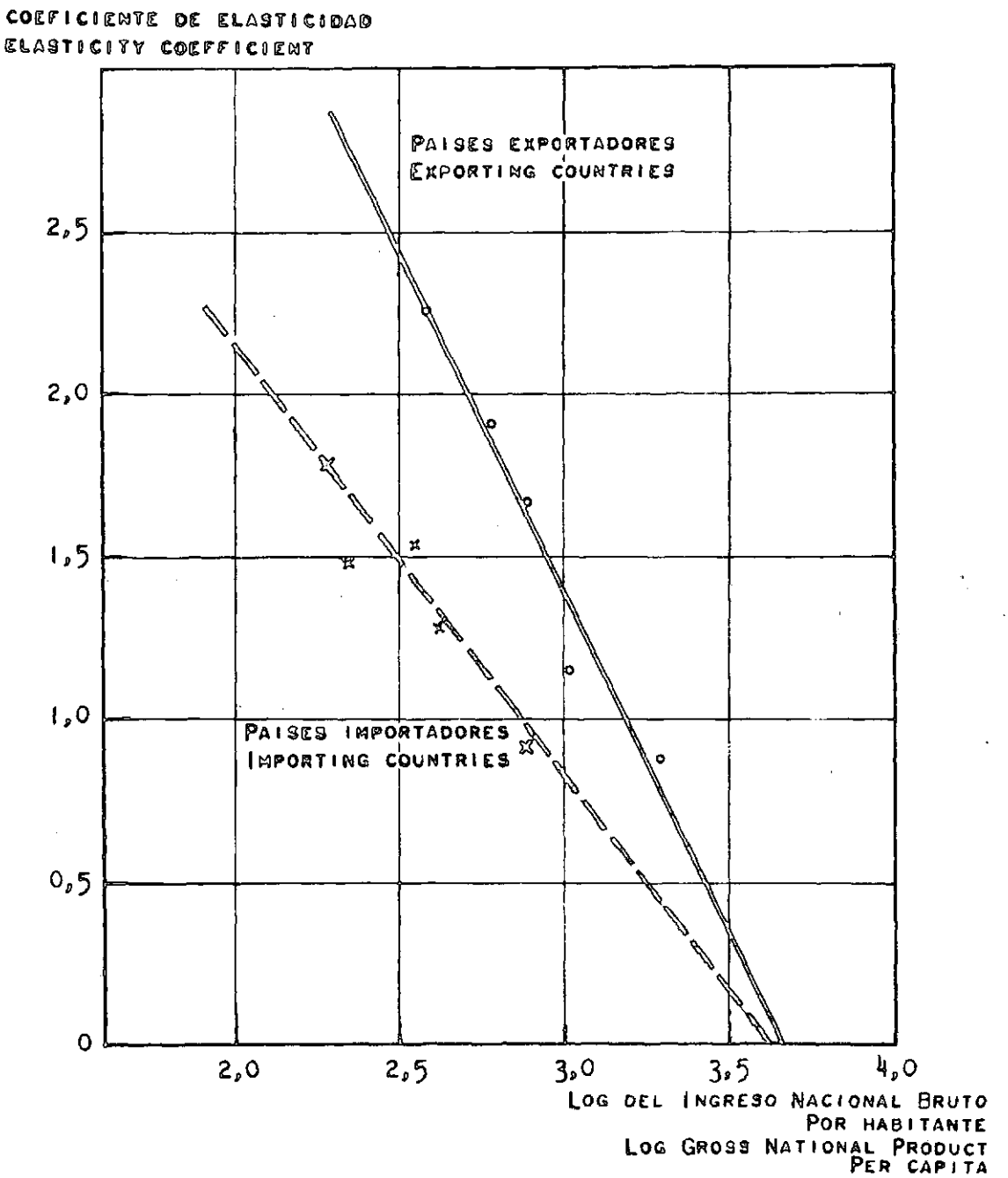


FIGURA I - V
FIGURE I - V

RELACION ENTRE EL CONSUMO DE PAPEL DE DIARIO Y EL PRODUCTO BRUTO NACIONAL POR HABITANTE

RELATIONSHIP BETWEEN NEWSPRINT CONSUMPTION AND GROSS NATIONAL PRODUCT PER CAPITA

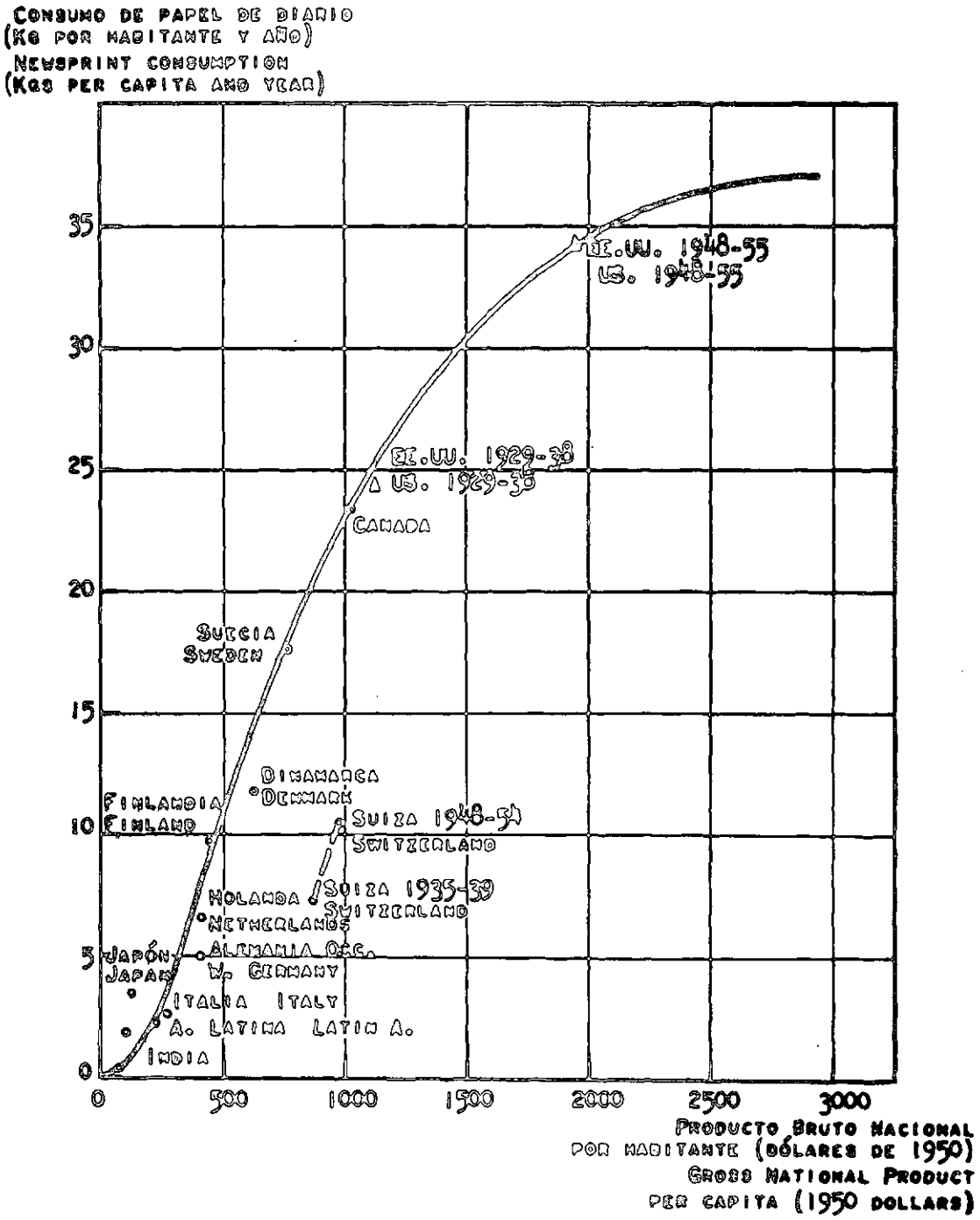


FIGURA I - VI
FIGURE I - VI

CONSUMO DE TODOS LOS PAPELES Y CARTONES,
EXCEPTO PAPEL DE DIARIO, EN FUNCION DEL INGRESO POR HABITANTE

CONSUMPTION OF ALL PAPERS AND BOARDS,
EXCEPT NEWSPRINT, AS A FUNCTION OF PER CAPITA INCOME

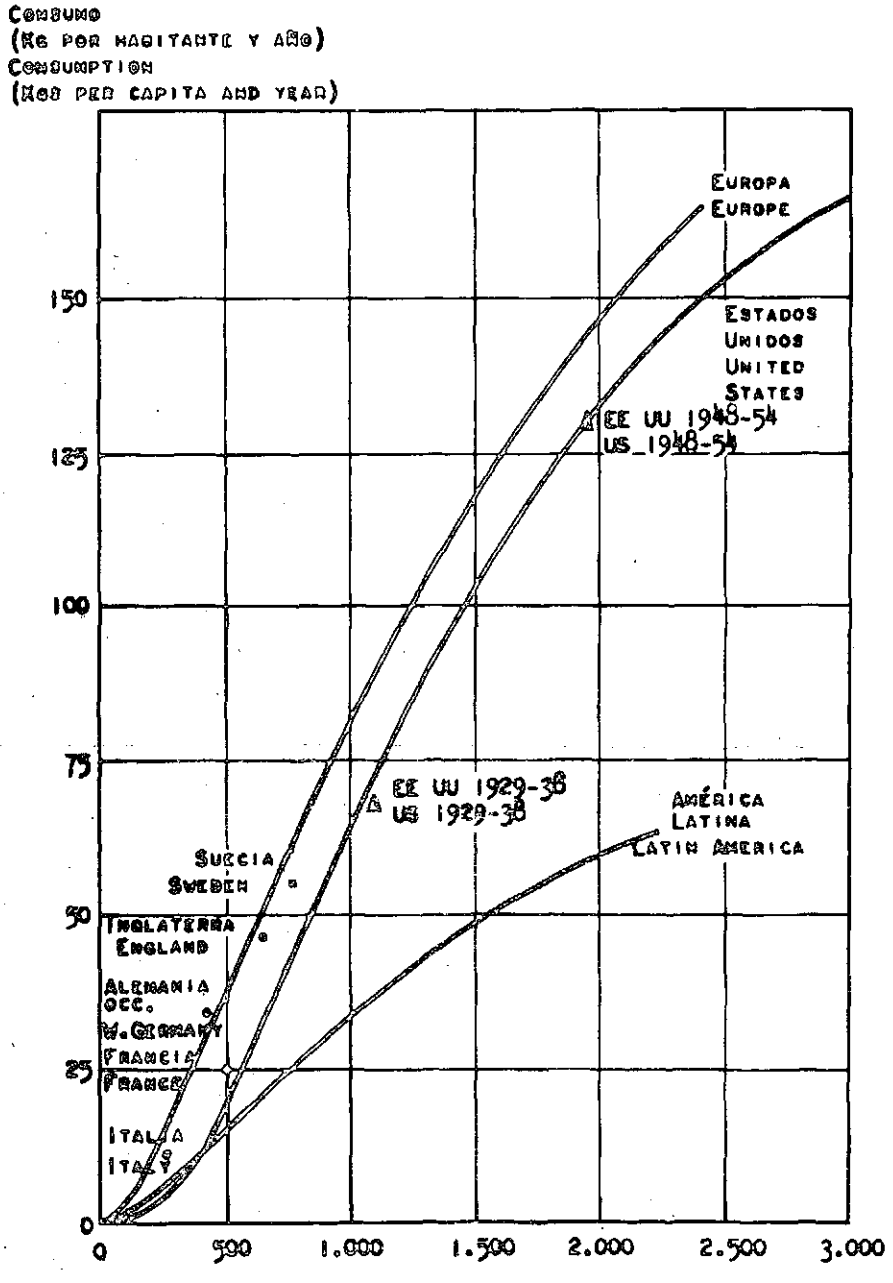
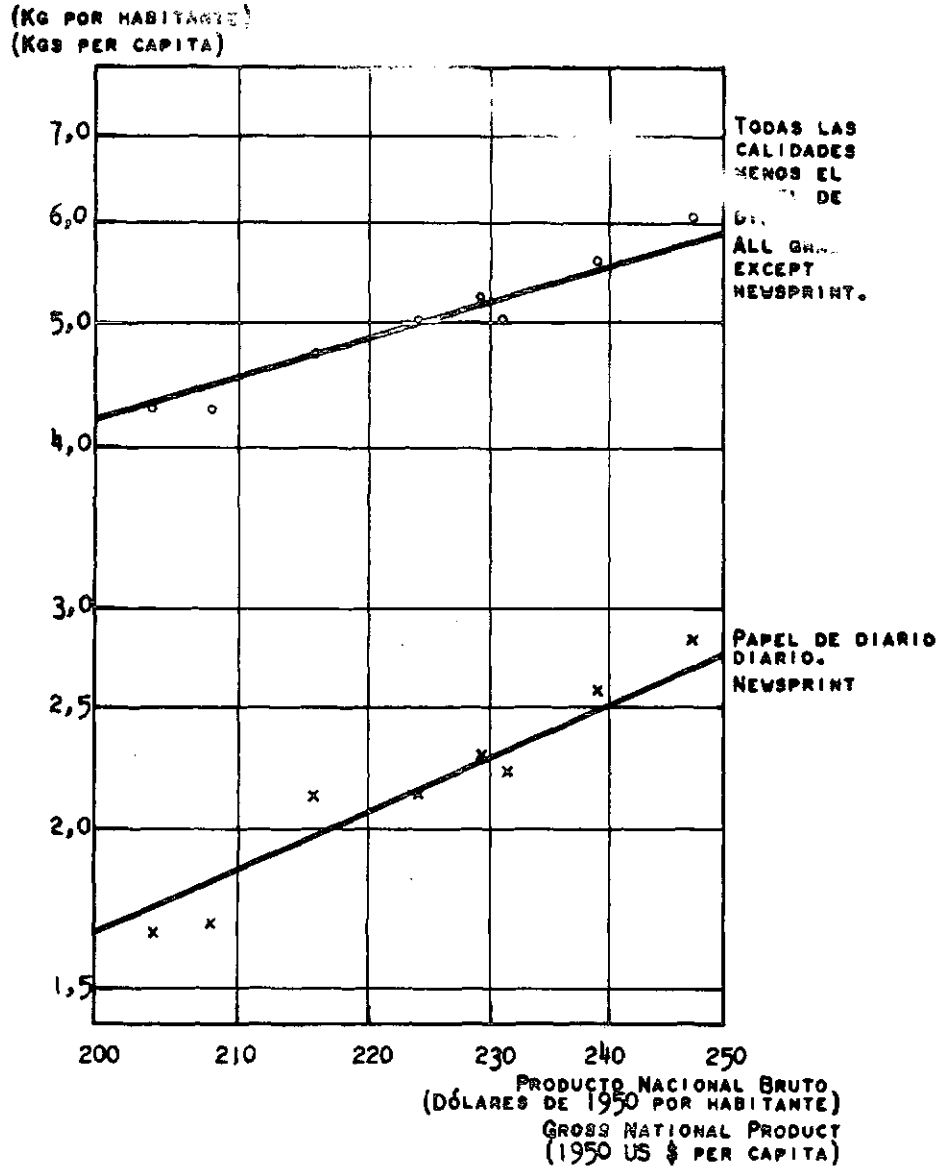


FIGURA I - VII
FIGURE I - VII

CORRELACION ENTRE EL PRODUCTO BRUTO POR HABITANTE Y EL CONSUMO DE PAPELES Y CARTONES POR HABITANTE Y AÑO EN TODOS LOS PAISES LATINOAMERICANOS CON EXCEPCION DE ARGENTINA

CORRELATION BETWEEN PER CAPITA GROSS PRODUCT AND PAPER AND BOARD CONSUMPTION PER HEAD AND YEAR IN ALL LATIN AMERICAN COUNTRIES EXCEPT ARGENTINA

1948 - 1955



ECUACIONES PARA LAS LINEAS AJUSTADAS MATEMÁTICAMENTE :

PAPEL DE DIARIO : $\text{Log } Y = 2.2112 \text{ Log } X - 4.86327$
TODAS LAS DEMÁS CALIDADES : $\text{Log } Y_1 = 1.4718 \text{ Log } X - 2.76456$

EQUATIONS FOR MATHEMATICALLY FITTED CURVES :

NEWSPRINT : $\text{Log } Y = 2.2112 \text{ Log } X - 4.86327$
ALL OTHERS : $\text{Log } Y_1 = 1.4718 \text{ Log } X - 2.76456$

Appendix I-A

EXPORTS OF NEWSPRINT FROM NORTH AMERICA AND EUROPE

	1937	1948	1949	1950	1951	1952	1953	1954	1955
Exports from Europe to									
Europe	99	150	255	284	284	373	359	413	
North America	267	236	218	146	179	163	148	115	113
Latin America		126	147	223	196	154	147	136	
Asia	206	75	74	71	61	66	110	89	404
Africa		15	16	41	31	46	57	43	
Oceania		14	89	129	134	85	134	139	
Extra regional exports:	473	466	544	610	601	514	596	522	517
Net exports	143	395	426	572	502	361	437	215	170
Exports from North America to									
North America	2,762	3,554	3,943	4,287	4,332	4,401	4,461	4,417	4,559
Europe	330	71	118	38	99	153	159	307	347
Latin America		167	145	115	151	212	171	244	
Asia	395	58	49	34	59	43	46	65	492
Africa		35	51	9	21	45	26	30	
Oceania		69	74	37	41	74	56	73	
Extra regional exports	725	400	437	233	371	527	458	719	839
Net exports	458	164	219	87	192	364	310	604	726
Total exports to deficit regions	601	559	645	659	694	725	747	819	923

Sources: 1937: Newsprint trends 1928-51, February 1954. N° 10; UNESCO and Newsprint Data 1953; Newsprint Association of Canada. 1948-55 FAO Yearbook of Forest Products Statistics. 1955 Newsprint Data 1955, op. cit.

Appendix I-B

NORTH AMERICA AND EUROPE: EXPORTS OF WOOD PULP (ALL GRADES)

(Millions of tons)

	1937	1948	1949	1950	1951	1952	1953	1954	(1955)
Export from Europe a/ to:									
Europe b/	3.121	2.162	2.458	2.893	3.035	2.518	2.998	3.469	3.748
North America	1.404	0.439	0.504	0.537	0.395	0.374	0.463	0.333	0.320
Latin America	0.206	0.145	0.238	0.319	0.326	0.186	0.242	0.320	0.327
Asia				0.068	0.041	0.035	0.095	0.044	0.035
Africa	0.283	0.103	0.113	0.008	0.014	0.007	0.021	0.023	0.040
Oceania				0.034	0.058	0.032	0.051	0.057	0.057
Extra regional exports:	1.893	0.687	0.855	0.966	0.834	0.634	0.872	0.777	0.779
Net exports	1.654	0.495	0.697	0.820	0.465	0.306	0.583	0.257	0.090
Export from North America to:									
North America	0.572	1.473	1.215	1.557	1.683	1.466	1.476	1.549	1.752
Europe	0.139	0.192	0.258	0.146	0.369	0.328	0.289	0.520	0.659
Latin America	0.007	0.032	0.019	0.030	0.072	0.087	0.055	0.170	0.170
Asia				0.010	0.071	0.048	0.081	0.104	0.096
Africa	0.215	0.050	0.041	-	-	0.001	0.001	0.004	0.005
Oceania				0.005	0.007	0.012	0.005	0.009	0.011
Extra regional exports	0.361	0.274	0.318	0.191	0.519	0.476	0.431	0.807	0.971
Net exports	-1.043	-0.165	-0.186	-0.346	0.124	0.102	-0.032	0.474	0.651
Total exports to deficit regions	0.611	0.330	0.511	0.474	0.589	0.408	0.551	0.731	0.741

Source: FAO Yearbook of Forest Products Statistics; 1951, 1953, 1954 and 1955. Wood Pulp Statistics 1951 and 1956; U.S. Pulp Producers Association.

a/ Sweden, Finland, Norway, Austria and Germany. Postwar export from Germany incl. only western Germany.

b/ Refers to the whole of Europe.

APPENDIX I-C

LATIN AMERICA: PRODUCTION, IMPORT AND APPARENT CONSUMPTION OF NEWSPRINT

(Thousands of tons)

	1948		1949		1950		1951		1952		1953		1954		1955	
	Production	Imp.	Production	Imp.	Production	Imp.	Production	Imp.	Production	Imp.	Production	Imp.	Production	imp.	Production	Imp.
Argentina	-	121	-	117	3	101	3	109	1	92	8	29	19	43	22	89
Bolivia	-	x	-	3	-	3	-	2	-	2	-	2	-	3	-	1
Brazil	26	53	31	47	31	61	34	79	39	82	37	105	27	130	32	130
Chile	6	15	8	14	11	19	11	13	12	10	9	11	12	10	11	14
Colombia	-	15	-	11	-	20	-	14	-	16	-	17	-	19	-	21
Costa Rica	-	1	-	1	-	2	-	2	-	2	-	2	-	2	-	3
Cuba	-	27	-	27	-	32	-	28	-	27	-	27	-	31	-	28
Dominican Rep.	-	2	-	1	-	1	-	1	-	1	-	1	-	2	-	2
Ecuador	-	3	-	2	-	6	-	3	-	4	-	4	-	5	-	5
El Salvador	-	2	-	2	-	2	-	3	-	3	-	3	-	3	-	4
Guatemala	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2
Haiti	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x
Honduras	-	x	-	x	-	1	-	1	-	1	-	x	-	1	-	1
Mexico	-	58	-	58	4	36	-	52	-	82	-	65	-	61	-	60
Nicaragua	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1
Panama	-	3	-	3	-	2	-	2	-	2	-	2	-	2	-	2
Paraguay	-	x	-	x	-	x	-	1	-	1	-	x	-	x	-	x
Peru	-	6	-	10	-	8	-	11	-	10	-	10	-	12	-	15
Uruguay	-	16	-	17	-	16	-	16	-	20	-	20	-	22	-	24
Venezuela	-	8	-	8	-	11	-	13	-	14	-	14	-	16	-	21
Total	32	332	39	324	49	322	48	353	52	372	54	315	58	365	65	423
Consumption	364		363		371		401		424		369		423		488	

Sources: Figures for Argentina: Pulp and Paper Advisory Group.
Figures for Brazil (production): 1951/54. O Papel, December 1955; 1955, ECLA.
Figures for Chile (production): 1951/55: Pulp and Paper Advisory Group.

All the other figures were obtained from the following sources: ECLA, Newsprint data 1953, 1955 and 1956, foreign trade statistics of several countries and from estimates of the Pulp and Paper Advisory Group.

PRODUCTION, IMPORT AND APPARENT CONSUMPTION OF ALL PAPERS AND BOARDS EXCEPT NEWSPRINT IN LATIN AMERICA

(Metric tons)

	1948		1949		1950		1951		1952		1953		1954		(1955)	
	Prod.	Import	Prod.	Import	Prod.	Import	Prod.	Import	Prod.	Import	Prod.	Import	Prod.	Import	Prod.	Import
Argentina	177,189	87,950	177,785	104,935	208,166	54,021	227,616	87,517	199,416	70,174	166,831	4,775	210,180	14,518	262,049	37,114
Bolivia	500	1,100	500	1,100	500	1,200	1,000	3,000	500	3,000	500	897	500	1,129	500	1,100
Brazil	161,402	11,300	185,920	6,800	216,935	9,800	227,044	13,000	229,347	15,000	254,443	7,600	287,325	14,800	300,547	16,100
Chile	97,600	631	36,100	762	33,800	1,014	36,000	602	45,000	460	41,989	438	39,639	598	41,919	1,000
Colombia	-	20,300	-	27,200	-	40,900	-	38,000	-	33,000	-	32,000	-	20,997	10,620	40,548
Costa Rica	-	2,600	-	2,500	-	1,800	-	1,600	-	2,000	-	4,500	-	4,124	4,200	3,500
Cuba	26,000	55,000	22,000	48,000	34,000	39,000	35,000	41,000	35,000	42,000	35,000	36,019	35,000	39,892	35,000	40,000
Dominican Rep.	..	2,200	..	2,400	200	2,500	..	5,000	..	6,000	..	5,000	..	4,596	-	8,100
Ecuador	200	3,100	300	3,700	400	5,300	400	5,000	0	3,000	0	5,614	0	5,888	-	6,000
El Salvador	-	2,000	-	1,900	-	1,900	-	5,000	-	3,000	-	4,500	-	4,614	-	8,200
Guatemala	-	4,900	-	3,800	-	4,100	-	4,000	-	4,000	-	4,000	-	4,000	-	3,400
Haiti	-	1,500	-	1,700	-	1,500	-	1,000	-	1,000	-	1,600	-	1,800	-	1,500
Honduras	-	500	-	800		2,200	-	1,000	-	1,000	-	2,300	-	2,500	-	2,500
Mexico	112,200	21,200	119,900	16,100	124,900	8,400	154,000	8,000	188,000	8,000	186,339	24,705	212,150	27,371	247,000	3,070
Nicaragua	-	1,000	-	1,000	-	2,000	-	1,000	-	1,000	-	1,000	-	1,000	-	1,500
Panama	-	5,700	-	5,800	-	5,800	-	4,000	-	9,000	-	6,238	-	6,954	-	3,300
Paraguay	-	1,600	-	1,600	-	1,400	-	1,000	-	1,000	-	1,500	-	1,500	-	800
Peru	17,800	3,000	19,600	4,000	16,500	4,800	20,000	6,000	25,000	6,000	25,000	6,712	30,000	5,118	28,464	6,220
Uruguay	29,600	5,600	19,500	6,200	30,000	8,000	30,000	8,000	30,000	9,000	25,000	2,914	24,800	3,636	26,500	4,000
Venezuela	8,700	29,900	8,400	29,800	7,700	31,700	8,000	36,000	9,000	30,000	6,500	40,346	6,400	41,808	14,500	35,000
Total	584,191	254,281	584,006	264,097	679,201	268,195	799,060	269,719	747,269	295,634	741,602	192,658	846,988	206,917	970,693	229,552
Apparent consumption (1,000 tons)	838		848		941		1,009		983		934		1,054		1,194	

Sources: United Nations Economic Commission for Latin America and Food and Agriculture Organization - Trade journals and national statistics.

Appendix 1 - E

EUROPE AND NORTH AMERICA: EXPORTS OF CHEMICAL AND MECHANICAL PULP TO LATIN AMERICA 1937-54

(Tons)

Sweden	Norway	Finland	Austria	Germany	Total Europe	Canada	United States	Total North America	Total
26,730	21,174	15,568	907	5,445	70,220	1,915	4,065	5,980	73,620
63,698	203	18,598	821	9,574	108,774	405	914	1,319	110,093
112,968	21,377	34,504	1,728	9,017	178,954	1,720	4,999	6,719	185,673
29.8	99.0	46.3	52.5	60.4	39.2	76.5	81.8	80.4	40.7
7,581	1,336	17,766	-	-	26,683	-	-	-	26,683
49,917	-	12,175	-	-	61,492	4,756	8,214	12,970	74,462
66,686	-	15,094	-	-	81,780	4,757	13,858	18,615	100,955
116,603	-	27,269	-	-	143,272	9,513	22,052	31,585	174,857
42.5		44.6			42.9	50.0	37.2	41.1	42.6
1,551	-	240	-	-	1,791	-	-	-	1,791
69,188	2,742	18,706	9,072	-	99,708	2,809	7,881	10,690	110,398
90,326	-	31,141	7,256	-	128,725	2,198	6,575	8,773	137,498
159,514	2,742	49,847	16,328	-	228,433	5,007	14,456	19,463	247,896
43.4	100.0	37.8	55.6		43.6	56.1	54.5	54.9	44.5
7,257	-	2,605	-	-	9,862	-	-	-	9,862
52,661	7,919	19,866	11,650	183	131,678	9,478	14,563	18,431	150,119
121,764	456	42,230	6,581	-	171,071	6,499	5,212	11,703	182,784
214,425	7,815	62,560	18,231	182	302,749	9,971	20,175	30,146	332,903
43.2	98.7	32.8	69.9	100.0	43.5	94.9	74.2	61.2	45.1
18,548	-	3,492	302	-	16,340	-	-	-	16,340
88,503	4,209	28,673	2,722	-	124,109	12,082	24,974	37,776	161,885
119,596	889	51,191	2,268	-	167,884	16,228	18,150	34,378	202,262
202,042	5,097	79,864	4,991	-	291,993	29,030	43,114	72,154	364,147
43.8	82.6	35.9	54.5	-	42.5	44.1	57.9	52.4	44.5
24,214	700	9,154	-		34,068	015	-	015	34,083
52,227	4,565	21,657	4,007	636	83,262	16,218	29,044	45,262	128,524
62,669	-	29,036	504	150	92,759	13,170	28,668	41,838	134,597
115,603	4,565	50,739	4,911	286	176,021	29,388	57,712	87,100	263,121
45.8	100.0	42.8	81.6	27.3	47.3	55.2	50.9	52.0	48.8
1,839	100	8,255	-	-	10,914	-	-	-	10,914
85,504	9,161	11,664	-	-	100,499	4,554	33,729	38,283	138,716
99,502	-	19,722			119,226	7,716	8,831	16,547	135,773
185,052	9,161	31,406			219,659	12,270	42,560	54,830	274,489
45.2	100.0	37.2			45.7	37.1	79.3	69.8	50.5
8,160	-	9,826			17,986	-	-	-	17,986
80,199	7,641	30,296	475	-	118,611	19,456	77,082	96,538	215,149
87,305	821	79,254	-		167,981	27,682	39,172	66,854	234,835
168,103	8,462	109,550	475		286,592	47,138	116,254	163,392	449,984
47.7	90.3	27.7	100.0		41.4	41.3	66.3	59.1	47.8
12,618	-	21,291	-		33,901	7,983	-	7,983	41,883
61,852	9,450	50,557	3,958	-	125,297	19,808	54,016	119,824	289,121
70,657	811	99,747	900	-	172,115	19,042	35,249	54,291	226,406
132,549	10,261	150,904	4,258		297,412	38,850	129,265	168,115	465,527
46.7	92.1	33.6	79.1	-	42.1	51.0	72.7	67.7	51.4
14,538	-	19,792	514	-	29,844	-	-	-	29,844

and 1939. U.S. Pulp Producers Association.
ted figures. - Not available.

APPENDIX I-F

CHILE: PROJECTION OF DEMAND FOR NEWSPRINT AND OTHER PAPERS AND BOARDS IN 1960 AND 1965

Year	Newsprint	Other papers and boards	Total	Population (Thousands)	Per capita consumption		Total per capita consumption (kilogrammes)	Gross national product per capita (dollars at 1950 prices)
					Newsprint	Papers and boards		
	(Tons)				(kilogrammes)			
1948	20,753	38,231	58,984	5,854	3.55	6.53	10.08	290
1949	22,023	36,862	58,885	5,962	3.69	6.18	9.87	297
1950	30,038	34,914	64,952	6,073	4.95	5.75	10.70	303
1951	25,000	36,602	61,602	6,185	4.04	5.92	9.96	296
1952	21,602	45,460	67,062	6,299	3.43	7.22	10.65	312
1953	22,643	42,427	65,070	6,437	3.52	6.59	10.11	316
1954	23,663	40,171	63,834	6,447	3.67	6.23	9.90	328
(Average) 1948/54 (1951)	23,675	39,238	62,913	6,180	3.84	6.35	10.18	306
1954	27,464	44,613	72,077	6,447	4.26	6.92	11.18	325
1956	31,262	50,377	81,639	6,901	4.53	7.30	11.83	338
1957	33,327	53,365	86,692	7,031	4.74	7.59	12.33	345
1958	34,955	55,728	90,683	7,163	4.88	7.78	12.66	352
1960	38,800	61,397	100,197	7,433	5.22	8.26	13.48	366
1965	49,507	76,666	126,173	8,156	6.07	9.40	15.47	404

Notes: The following elasticity coefficients were used: newsprint: 1.8; other papers and boards: 1.5.
The assumption was that the gross product per capita would grow at an annual rate of 2 per cent, or at the historical rate registered in 1940/54.
The growth rate of the population was that corresponding to 1937/55, or 1.88 per cent.

ANNEX II

FORESTRY ASPECTS

A. PLANTATIONS OF PINUS RADIATA IN THE SOUTHERN AREA OF CENTRAL CHILE

For many years forest exploitation has been acquiring growing importance in Chile, both on account of the volume and the value of production. This process, however, has damaged large stands of natural forests, whose destruction has given rise to a rapid process of erosion with all its serious consequences. A partial reaction against such devastation set in at the end of the nineteenth century and acquired remarkable impetus by 1930, when the plantation of rapid growing exotic species in deforested areas unfit for other uses was initiated. The artificial forests thus created have become very significant for soil conservation, but they are still more important as an actual and potential source of industrial raw materials. In order to obtain an exact appraisal of the importance of artificial forests in this respect, the Corporación de Fomento de la Producción, in 1952-53 made a complete inventory of forest plantations in the Provinces of Maule, Linares, Ñuble, Bío-Bío, Concepción, Arauco and Malleco, that is the southern area of central Chile (approximately between parallels 35° and 38° S.) which is where most of them have been established. The present notes have been taken from the Report 1/ on this survey.

1. Forested areas and soils

The seven provinces mentioned above lie in a central valley which runs north and south, flanked by the Andes, with a maximum height of some 5,000 metres and the old, worn-down hills of the Cordillera de la Costa which only in a few places rise above 1,000 metres. It is on the latter, which used to be covered by native forests that reforestation has mainly progressed. Other important plantations are found in some alluvial terraces of the central valley, which often extend to the first foothills of the Andes.

In 1953, the total area under artificial forests amounted to almost 190,000 hectares, as shown in table II-1.

It should be noted that the inventory excludes plantations of less than one hectare and trees outside the forest (windbreaks, avenues, small stands for shelter, etc.)

Pinus radiata, which in Chile is known as "pino insignis", stands out in the following table. It was introduced to Chile in 1885 and spread quickly because it grows very fast; yet the wood neither warps nor splinters easily and is good for a number of uses. It is planted between May and September, usually at distances of 2 metres (2,500 trees per hectare) or, less frequently, it is reproduced from seed trees.

In 1953 the Pinus radiata forests were classified according to age. (See table II-2).

The table shows that in the years 1943-53 between 10 and 15,000 hectares were planted annually with this species in the area being considered. Moreover, most stands are young, although, as will be shown later, they are already reaching the age of maximum economic yield.

To determine the quality of Pinus radiata plantations with regard to yields, the system of "site indices" was used. This classification has been based on average total height (site index) which the dominant and co-dominant trees of the stand had, have, or will have when they are twenty years old. In order to simplify the method, the site indices -from 40 to 140 feet- have been grouped in five groups or "site classes" 2/ (See table II-3).

1/ *"Mensura de las plantaciones forestales de las provincias de Linares a Malleco" Corporación de Fomento de la Producción de Chile, Santiago, 1955.*

2/ *For comparison with N. Zealand classification of sites see: Preface and comments to 2nd edition.*

Table II-1

AREA UNDER PLANTATIONS, BY PROVINCES AND SPECIES IN APRIL 1953

(Hectares)

Province	Pinus radiata	Eucalyptus Sp.	Other a/ species	Total
Linares	1,907	272	694	2,873
Maule	33,257	488	575	34,320
Ñuble	18,333	279	182	18,794
Concepción	62,331	7,582	1,434	71,347
Arauco	19,769	3,017	990	23,776
Bio-Bio	21,810	20	65	21,895
Malleco	16,131	176	59	16,366
Total	173,538	11,834	3,999	189,371
Percentage	91.6	6.3	2.1	100.0

a/ Populus nigra var. italica, Cupressus Macrocarpa Gord., Pinus Pinaster Art., Acacia melanoxylon R. Br., etc. and forests made up of two or more species.

Table II-2

AREA UNDER PINUS RADIATA, BY PROVINCES AND AGE GROUPS; 1953

(Hectares)

Age (year)	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25 & more	Total
Provinces										
Linares	282	1,005	262	113	200	31	8	5	1	1,907
Maule	13,407	11,381	5,125	2,880	180	154	130	-	-	33,257
Ñuble	2,598	3,390	6,516	2,914	2,204	539	69	27	76	18,333
Concepción	5,636	12,832	15,697	12,483	9,983	3,597	746	823	534	62,331
Arauco	4,163	10,153	2,783	1,438	782	437	-	-	-	19,756
Bio-Bio	3,364	4,041	6,297	5,676	1,443	827	156	11	13	21,810
Malleco	5,913	4,461	2,399	2,193	899	132	17	45	72	16,131
Total (ha)	35,363	47,263	39,079	27,697	15,691	5,717	1,126	911	696	173,543
(%)	20.38	27.23	22.52	15.96	9.04	3.29	0.65	0.53	0.40	100.00

Table II-3

PLANTATIONS OF PINUS RADIATA, RELATIONSHIP BETWEEN SITE INDICES AND CLASSES

Site class	Site index
I	120 - 140 feet
II	100 - 120 "
III	80 - 100 "
IV	60 - 80 "
V	40 - 60 "

According to this grouping, the plantations of this species are distributed as shown in table II-4:

Table II-4

PINUS RADIATA: AREA OF PLANTATIONS BY SITE CLASS, IN APRIL 1953

Site class	Area	
	Hectares	Percentage
I	435	0.25
II	2,793	1.61
III	31,377	18.08
IV	66,853	38.52
V	72,080	41.54
Total	173,538	100.00

The determination of limit curves for site indices was made on the basis of representative samples distributed evenly throughout the surveyed area. Thus, when the previous table revealed that plantations were concentrated in the lowest site classes, it confirmed one of the factors observed in the field, namely, that the major share of plantations are found in sandy areas, eroded slopes and other poor soils.

If the plantations are appraised in absolute figures and within the general economic framework of the country, there is no doubt that the effort developed in these provinces is remarkable. But there is still much to be done. In fact, when 189,371 hectares of forest plantations were inventoried, it was, at the same time, estimated that there were 1,476,451 hectares of land which on account of natural conditions or erosion should be covered by forests. This means that only 11.4 per cent of the reforestable area has as yet been planted and that there are vast tract lands available which are only suitable, from the economic viewpoint, for forestry.

2. Volume in Plantation of Pinus Radiata (1953)

The volumes indicated below are actual gross cubic content, that is, the solid volume, without deduction for defects.

Diameters were measured at breast-height (4.5 feet above the ground) for diameter groups of even numbers of inches. Each group ranges from 2n - 0.9 to 2n - 1 inches. When calculating actual volumes only trees from 5.1 inches up (diameter group 6) at breast-height were included 3/.

In assessing the volumes of wood suitable for sawn goods and pulping the following criteria were used: as sawlogs were defined logs 12 ft. long with a minimum diameter of 12 inches with bark; pulpwood includes logs 4 ft. long with a minimum diameter of 4 inches with bark. According to these criteria, the volumes listed in table II-5 were obtained.

Table II-5

ACTUAL CUBIC VOLUMES OF PLANTATIONS OF PINUS RADIATA, BY USE

(Cubic foot)

Age group (1953)	Pulpwood	Actual cubic volume sawlogs	Total
1 - 3	-	-	-
4 - 6	2,903,150	-	2,903,150
7 - 9	28,254,140	85,500	28,339,640
10 - 12	87,246,590	715,690	87,962,280
13 - 15	115,720,180	6,370,910	122,091,090
16 - 18	52,188,840	7,950,650	60,139,490
19 - 21	11,977,860	2,437,060	14,414,920
22 - 24	10,502,700	3,137,400	13,640,100
25 and over	8,546,800	7,129,360	15,676,160
Total	317,340,260	27,826,570	345,166,830

3. Growth and yields of pinus radiata plantations 4/

Forecasts of yields for Pinus radiata plantations have been based on a special study of growth according to the site class of each stand. Rotation period was calculated according to the criterion of maximum yield, that is to say, it corresponds for each site class to the age in which annual average growth (in useful volume) per hectare over the whole period is maximum.

The difference in yields between the classes of site is large (see table II-6).

3/ *Excluding the stump (1 ft. from the ground and the bark).*

4/ *Referring to the yields, see also Appendix 2c.*

Table II-6

AVERAGE MAXIMUM ANNUAL GROWTH IN PLANTATIONS OF PINUS RADIATA

Site class	Maximum average annual growth (c.ft.)	Maximum average annual growth (m3) a/	Age (years)
I	2,189	62	25
II	1,574	44	25
III	1,112	31	24
IV	723	20	24
V	320	9	22

a/ Useful volume.

On the basis of table II-6 and of the proportion in which the various site classes are found (table II-4), the average maximum yield for all Pinus radiata plantations surveyed in 1953 is 642 cubic feet (18.2 cubic metres) of solid wood without bark per hectare and year.

The calculation (stand by stand) on the basis of rotation periods and calculated yields is shown in the following summary table II-7:

Table II-7

PINUS RADIATA PLANTATIONS: FUTURE YIELDS

(Base: 1953)

Period	Estimated useful volume: cft per year		
	Pulpwood	Sawlogs	Total
1956-1958	11,759,880	2,369,860	14,129,740
1959-1961	30,589,820	10,888,770	41,478,590
1962-1964	94,282,830	41,793,630	136,076,460
1965-1967	105,910,260	44,894,400	150,804,660
1968-1970	124,081,470	54,947,690	179,029,160
1971-1973	127,772,860	54,952,360	182,725,220

4. Forest ownership

Of the Pinus radiata plantations, 84.3 per cent (area) belong to private concerns, while only 0.4 per cent belongs to the State, and 15.2 per cent to para-Statal organizations. A little over one-sixth of private stands of this species have been sold by lots to small investors who have bought from one hectare and more on 3 to 6-year paying terms (see table II-8).

Table II-8

PINUS RADIATA PLANTATIONS: OWNERSHIP DISTRIBUTION

Ownership	Area	
	Hectares	Percentage
State	608	0.4
Para-statal organizations:		
Corporación de Fomento	4,332	0.5
Caja de EE.PP. y PP.	11,676	6.7
Servicio de Seguro Social	7,672	4.4
Caja de Colonización Agrícola	2,852	1.6
Total Para-Statal	26,532	15.2
Municipal	144	0.1
Private		
Small lots (parcelaciones)	25,214	14.5
Other property	121,040	69.8
Total private	146,254	84.3
Grand total	173,538	100.0

The size distribution of the holdings is shown in table II-9.

Table II-9

DISTRIBUTION OF THE AREA UNDER PINUS RADIATA, BY SIZE OF HOLDINGS

Size of the holdings (hectares)	Owner a/		Area	
	Number	Percentage	Hectares	Percentage
1 - 10	591	37.6	4,503	2.6
11 - 30	369	23.5	6,950	4.0
31 - 60	189	12.0	8,086	4.6
61 - 100	115	7.3	8,870	5.1
101 - 250	154	9.8	24,073	13.9
251 - 500	75	4.8	25,852	14.9
501 - 1,000	45	2.9	31,188	18.0
1,001 and over	33	2.1	64,016	36.9
Total	1,571	100.0	173,538	100.0

a/ Properties sold by lots were taken as units, since according to the law in force, the purchasers must remain grouped in co-operatives or societies in order to care for an exploit the forest.

5. *Production and consumption of pinus radiata wood*

Very little statistical information is available on the production and consumption of wood, and most available data are assumed to be under-estimated. Moreover, no information is available on production in Maule, so that the production of this province is not included in the totals given below. Production of sawnwood from Pinus radiata in the six remaining provinces usually equals or almost equals total production in the country (see table II-10).

Table II-10

PRODUCTION, EXPORT AND APPARENT DOMESTIC CONSUMPTION OF PINUS RADIATA SAWNTIMBER

(Thousands of "pulgadas" a/)

	1949	1950	1951	1952	1953
Production	2,127	2,491	1,156	2,312	1,626
Export	963	1,315	350	194	874
Apparent consumption	1,164	1,176	806	2,118	752

a/ A "pulgada" in the case of Pinus radiata is a board 1 in. by 10 ins. by 3.20 metres, which is equivalent to about 0.73 cft.

Consumption of wood for pulping has totalled about 1.5 million cubic feet annually, exclusively for the production of mechanical pulp. No statistics are available on consumption for other uses.

6. *Damages*

Damages in plantations are caused by insects, diseases, fire and climatic factors.

Among the most important damages are those caused by the "pine bug" and the "pine caterpillar". The former belongs to the homoptera of the Adelgidae family, called the Pineus Borneri Ann. It is found in almost all Pinus radiata plantations, but has not to date constituted a real problem.

The caterpillars belong to the Saturnidae Lepidoptera species, and the most important sub-species seems to be Dirphia amphimone (F) Berg, which in its larval state eats the pine needles. Fortunately, it only attacks some specimens, which are then retarded in their growth. Also, a natural biological equilibrium seems to exist between this plague and its natural predators, so that it has not become a serious nuisance.

A fungoid complex also attacks Pinus radiata. Diplodia pinea (Desm.) Kickx and Deuteromycete Phoma sp., have been identified in this complex, causing the diseases commonly known as "drying" and "blight" 5/ of the needles. In 1953, this pest seemed to be confined to certain plantations in the Provinces of Bio-Bio and Concepción, and has not become particularly important.

Fire is undoubtedly the worst enemy of artificial and natural forests. It is estimated that from 550 to 660 hectares of plantations are burnt up annually and mainly due to human neglect and carelessness.

Losses caused by wind, frost, hail, drought, etc., are slight and occasional, and, owing to their very nature, difficult to assess. Perhaps the most important of these damages are caused by frost attack on young trees. The latter, however, are only retarded in their growth and usually recover quickly.

5/ Sp. 'tizón'.

B. COST OF PULPWOOD FROM PINUS RADIATA

The aggregate costs of pulpwood delivered to a mill site comprise the following separate items:

(1) Value of standing timber (stumpage price);
(2) Cost of felling and transport to roadside, including the maintenance of forest roads;
(3) Cost of transport from roadside to mill site; and
(4) Administration and supervision (overheads).

Cost items (1) and (2) are not influenced by the size of operation; item (3) depends on the transport distance alone; while item (4) is directly affected by the size of operation.

The different cost items are estimated separately below and are all based on solid volume of wood without bark. The average weight of green wood has been calculated at 1 ton per cubic metre (m^3).

1. Value of standing timber

All data regarding the plantations used in the following calculations, such as management plan, yields, etc., are taken from the study prepared by the Corporación de Fomento.1/ (For a summary of this study see section A of this annex).

According to this study the plantations are classified in five different categories (site classes), by the type of site and are numbered from I to V. The difference between the sites is the rate of growth which in turn depends upon soil and climate conditions, etc. Site class I represents agricultural land, which constitutes only 0.25 per cent of the total area planted. Because the value of this land is difficult to assess and varies considerably according to location and demand, it has been included in site class II for the purposes of this study. The error resulting from this simplification in the calculations is negligible.

It should be noted that all yield figures quoted in the calculations below include only trees with a diameter at breast height of 5.1 inches or more. The figures thus represent an under-estimate since trees of smaller dimensions could also be used as pulpwood. On the other hand, extraction costs will probably rise sharply as dimension decreases and it is therefore doubtful whether it will be a paying proposition to salvage this material except in the final, clear-cutting operation.

The cost of establishing and maintaining the plantations shown in table II-II represents an average of data supplied by several large organizations engaged in this field. Needless to say, the figures will vary considerably from one area to another depending on the topography of the country, soil conditions, etc., as will also the land value. The figures cannot therefore be applied to any given site.

1/ See 'Monsura de las Plantaciones Forestales de las Provincias de Linares a Malleco, 1953-54', op.cit.

Table II-11

AVERAGE COST OF ESTABLISHING AND MAINTAINING PINUS RADIATA PLANTATIONS

(Values in pesos)

	Year	Type of site			
		I and II	III	IV	V
Costs:					
Land value	1	30,000	20,000	15,000	14,000
Land preparation	1	4,500	4,500	4,500	4,500
Planting	1	4,600	4,600	4,600	4,600
Replanting	2	2,400	2,400	2,400	2,400
Seedlings	1	1,700	1,700	1,700	1,700
Fencing	1	1,400	1,400	1,400	1,400
Miscellaneous	1	600	600	600	600
Overheads	1	2,800	2,800	2,800	2,800
Total		48,000	38,000	33,000	32,000
Maintenance a/	Each year	2,000	2,000	2,000	2,000
1st Thinning b/		10,000	10,000	(10,000) c/	(10,000) c/
Annual costs:					
1st Year		45,600	35,600	30,600	29,600
2nd Year		2,400	2,400	2,400	2,400
Year of 1st thinning		10,000	10,000	(10,000) c/	(10,000) c/
3rd Year and following		2,000	2,000	2,000	2,000

a/ Includes expenditure on tools, clearing, fencing repairs, clearing of fire paths, waterproof clothing, etc.

b/ Sites I and II, 10 years; site III, 11 years; site IV, 12 years; and site V, 15 years.

c/ Parentheses indicate an alternative management plan for the production of pulpwood alone, in which case no thinning will be made.

For site classes II and III the cost of the first thinning operation has been included, since this is a sylvicultural measure which must be undertaken if saw timber of good quality is to be obtained. If the plantations are managed exclusively for the production of pulpwood, this expenditure could probably be dispensed with and the average cost of wood is consequently overestimated. This is most definitely the case for site classes IV and V, as the calculations show that the maximum return on investment is obtained if the plantations are managed for pulpwood production, only which implies a clear cutting before the age when the trees have reached saw timber dimensions. Alternative calculations excluding the first thinning operation for these sites have therefore been made.

The second and subsequent thinning operations are charged as extraction costs and are therefore excluded from the costs of maintenance.

In calculating the stumpage value, a rate of compound interest of 10 per cent annually has been used. This interest, which is slightly higher than that of security investments in the country, is the rate applied by the large organizations operating in this sphere and is considered to give an acceptable return on the investment.2/ The value of the land has not been depreciated over the period of the rotation cycle, since it will probably be fully recovered at the end of the period.

The value of the wood extracted in thinning operations is considered as an asset which is liquidated in anticipation of the final cutting year and yields the same rate of interest, - 10 per cent. Mathematically the value of the wood may be expressed as follows:

$$x_n = \frac{S - V_1 . x_n . 1.10^{n-r}1 - V_2 . x_n . 1.10^{n-r}2 \ldots\ldots\ldots}{V_n}$$

$$\text{or} \qquad x_n = \frac{S}{V_n + V_1 . 1.10^{n-r}1 + V_2 . 10^{n-r}2 + \ldots\ldots\ldots\ldots}$$

where:

n = the year for which the calculation is made

x_n = the average value of the pulpwood per unit at the year n

S = total investment value at year n

V_n = volume of standing timber at year n

V_1 etc. = the volume of timber extracted in the thinning operations

r_1 etc. = the year when the thinning operation is made

The stumpage value calculated in this way for the different sites and years are listed in table II-12 and are also recorded graphically in figure II-I. As will be seen from the statistics and the graph, the stumpage values attain a minimum at a given age of the plantations and which is different for each of the four sites. The reason lies in the fact that below the minimum point, the volume of wood increases faster than the capital at the particular rate of interest applied, and above the minimum point the capital grows faster. An increment in the rate of interest means that the minimum value will be obtained at an earlier date and, since a rate of interest of 10 per cent may be considered as a minimum attractive return on the capital, the years of minimum costs shown in figure II-I also denote the maximum age at which the plantations should be clear-cut in order to give maximum return on the investment.

In the case of sites IV and V, the maximum return is obtained during the years 18 and 16 respectively, at which age the plantations contain only very limited quantities of saw timber (with dimensions of 12 inches and above). Hence, the conclusion is reached that the plantations belonging to these sites should in principle be devoted to the production of pulpwood only. Naturally, a final decision on this point depends on a number of considerations, such as location of a particular plantation, the prospective market for saw timber dimensions versus pulpwood, sylvicultural measures already undertaken, etc. It is

2/ *The rate of interest may seem excessive in comparison with expected returns from forest operations in Europe and North America. It should however be taken into account that: (a) data on fields etc., based on long experience are much safer in the case of these forests, (b) the risk of damages through diseases is much higher in plantations than in natural forests and; (c) the interest on security investments is lower in the industrialized regions than in Chile.*

recommended, however, that for future plantation work this point of maximum return should be taken into account. (See table II-12).

Table II-12

STUMPAGE VALUE OF PINUS RADIATA ACCORDING TO YEAR AND SITE

Year	Sites							
	I and II		III		IV		V	
	Pesos per cu.ft.	Dollars per m3	Pesos per cu.ft.	Dollars per m3	Pesos per cu.ft.	Dollars per m3	Pesos per cu.ft.	Dollars per m3
10	39.42	2.78	-	-	-	-	92.74	6.55
11	-	-	33.83	2.39	-	-	-	-
12	-	-	-	-	33.95	2.40	-	-
13	-	-	-	-	-	-	49.40	3.49
14	18.55	1.31	20.24	1.43	25.25	1.78	45.00	3.18
15	-	-	-	-	-	-	43.24	3.05
16	16.42	1.16	19.21	1.36	24.05	1.70	42.51	3.00
17	-	-	-	-	-	-	43.51	3.07
18	16.63	1.17	18.06	1.28	24.75	1.75	45.02	3.18
19	-	-	-	-	23.37	1.65	-	-
20	14.59	1.03	18.14	1.28	23.68	1.67	-	-
21	-	-	-	-	-	-	-	-
22	14.69	1.04	18.41	1.30	24.57	1.74	-	-
23	-	-	-	-	-	-	-	-
24	15.49	1.09	19.61	1.38	26.69	1.88	-	-
25	-	-	-	-	-	-	70.0	4.94
26	17.22	1.22	22.48	1.59	-	-	-	-

The following unit values of standing timber and age of maximum return for the different sites may be computed from figure II-I.

Table II-13

MINIMUM STUMPAGE VALUE AND AGE OF MAXIMUM ECONOMIC YIELD FOR PINUS RADIATA PLANTATIONS ON DIFFERENT SITES

Site class	Age of maximum return	Stumpage value	
		Pesos per cu.ft.	Dollars per m3
I and II	20	14.2	1.00
III	18	16.8	1.19
IV	18	23.2	1.64
V	16	42.5	3.00

Table II-14

AREA DISTRIBUTION AND YIELDS FROM PINUS RADIATA PLANTATIONS ACCORDING TO SITE

(Average yields up to year of maximum economic yield)

Site	Area		Unit yield		Total yield		
	Hectares	Percentage	Cu.ft. per ha. and year	m3 per ha. and year	1000 cu. ft. per year	1000 m3 per year	Percentage of total
I and II a/	3,228	1.86	1,410	39.9	4,551	129	4.94
III	31,377	18.08	883	25.0	27,706	785	30.08
IV	66,853	38.52	576	16.3	38,507	1,090	41.76
V	72,080	41.54	297	8.4	21,408	606	23.22
Total	173,538	100.00	(531) b/	(15.0) b/	92,172	2,610	100.00

a/ Site I covers an area of 425 hectares or 0.25 per cent of the total.
b/ Weighted average.

From the data in tables II-13 and II-14, the weighted average stumpage value at the years of maximum return has been calculated as follows:

$$z = 0.0494 \times 1.00 + 0.3008 \times 1.19 + 0.4176 \times 1.64 + 0.2322 \times 3.00$$

z = 1.79 dollars per m^3, or 0.051 dollars per cu.ft.

As a comparison to the value calculated above, it may be mentioned that the average stumpage price paid at State Forest auctions in Sweden during 1955 was 0.257 dollars per cu.ft. and in the same year the price in Finland fluctuated between 0.217 and 0.348 dollars.3/ Thus the stumpage value of insignis pine in Chile, as calculated above, would be about one-fifth to one-sixth of the average stumpage price of spruce and pine in Scandinavia. This ratio also roughly corresponds to the growth rates in the two regions, the average growth in Scandinavia being about 2.3 m^3 per hectare annually.

To assess the average production costs of pulp and paper made elsewhere in this study, a weighted average stumpage value has been calculated from data on area distribution and yields contained in the inventory prepared by the Corporación de Fomento. In the case of sites II and III, the yields have been determined according to the management plan suggested in this inventory; i.e., for site II, a first thinning operation in the 10th year, a second in the 14th and a third in the 18th year; for site III a first thinning in the 11th and a second in the 16th year. In the case of sites IV and V, the yields have been calculated on the assumption that no thinning operations will be made and that the volume of thinnings as indicated in the inventory will have the same rate of growth as the main stand of timber.

The results of these calculations are recorded in table II-14.

3/ *See Timber Bulletin for Europe, Geneva, February 1956.*

2. Cost of felling and transport to roadside

The extraction costs as indicated in table 5 are based on actual experience as encountered in a number of operations in different locations of the country. The data which have been supplied by various sources are raised by 30 per cent as a safety factor, since the costs vary within fairly wide margins. On the other hand, it should be borne in mind that the statistics refer to operations at their present stage of development, i.e. mainly with manual labour and animal traction. Time has not permitted any calculations to be made of the influence on aggregate costs of mechanizing the operations, but it is believed that this would reduce the cost, at least for operations in the larger stands.

Table II-15

PULPWOOD EXTRACTION COSTS IN PINUS RADIATA PLANTATIONS

Operations	Pesos per m3	Dollars per m3
Felling and bucking	300	0.60
Transport to roadside, maintenance of roads and trails	250	0.50
Miscellaneous expenses	100	0.20
Social security payments	155	0.31
Total	805	1.61

3. Cost of transport from roadside to mill site 4/

Calculations have been made for direct operational costs as well as for total costs (including amortization and interest) per cubic metre and kilometre distance.

(a) *Basis for the calculations*

Type of truck: Truck with a loading capacity of 11 tons (or 11 m^3.)
Price: 8,519,000 pesos.

Diesel oil and oil consumption: Diesel oil consumption is estimated at 0.4 litres per km and oil consumption at 1 litre per 100 kilometres. Present price: diesel oil, 33.8 pesos per litre; lubricating oil, 370 pesos per litre.

Tubes and tires: One set of tubes and tires is estimated to last for a total travelling distance of 30,000 kilometres. The price for one set is 650,600 pesos.

Labour: Each truck will be operated by two crews, consisting of driver and helper. Total working time per crew and year is 2,100 hrs; i.e. 4,200 man-hours. An allowance of 5 per cent of waste time has been included. Monthly salaries are 45,000 pesos for the driver and 30,000 for the helper, plus 26 per cent social security payments. This gives an annual cost per crew of 1,134,000 pesos.

4/ For additional information on transport cost see Preface to 2nd edition.

Lubrication: Cost is estimated at 20 per cent of the cost of lubricating oil.

Repair and maintenance: The cost is estimated at 40 per cent of the total operating cost plus amortization.

Amortization: Period of amortization is 5 years, at the end of which the truck will have a recovery value of 20 per cent.

Interest: A rate of interest of 10 per cent on book value, or an average of 6 per cent on the initial investment for the amortization period has been used.5/

To calculate operating costs per kilometre, the following travel speeds and loading and unloading times have been assumed: average speed 30 kilometres per hour, loading and unloading time total, 60 minutes. The annual transport capacity and travel distance per truck are recorded in figure II-II and table II-16.

Table II-16

TRAVEL DISTANCE AND TRANSPORT CAPACITY OF TRUCKS PER YEAR

Distance with load (kms)	Total time per cycle (min)	No. of cycles per year	Travel distance with load (kms per year)	Capacity per truck and year (m3)
10	100	2,310	23,100	25,410
15	120	1,925	28,900	21,190
20	140	1,650	33,000	18,150
26	168	1,375	35,750	15,125
30	180	1,285	38,500	14,115
40	220	1,050	42,000	11,550

(b) Operating costs

Using the basic data given above, transport costs have been calculated as follows:

5/ *A more accurate method of calculating average annual capital costs is the sinking fund method, which gives a slightly lower cost than the approximate method used here.*

Table II-17
TRANSPORT COSTS FOR PULPWOOD

(Pesos per kilometre and truck load of 11 tons)

Transport distance one way	10	15	20	26	30	40
Operating costs:						
1. Diesel oil	27.00	27.00	27.00	27.00	27.00	27.00
2. Lubr. oil	7.40	7.40	7.40	7.40	7.40	7.40
3. Lubrication	1.60	1.60	1.60	1.60	1.60	1.60
4. Tyres and tubes	43.20	43.20	43.20	43.20	43.20	43.20
5. Labour	98.40	78.50	68.60	63.40	58.90	53.90
6. Repair and maint. a/	94.60	82.00	75.70	72.30	69.40	66.30
7. Maint. of housing b/	14.05	11.25	9.85	9.10	8.45	7.75
Sub-total: pesos	286.25	250.95	233.35	224.00	215.95	207.15
dollars	0.573	0.502	0.467	0.448	0.432	0.414
Capital costs:						
8. Amortization, trucks c/	59.00	47.20	41.30	38.10	35.40	32.50
9. Amortization, housing d/	10.05	8.00	7.05	6.50	6.00	5.50
10. Interest e/	32.15	25.70	22.55	20.80	19.30	17.70
Sub-total: pesos	101.20	80.90	70.80	65.40	60.70	55.70
dollars	0.202	0.162	0.142	0.131	0.121	0.111
of which amortization, dollars	0.138	0.110	0.097	0.089	0.083	0.076
Total: pesos	387.45	331.85	304.15	289.40	276.65	262.85
dollars	0.775	0.664	0.609	0.579	0.553	0.525

(dollars per m3 and total distance)

Operating costs:	0.521	0.685	0.849	1.059	1.178	1.505
Capital costs:	0.184	0.221	0.258	0.310	0.330	0.404
Total	0.705	0.906	1.107	1.369	1.508	1.909

a/ 40 per cent of items 1 - 5 and 8.
b/ Calculated at 7 per cent per annum of investment, (see appendix II-A).
c/ Five years with 20 per cent residual value.
d/ Twenty years.
e/ 10 per cent on book value, i.e. 6 per cent average interest on investment in trucks and 5 per cent on housing.

As may be seen in figure II-III, the cost is a straight-line function of the distance. It is mathematically expressed as follows:

Operating cost: z = 0.0331 x + 0.185 dollars per m^3
Capital cost: z = 0.00735 x + 0.112 dollars per m^3
Total cost: z transp. = 0.04049 x + 0.297 dollars per m^3
of which amortization z_{am} = 0.0056 x + 0.0765 dollars per m^3
where x is transport distance with load in kilometres.

4. Administration and supervision

The overhead costs depend on the size of operation. The following calculations have been made for annual pulpwood volumes of 90, 180, 360 and 540 thousand cubic metres, which roughly correspond to the needs of pulp mills with daily capacities of 50, 100, 200 and 300 tons and operating 350 days per annum:

Table II-18

FOREST ADMINISTRATION AND SUPERVISION BY SIZE OF OPERATION

(Pesos per m3)

Pulpwood quantity per year (m3)	90,000	180,000	360,000	540,000
Salaries a/	135.20	77.60	46.00	39.20
Amortization, housing b/	12.40	7.40	4.35	3.70
Interest, housing c/	12.40	7.40	4.35	3.70
Total: pesos	160.00	92.40	54.70	46.60
dollars	0.320	0.185	0.109	0.093

a/ See appendix II-B.
b/ Twenty years, see appendix II-B.
c/ 10 per cent interest on book value, see appendix II-C.

Note: Maintenance of housing is charged to general community expenses.

As will be seen from figure II-IV, the annual cost is approximately a straight-line function of the pulpwood requirements (Q) and the cost per cubic metre will consequently be a hyperbolical function of the pulpwood volume. The function may be expressed as follows:

Operating cost $z_1 = \frac{20.58}{Q}$ + 0.0388 dollars per m^3
Capital cost $z_2 = \frac{3.83}{Q}$ + 0.0075 dollars per m^3
Total cost $z_{adm} = \frac{24.41}{Q}$ + 0.0462 dollars per m^3
of which amortization $z_{am} = \frac{1.92}{Q}$ + 0.0038 dollars per m^3

5. *Summary of pinus radiata pulpwood costs*

Summing up the different items 1-4 calculated above, the following average costs of pulpwood delivered to mill site are obtained for various transport distances and annual supply quantities:

Operating cost	$3.62 + 0.03314\ x + \frac{20.58}{Q}$ dollars per m^3
Capital cost	$0.12 + 0.00735\ x + \frac{3.83}{Q}$ dollars per m^3
TOTAL COST	$3.74 + 0.04049\ x + \frac{24.41}{Q}$ dollars per m^3

In order to determine the average transport distances required for different annual supply quantities of pulpwood, a study was made of a hypothetical mill site in the Huépil area. Table II-19 shows the results of this analysis. It indicates the total available supply as well as estimated probable quantities -50 per cent of the total- which may be taken into consideration for a pulp mill established in the area. The difference between aggregate and available quantities is partly to be considered as a safety factor and is partly accounted for by the fact that the mill is unlikely to control the whole forest area and consequently must buy a proportion of the pulpwood on the open market.

Table II-19

ESTIMATED AVERAGE TRANSPORT DISTANCES FOR DIFFERENT SUPPLY QUANTITIES OF PULPWOOD IN THE HUEPIL AREA

Average transport distance (kms)	15	20	26	30	35
Total pulpwood quantity, 1,000 m3 per annum	90	180	360	540	840
Available pulpwood quantities, 1,000 m3 per annum	45	90	180	270	420

The available volume of pulpwood in terms of transport distance are recorded in figure II-V, together with the corresponding pulpwood costs as calculated from the mathematical expressions above. These costs are also listed in table II-20.

Table II-20

PULPWOOD COST AS A FUNCTION OF PULP MILL SIZE

Pulpwood consumption: 4.7 m^3 per ton of unbleached pulp; 5.3 m^3 per ton bleached pulp

(Costs in dollars per m)

Mill capacity, tons/day	50		100		200		300	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Pulpwood, 1,000 m3/year	82.25	92.75	164.5	199.5	329.0	371.0	493.5	556.5
Pulpwood cost; operating	4.50	4.50	4.58	4.58	4.74	4.79	4.89	4.94
Pulpwood cost; capital	0.31	0.31	0.31	0.34	0.37	0.38	0.40	0.41
Pulpwood cost; total	4.81	4.81	4.89	4.92	5.12	5.17	5.29	5.35
of which amortization;	0.17	0.18	0.19	0.20	0.21	0.21	0.22	0.23

C. FUTURE YIELDS FROM PINUS RADIATA PLANTATIONS IN CHILE

The following calculations refer to plantations existing in 1953.

Since section B showed that the maximum economic return from the plantations is obtained when site classes IV and V are devoted to the production of pulpwood alone, the estimate of future yields has been based on clear cutting these sites at the age of maximum return, 18 and 16 years respectively without previous thinning. The volume which, according to the CORFO management plans, should be taken out in thinning operations, is assumed to grow at the same rate as the remaining stand. The volume contained in stands of these site classes, which at present exceed the age limits, is considered as immediately available as pulpwood.

In site classes I, II and III, the management plans prepared by the Corporación de Fomento are accepted. Forests which today exceed the clear cutting ages specified by the plans (25, 25 and 24 years, for site classes I, II and III, respectively) are presumed to be managed mainly for the production of sawtimber and that they will be cut at 35 years. Moreover, thinning is presumed to have proceeded at the appropriate time. It is known, however, that such has not been the case in most stands, which has had two consequences: a larger total volume is available than that shown by the calculations and the volume of sawtimber is less than the assessment; but pulpwood volumes are greater.

The classification of sawtimber and pulpwood given in section A has been maintained and in both cases gross volume is given, that is without deduction for defects in the logs.

The following tables II-21 and II-22 give a summary of future yield estimates, which is also recorded in graphical form in figure II-VI.

Table II-21

FUTURE ANNUAL YIELDS BY SITE CLASSES

(1,000 cubic feet annually)

Year	Site classes					Total
	I	II	III	IV	V	
			Pulpwood			
1956	53	1,048	3,767	82,790	28,983	116,641
1957	104	1,048	3,160	24,342	15,878	44,508
1958	104	1,206	3,511	24,342	15,878	45,041
1959	101	618	12,108	40,454	15,878	69,159
1960	231	1,539	12,777	40,454	25,051	80,052
1961	231	1,463	12,452	40,454	25,051	79,651
1962	231	1,819	28,904	51,858	25,051	107,863
1963	655	7,283	29,136	51,858	31,676	120,608
1964	655	7,097	30,372	51,858	31,676	121,658
1965	655	7,000	33,829	62,132	31,676	135,292
1966	774	2,928	31,911	62,132	33,760	131,505
1967	774	2,925	30,447	62,132	33,760	130,038
1968	774	2,339	40,851	39,152	33,760	116,876
1969	486	4,804	39,967	39,152	- a/	84,409
1970	486	4,804	39,967	39,152	-	84,409
1971	486	4,795	43,573	- a/	-	48,854
1972	2,459	4,118	43,573	-	-	50,150
1973	2,459	4,118	43,573	-	-	50,150
			Sawtimber			
1956	-	-	1,302	-	-	1,302
1957	-	15	649	-	-	664
1958	-	54	935	-	-	989
1959	-	54	6,214	-	-	6,268
1960	33	756	6,214	-	-	7,003
1961	33	717	6,064	-	-	6,814
1962	33	717	16,168	-	-	16,918
1963	221	4,895	16,168	-	-	21,284
1964	221	4,895	17,288	-	-	22,404
1965	221	4,895	19,411	-	-	24,527
1966	201	1,782	19,411	-	-	21,394
1967	201	1,782	18,155	-	-	20,138
1968	201	1,782	24,545	-	-	26,528
1969	1,921	3,666	24,545	-	-	30,132
1970	1,921	3,666	24,545	-	-	30,132

a/ Since the final cuttings in site classes IV and V are realized in the 16th respectively 18th year the yields from these sites will discontinue in the years 1969 and 1971. No account has been taken of yields from plantations established after 1953.

FIGURA II - 11
FIGURE II - 11

CAPACIDAD DE TRANSPORTE DE MADERA PARA PASTA Y DISTANCIA RECORRIDA POR CAMION Y POR AÑO

PULPWOOD TRANSPORT CAPACITY AND TRAVEL DISTANCE PER TRUCK AND YEAR

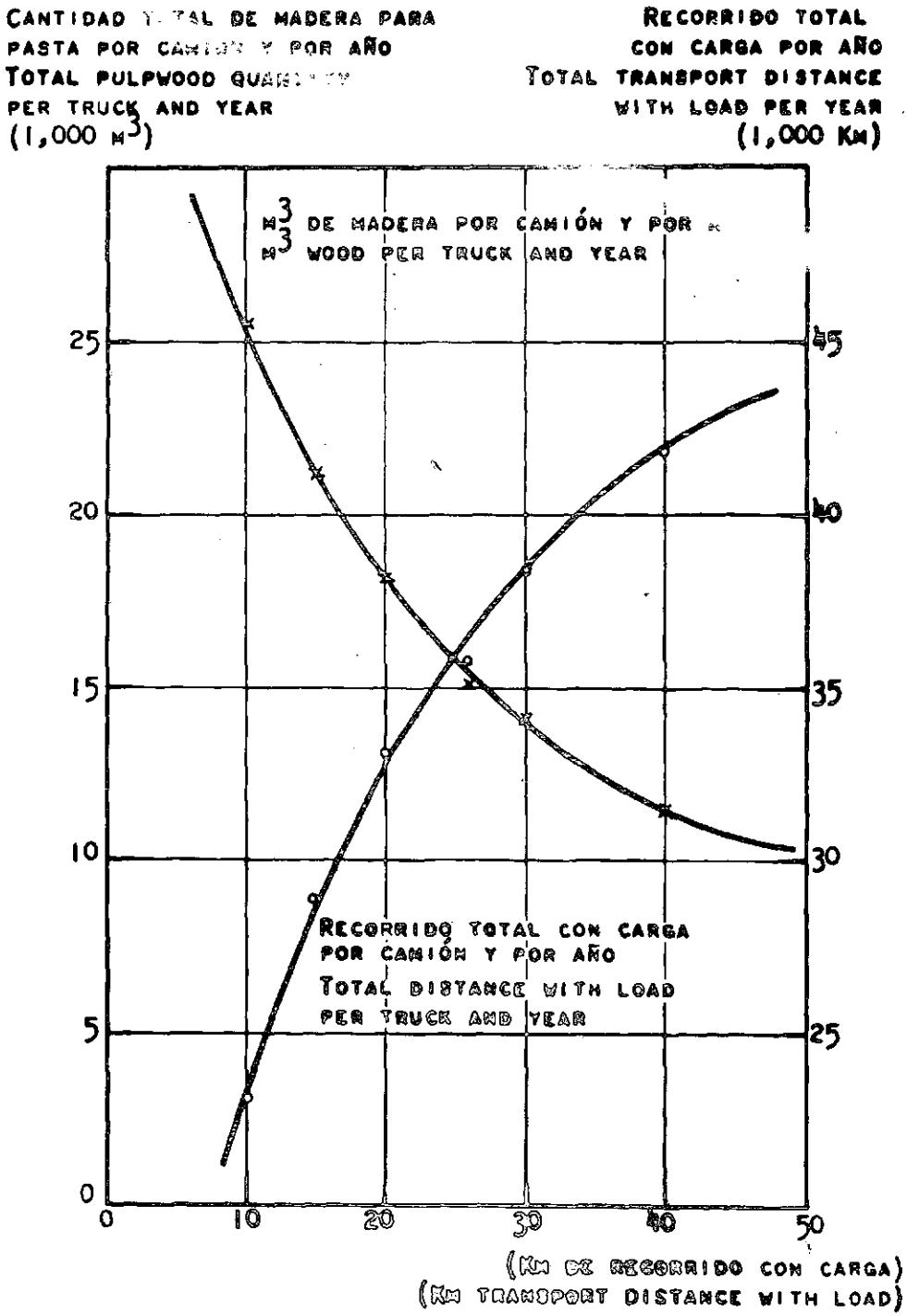


FIGURA II - 101
FIGURE II - 101

COSTO DE TRANSPORTE DE LA MADERA PARA PASTA
TRANSPORT COST FOR PULPWOOD

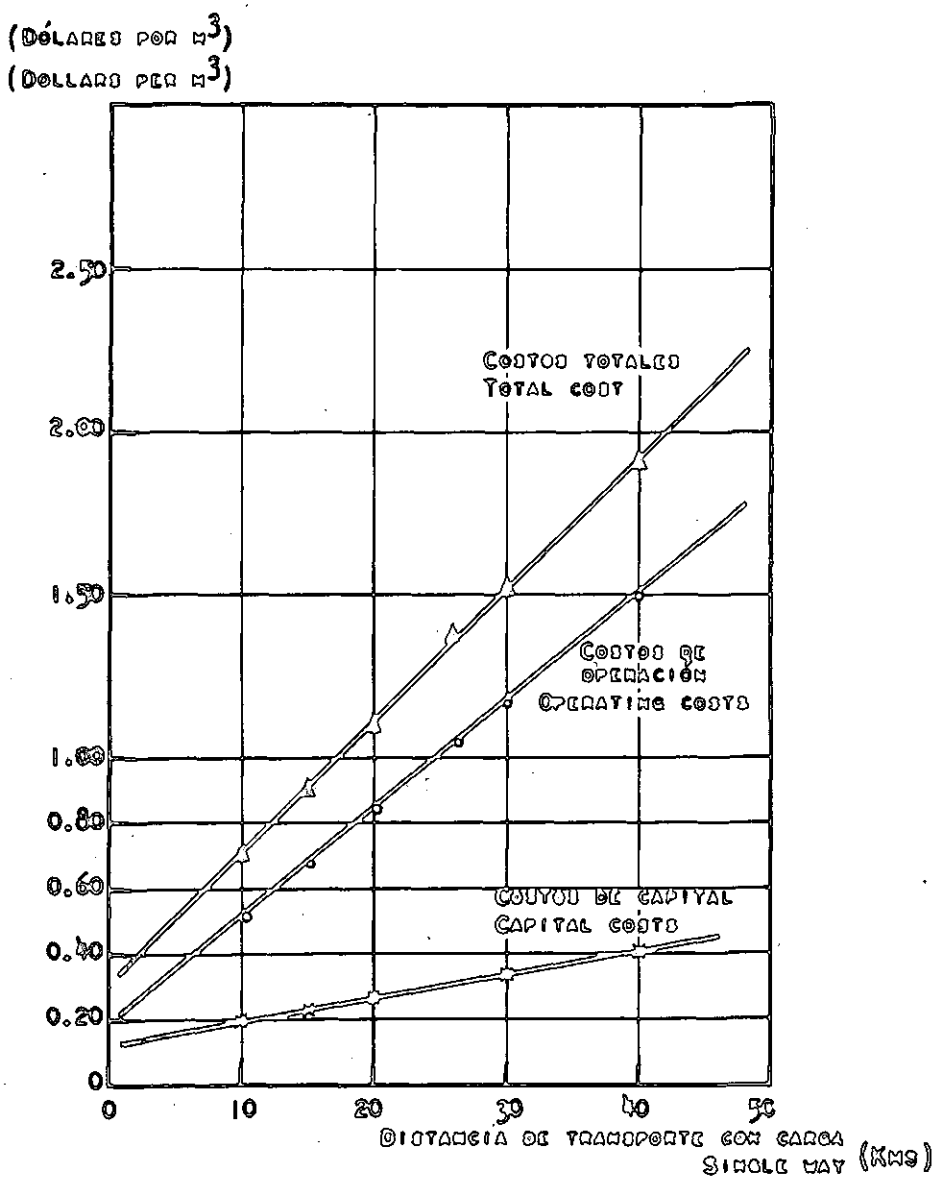
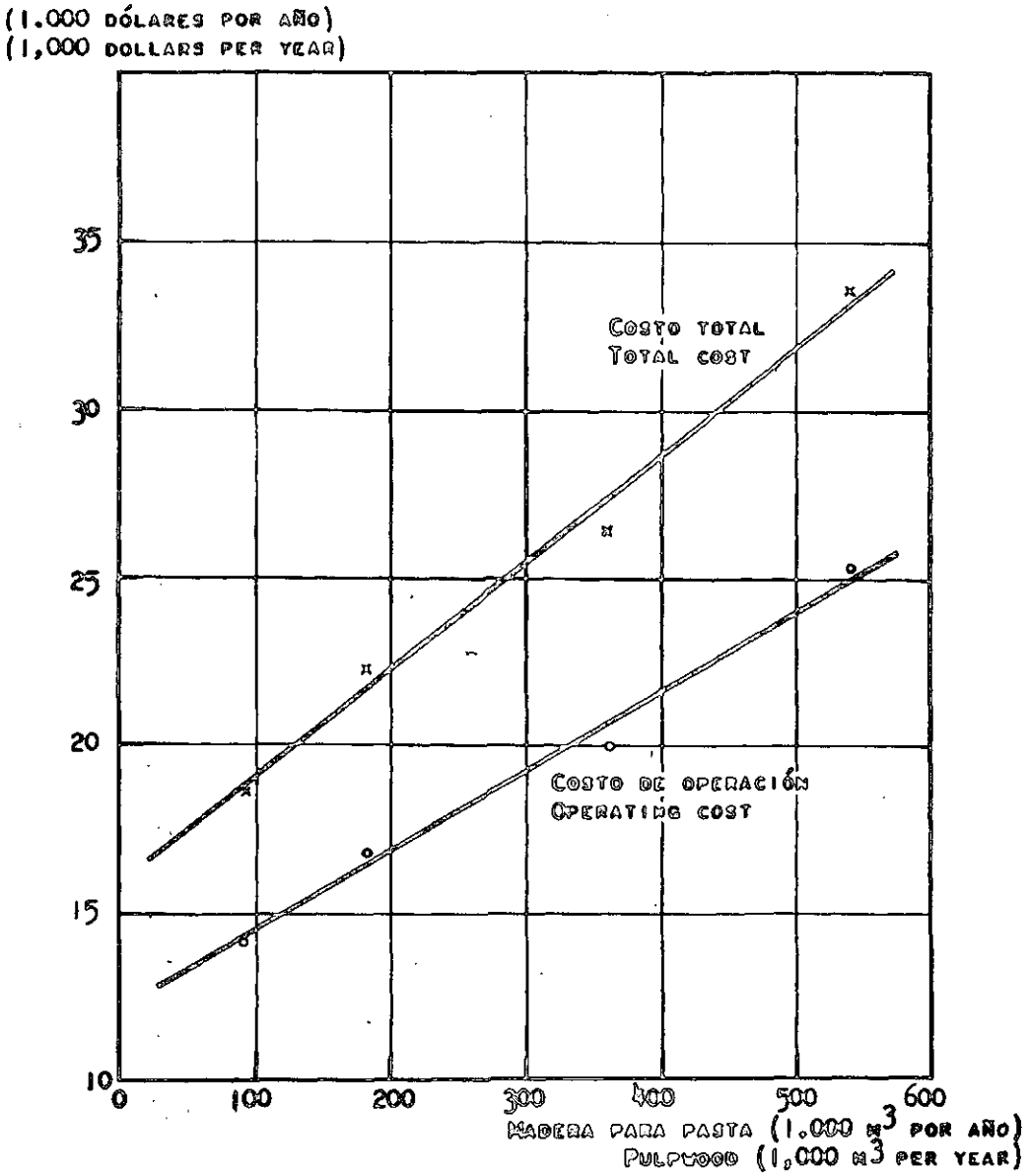


FIGURA II - IV
FIGURE II - IV

COSTO DE ADMINISTRACION: DEPARTAMENTO FORESTAL

ADMINISTRATION COST: FOREST DEPARTMENT



COSTO DE OPERACIÓN $= Z_1 = \frac{12,09}{q} + 0,0237$ $ POR M^3

COSTO DE CAPITAL $= Z_2 = \frac{3,74}{q} + 0,0081$ "

COSTO TOTAL $= Z_{ACM} = \frac{15,80}{q} + 0,0318$ "

OPERATING COST $= Z_1 = \frac{12.09}{q} + 0.0237$ $ PER M^3S

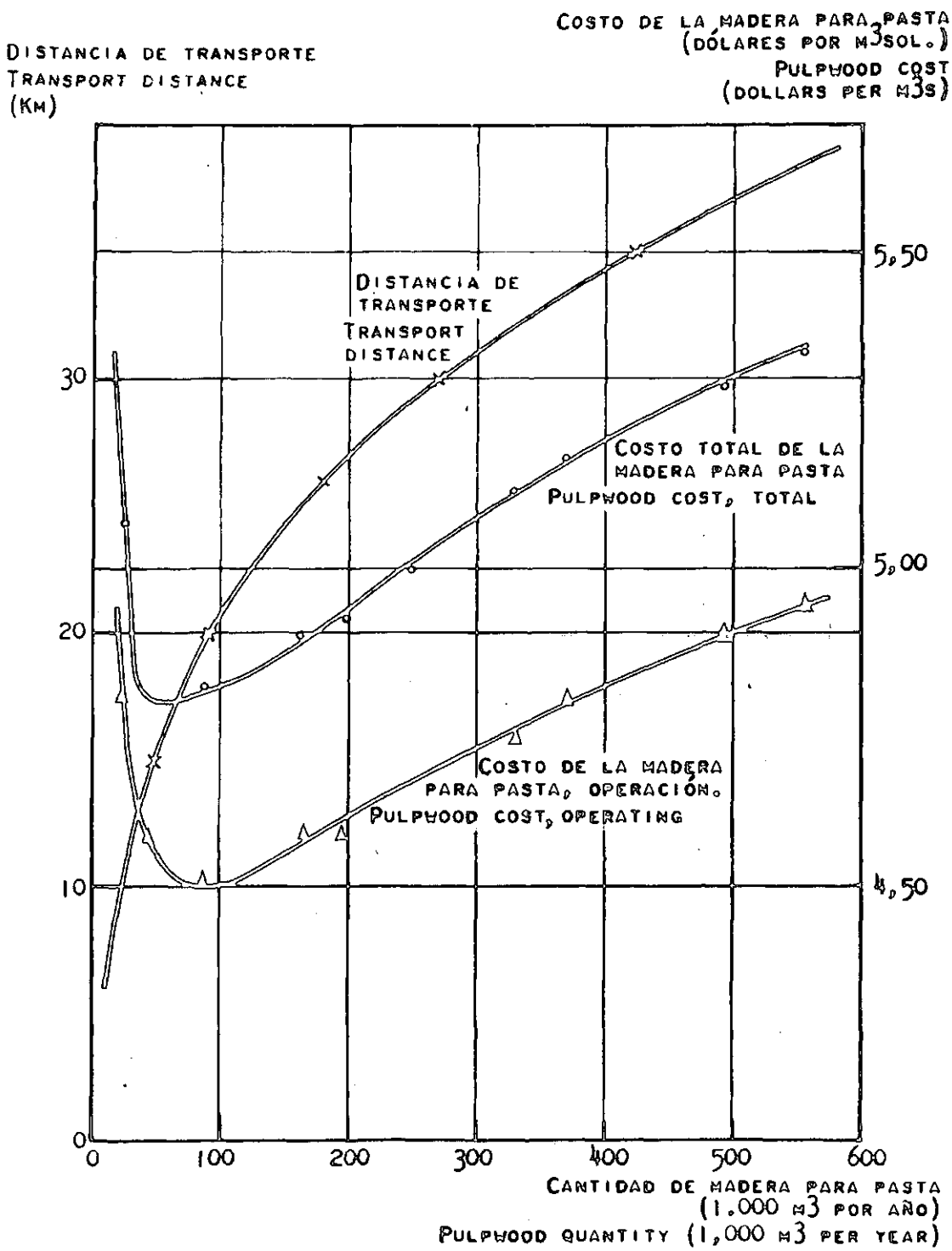
CAPITAL COST $= Z_2 = \frac{3.74}{q} + 0.0081$ "

TOTAL COST $= Z_{ACM} = \frac{15.80}{q} + 0.0318$ "

FIGURA II - V
FIGURE II - V

DISTANCIA DE TRANSPORTE Y COSTO DE LA MADERA PARA PASTA
EN FUNCION DE LAS CANTIDADES SUMINISTRADAS

TRANSPORT DISTANCE AND PULPWOOD COST
AS FUNCTION OF SUPPLY QUANTITIES



least affected by this substitution process, perhaps because the use of alternative products has not yet become widespread in the applications for which it chiefly serves -concrete forms, cabinet-making, etc.

As regards the destination of exports of Pinus radiata, it is worth while pointing out that during the period 1951-55 Argentina absorbed almost 98 per cent of average exportable surpluses, the rest being shipped to Peru and the United Kingdom.

3. *Estimate of potential supply and demand for 1960 and 1965*

(a) Availabilities

Estimates contained in annex II indicate that availabilities of Pipus radiata sawnwood will be 98,000 and 344,000 cubic metres by 1960 and 1965 respectively. This estimate implies increases of 75 and 500 per cent over the average annual output of 56,000 cubic metres registered for 1951-55, or, in others words, a cumulative annual rate of expansion of 20 per cent throughout the period 1956-65 (12 per cent in 1956-60 and 29 in 1961-65).

(b) Domestic demand

As mentioned earlier, the annual per capita consumption of Pinus radiata decreased from an average of 5 cubic decimetres in 1946-50 to 4.4 cubic decimetres in 1951-55. For present purposes, the downward trend recorded for 1946-55 has been disregarded, and it has been assumed that by 1965 per capita consumption in Chile will be 100 per cent higher than in 1951-55, and will amount to 6.6 and 8.8 cubic decimetres in 1960 and 1965 respectively. With these consumption figures, export availabilities would be 49,000 cubic metres in 1960 and 272,000 cubic metres in 1965. (See table III-3).

Table III-3

CHILE: ESTIMATE OF DOMESTIC CONSUMPTION AND EXPORT AVAILABILITIES OF PINUS RADIATA, 1960 AND 1965

Year	Production (thousands of m3)	Population a/ (thousands)	Apparent consumption		Export availabilities (thousands of m3)
			Per capita (dm3)	Total (thousands of m3)	
Average 1951-55	56	6.428	4.4	28	28
1960	98	7.433	6.6	49	49
1965	344	8.156	8.8	72	272

a/ Calculated on the basis of data from the United Nations Monthly Bulletin of Statistics, March 1956.

(c) Foreign demand

In order to estimate potential future exports, Argentine demand for imports of sawnwood from conifers was first projected. A per capita consumption series for conifer sawnwood from 1945 to 1955 was thus constructed. However, as domestic production data were available only for 1951, 1953 and 1954, it was assumed that in the remaining years 89 per cent of the volume consumed would be made up of imports and 11 per cent would be supplied by domestic production, these being the percentages obtained by averaging the shares of imports and domestic production in the years mentioned. The resulting per capita consumption series is shown in table III-4.

Table III-4

ARGENTINA: CONSUMPTION OF SAWNWOOD FROM CONIFERS AND GROSS INVESTMENT

Year	Production	Imports	Consumption	Population (thousands	Per capita consumption (dm3)	Gross investment per capita (1950 dollars)
	(Thousands of m3)					
1945	41.1	333.1	374.2	15,260	25	63
1946	66.8	540.3	607.1	15,520	39	100
1947	86.5	700.0	786.5	15,787	50	158
1948	117.9	953.6	1,071.5	16,100	67	159
1949	91.3	738.7	830.0	16,519	50	112
1950	82.2	664.7	746.9	16,901	44	107
1951	116.8	1,007,5	1,124.3	17,422	65	122
1952	65.2	527.8	593.0	17,855	33	108
1953	65.4	460.0	525.4	18,228	29	85
1954	70.1	584.5	654.6	18,562	35	100
1955	109.0	881.8	990.8	18,919	52	101

Sources: Population figures were taken from Appendix 5 of the Informe Preliminar acerca de los problemas de la Industria del Papel y Celulosa en la Argentina prepared by the United Nations Pulp and Paper Advisory Group to Latin America. Gross investment data were obtained from the Argentine official publication Producto e Ingreso de la República Argentina 1935/1954.

The per capita consumption series for sawnwood from conifers was correlated with per capita gross investment because this was the economic index most closely inter-connected with the series in question. The correlation coefficient was 0.82 and the elasticity coefficient 1. The choice of the base year for the projection was 1953, to which average values of consumption and gross investment for the five-year period 1951-1955 were applied. The projections are recorded in table III-5.

Table III-5

ARGENTINA: PROJECTION OF APPARENT CONSUMPTION OF SAWNWOOD FROM CONIFERS a/

Year	Population b/ (thousands)	Per capita consumption (dm3)	Total consumption (Thousands of m3)
Average 1951-55	(18,197)	(43)	(778)
1955	(18,919)	42 (52)	795 (882)
1960	20,376	59	1,202
1965	21,951	70	1,537

a/ Figures in brackets refer to actual data.
b/ Population data from the same source as for table III-4.

Assuming that consumption will continue to be distributed between imports and production in the same proportions as were estimated for 1945-55, that is, 89 and 11 per cent respectively 3/, and further, that the share of Chilean conifers and Pinus radiata in particular in Argentina's total imports of conifers will remain the same as in 1951-55, namely, 10 per cent in the first case and 4 per cent in the second, Argentine imports from Chile in 1960 and 1965 will attain the volumes given in table III-6.

Table III-6

ARGENTINA: PROJECTION OF IMPORTS OF CONIFER AND PINUS RADIATA SAWNWOOD FROM CHILE a/

Year	Total imports (Thousands) of m3	Imports from Chile	
		Conifers	Pinus radiata
		(thousands of m3)	
1955	708 (882)	71 (102)	28 (42)
1960	1,070	107	43
1965	1,369	137	55

a/ Figures in brackets refer to actual data.

As regards market other than Argentina, it was estimated that Peru, which in 1951-55 purchased on an average nearly 2 per cent of Chilean exports of Pinus radiata annually, should be able to absorb some 6,000 cubic metres in 1960 and about 12,000 cubic metres in 1965.

The study of importer markets was confined to the two countries reviewed above, as, to judge from available data, it seems unlikely that any additional importers will purchase volumes of more than negligible significance within the next ten years.

(d) Projection of export availabilities in 1960 and 1965

Consequently, export availabilities of Pinus radiata in 1960 and 1965 will probably be as shown in table III-7:

Table III-7

CHILE: PROJECTION OF EXPORT AVAILABILITIES OF PINUS RADIATA

(Thousands of m3)

Year	Export availabilities	Exports to			Net surplus
		Argentina	Peru	Total	
1951-55 a/	28	27	1	28	-
1960	49	43	6	49	-
1965	272	55	12	67	205

a/ Average of actual figures.

3/ *For lack of the relevant data, it was impossible to evaluate how this proportion will be affected by the future development of the production of salicaceous species in the Paraná delta.*

4. *Conclusions*

Even on the assumption that stands of Pinus radiata in class sites IV and V (see annex II) are devoted exclusively to the production of pulpwood, and that only logs with a minimum diameter or 12 inches are used in the production of sawnwood, the volumes of this latter obtainable up to 1960 will satisfy and later far outstrip both foreign and domestic demand as forecast.

The figures for these demands were estimated on the basis of substantial increments in current volumes or in those to be inferred from the trends indicated by available statistical series. This was done in consideration of the possibility of a future expansion of consumption both in Chile and abroad as a result of co-ordinated, intensive and sustained action on the part of producers. A programme with this objective would therefore seem essential.

Appendix III-A

PROBLEMS AFFECTING EXPORTS OF PINUS RADIATA LUMBER

Everything seems to suggest that export prospects for Chilean Pinus radiata are closely connected with an improvement in its quality from the technical standpoint and with a reduction in c.i.f. prices at the ports of destination. The first important step towards attaining the former objective would be to increase the length of the lumber, since the length most usual at present -approximately 10.5 feet- is considered too short by most buyers. Attention has also been drawn to the desirability of properly-timed pruning and thinning, and, in general, of adopting all those sylvicultural and technological improvements that have been put into practice in other areas in the Southern hemisphere which are also producers of Pinus radiata, like New Zealand and the Union of South Africa.

As regards the possibilities of reducing the port-of-destination price of sawnwood, it is first of all of interest to ascertain how the various cost items influence this price. The separate and aggregate costs per "pulgada", 4/ in Chilean pesos, have been estimated as follows:

		Pesos per "pulgada" 5/
1)	Stumpage price	80
2)	Converting cost and transport to railway station	100
3)	Transport to port and shipping expenses	127
	f.o.b. price	307
4)	Ocean freight to Buenos Aires (Argentina)	213
	Ocean freight to El Callao (Peru)	123
	c.i.f. price Buenos Aires	520
	c.i.f. price El Callao	430

The Buenos Aires and El Callao c.i.f. prices in Chilean pesos are equivalent to 1.10 and 0.85 dollars per "pulgada" respectively, while that of Brazil pine works out at 1.60 dollars and that of Oregon pine at El Callao is 1.25 dollars. (For Argentina: 1 dollar / 475 Chilean pesos).

While it is assumed that all the components of the final price can be reduced, the third and fourth are estimated to be those for which the immediate outlook is most hopeful in this connexion. In the case of shipment expenses, which, together with those of rail transport to the port, amount to between 25 and 30 per cent of the price at the ports of destination, it should be borne in mind that current high expenditure is largely occasioned by the utilization of the expensive lighter system for the loading of a large proportion of the lumber.

Ocean freight is the other factor which has a heavy percentage incidence on the price (41 per cent in the case of lumber exported to Argentina and 29 per cent for that shipped to Peru). The information gathered suggests that charges could be considerably reduced.

At the present time, under the terms of the trade agreement between Chile and Argentina, maritime transport from each of these two countries to the other must be equally divided between Argentine and Chilean vessels. Consequently, the Conferencia de Fletes del Pacífico Sur, made up of Chilean and Argentine ship-owners, holds what is virtually a monopoly of maritime transport, and has fixed its tariff at 45 dollars per 1,000 square feet. It should be pointed out in this connexion that transport tenders have been received from "tramps" for as little as 20 dollars per 1,000 square feet.

The general conclusion is that while a reduction in all the factors contributing to the c.i.f. price of lumber at the ports of destination would be desirable, it is in shipment and maritime transport expenses that such a modification is most likely to be feasible. It should be taken into account that because of their great incidence on the c.i.f. price (almost two-thirds in the case of Argentina and 60 per cent in that of Peru), this latter would be greatly affected by any decrease that might be achieved in the above items. By the consequent lowering of the price in question, a considerable impetus would be given to exports of Pinus radiata, whose ability to compete with other soft-woods -which as a rule are of better physical quality- is bound to depend mainly on its more attractive price.

4/ The "pulgada" is a measure used in Chile, which corresponds to a 1 inch plank, 10 inches wide and 3.20 metres long. It is equivalent to 8.75 square feet.

5/ This price corresponds to 48 pesos per cubic foot, approximately. See appendix III-B.

Appendix III-B

SAW TIMBER STUMPAGE PRICE [a]

(Pesos per cubic foot)

Class site	Age		
	25	30	35
II	24.1	42.2	74.8
III	29.8	53.8	95.7
IV [b]	39.5	75.9	139.2
V [b]	203.4	397.1	728.5

[a] Based on the plantation and maintenance costs given in annex II, with 10 per cent annual compound interest. The values are calculated assuming that the pulpwood is excluded at the age of maximum of economic return and credited at the value indicated in table II-13.

[b] Without thinnings.

AVERAGE DIAMETER OF STANDING TREES [a]

(Inches)

Class site	Age	
	25	30
II	17.4	18.7
III	12.6	13.6
IV	10.1	10.7
V	8.3	8.9

[a] At breast height.

ANNEX IV

AVAILABILITY AND COST OF CHEMICALS AND FUELS

For the manufacture of pulp and paper and for ancillary processes, various chemicals and fuels are required, the availability of which as to quality and volume should be ensured within reasonable price limits. In this respect, Chile is in a favourable position. Mining and industrial concerns can supply most of the important materials required in more than sufficient quantity and with all the mentioned requisites.

As to the prices shown in the table below, they may for some chemicals be reduced if purchases are made on the basis of long-term contracts and by railway car loads. All quotations were made for March 1956. (See table IV-1).

Table IV-1

PRICES OF CHEMICALS AND FUELS

Product	Form of delivery	Price (pesos per ton)	Comments
1. Aluminium sulphate	Bulk	22,000 FOB Santiago	13% Al_2O_3 max. 25% insolubles
2. Aluminium sulphate	Bulk	31,500 FOB Santiago	15-17% Al_2O_3 0% insolubles
3. Kaolin	Paper sacks 25 Kg.	30,400 FOB Santiago	200-300 mesh
4. Coal (culm)	Bulk	5,796.21 FOB Coronel	Net calorific value; 6,700 kcal/kg.
5. Sodium sulphate	Bulk	15,000 FOB Iquique a/	95.6% Na_2SO_4
6. Limestone	Bulk	5,400 FOB Huachipato a/	loss through burning 42.7%
7. Sodium chloride	Bulk	10,000 FOB Iquique	99.9 per cent NaCl
8. Fuel oil b/	By cars	14,420 FOB Talcahuano	Calorific value; 10,000 kcal/Kg.
9. Rosin b/	Drums	165,000 FOB Valparaíso	

Sources: 1 and 2 Química Industrial Spes; 3 Domingo Arteaga I; 4 Compañía Carbonífera y de Fundición Schwager; 5 Compañía Salitrera de Tarapacá y Antofagasta; 6 Compañía de Acero del Pacífico; 7 Plutarco Valenzuela L.; 8 Shell, Chile Limited; 9 Compañía Manufacturera de Papeles y Cartones S.A.

a/ Producer estimate, since there are no sales at present

b/ Imported; f.o.b. railway car including customs duties.

This table includes only the more important products. Table IV-2 gives the estimated costs as well as those of other chemicals and some building materials, f.o.b. at hypothetical plant located in the Huépil area, some 510 and 135 kilometres from Santiago and Talcahuano, respectively, by rail.

Table IV-2

RAW MATERIALS: ESTIMATED COST AT MILL
(Pesos per ton)

Basis: a hypothetical plant located 510 kilometres from Santiago and 135 from Talcahuano by rail

Product	Origin	Value	Transport		Cost at plant
			Railway	Ship	
Rosin	U.S.A.	165,000	5,000	-	170,000
$Al_2(SO_4)_3$ (Water treatment)	Santiago	22,000	3,920	-	25,920
$Al_2(SO_4)_3$ (Sizing)	Santiago	31,400	3,920	-	35,420
Kaolin	Santiago	30,400	3,470	-	33,870
Coal (culm)	Lota	5,800	1,000	-	6,800
Sodium sulphate	Iquique	15,000	1,150	3,200	19,350
Sodium carbonate	Santiago	66,150	3,470	-	69,620
Limestone	Huachipato	5,400	980	-	6,380
Sodium chloride	Iquique	10,000	980	2,820	13,800
Sulphuric acid	Santiago	23,100	9,750	-	32,850
Fuel oil	Talcahuano	14,420	1,150	-	15,570
Diesel oil a/	Talcahuano	17,920	1,150	-	19,070
Cement b/	Calera	-	-	-	14,350
Bricks c/	-	-	-	-	10,000
Reinforcement iron d/	Huachipato	68,000	1,480	-	69,480

a/ By thousands of litres.

b/ In 42.5 kg. bags.

c/ Value of 1,000 bricks (30 x 15 x 7 cm.) estimated on the basis of Santiago price.

d/ Based on the cost of steel with a diameter of one inch.

Table IV-3

WATER REQUIREMENTS IN PULP AND PAPER MILLS a/

(m3/sec.)

Mill capacity, ton/day	50	100	200	300	400
Unbleached pulp	0.09	0.18	0.37	0.56	
Bleached pulp	0.10	0.21	0.42	0.62	
Unbleached kraft papers b/	0.21	0.42	0.84	1.26	
Bleached Kraft papers b/	0.21	0.42	0.84	1.26	
Newsprint		0.13	0.26	0.38	0.51

a/ Unit water requirements used: Unbleached pulp 160 m3/ton.
Bleached pulp 180 m3/ton.
Papers 360 m3/ton.
Newsprint 110 m3/ton.

b/ Includes pulp manufacture.

Table IV-4

MINIMUM STREAM FLOW REQUIREMENTS c/

(m3/sec)

Mill capacity, ton/day	50	100	200	300	400
Unbleached pulp	3.5	7	14	21	
Bleached pulp	4.5	9	18	27	
Papers	4.5	9	18	27	
Newsprint		11	22	33	44

c/ To maintain dissolved oxygen above 3 p.p.m.; water temperature: 20°C.

ANNEX V

ELECTRIC ENERGY SITUATION

Until 1940, the production of electric energy was exclusively in the hands of private enterprise. That year marked the establishment of the Corporación de Fomento de la Producción which recognized the need to develop a sustained campaign for the systematic electrification of the country and without which national economic activities could not be adequately promoted. In consequence an electrification plan was prepared, which was put into operation immediately, and to carry out this task the Empresa Nacional de Electricidad, S. A. (ENDESA) was created. During the first stage of the plan (1940-52), ENDESA installed a capacity of 207,200 kW, 98 per cent of which was in the form of hydroelectric power stations. During the second period of work, which will end in 1964, an additional 568,500 kW is to be installed.1/

To facilitate the work, ENDESA divided the country into seven "geographic areas". The fourth area is that which offers possibilities for installing new pulp and paper factories (36° to 38°20' S). Owing to existing or planned links between the various distribution networks, however, the situation of each "geographic area" cannot be considered alone. In fact, the major population and industrial centres of Chile lie in the third area, where demand has grown to such extent that, despite the activities of various concerns in this field, ENDESA has had to supply energy generated in the fourth area in order to improve the power situation.

In the fourth area, ENDESA has installed the Abanico power station (86,000 kilowatts), while another public utilities company has an installed capacity of 11,100 kilowatts. Only from the former can any increment in capacity be expected.

For financial reasons, the electrification plan has been delayed in recent years, considerably so in some areas. (See appendix V-A). It has caused consumer requests from new industries to be rejected or postponed, even in the fourth area which is the least affected by such delays. (See appendix V-B). General possibilities for making up lost ground are to be found in two aspects:

a) Prompt modification by Congress of the present Electric Services Act, so that tariffs may be adjusted more rapidly to real costs and the value of the capital invested by the enterprises.

   If ENDESA, for instance, could obtain a net yield of 8 per cent on its capital in 1956, it could reinvest 2,300 million pesos in new works.

b) Loans from abroad.

   During the first week of July ENDESA has announced that it will obtain 12.5 million dollars as the first instalment of a credit granted by the International Bank for Reconstruction and Development to Chile.2/ Moreover, ENDESA is negotiating direct loans from the Bank.

If both aspects can be favourably solved, present problems will be eliminated over the short term, particularly in the fourth area.

In addition, if a private industry should participate actively in the required capital formation, ENDESA would have no difficulty in supplying the energy requested within a short period.

1/ The 'Ciprosas' power station, with 88,000 kilowatts, is already operating. This is the first project of the second stage.

2/ Loan granted for the so-called 'Agricultural Development and Transport Plan'. (See also annex VII).

APPENDIX V-A

LETTER FROM THE GENERAL MANAGER OF ENDESA TO THE VICE-PRESIDENT OF CORFO

GERENCIA GENERAL N°3252
SANTIAGO, 26 APRIL 1956

To the
Executive Vice-President
Corporación de Fomento de la
Producción
Santiago

REF. POWER DEFICIT IN THE COUNTRY-NEED TO ACCELERATE THE ELECTRIFICATION PLAN

Mr. Vice-President:

As you know, the Board of directors of ENDESA, since the establishment of this enterprise has been permanently concerned over the need to accelerate the country's electrification plan in order to prevent the growing deficit in power supplies which is hampering production. The Board has sought to obtain the necessary means to eliminate this deficit by the construction of new power stations with their corresponding transmission lines and primary substations.

On behalf of the Board, I am addressing you to stress the gravity of the lack of sufficient power and of the need to solve this problem over the short term.

Public opinion should be made increasingly aware of the fundamental importance of developing power sources for the country's progress.

Among many weighty opinions which share this viewpoint, the following should be stressed: 1/

"Briefly economic development represents an increase in the average productivity of the labour force. Such increase is directly influenced by the amount of energy which man is in a position to incorporate into the productive process and by the ways in which he does so".

Hydro-electricity appears to be the main source of power for Chile because it is plentiful, potential resources are well-located and it can be developed economically on a large scale.

The utilization of power sources through electrification is carried out by the Corporación de Fomento through the Empresa Nacional de Electricidad S.A., ENDESA and by public utilities concessionaires and private companies.

During the last 10 or more years, public utility companies have suffered acute disinvestment and a decreasing interest in their activities and progress, because our electric service legislation is somewhat old-fashioned and has caused slow and cumbersome procedures for establishing up-to-date and adequate tariffs. The general practice of making public utility rates a subject of demagogic policy has also been detrimental. Thus such rates have lagged further and further behind the levels of prices, wages and salaries.

As to the Corporacion de Fomento and ENDESA, electrification plans based on the utilization of the country's hydro-electric resources have not hitherto developed with the speed which is considered requisite. This is due to the scarcity of the financial resources placed at the disposal of ENDESA and to the small return on existing investment, due to the causes already outlined which affect the rates for the services.

The consequences of all this are obvious; industries have gained no foothold, efforts to increase production have been hampered or impeded, and a real decline in the supply of electric energy to cities and main towns has taken place. All this has already resulted in heavy losses to the national economy.

1/ *ECLA. A summary of the Preliminary Report on the Development of Energy Production and Utilization in Latin America - Possibilities and Problems. (Document E/CN.12/379/Rev.1)*

which will become greater if strong incentives are not given to electrification works.

In order to measure the power deficit of the country and to reaffirm the need for accelerating the implementation of electrification plans, the deficit has been estimated by two methods.

First, the development of electrification in Chile was examined on the basis of a comparison with the forecasts in the 1942 Electrification Plan prepared by the Corporación de Fomento.

Secondly, the power deficit was calculated on the basis of the consumption which could have been covered if electricity had been available and of consumer requests which had to be rejected or postponed owing to lack of generating facilities.

First method. *Deficit in the country's supply of electric energy, calculated on the basis of consumption forecasts made in 1942 for 1956 and of existing generating facilities in 1956.*

Table A compares the consumption forecast for 1956 and available generating facilities in the same year, for each geographic area. This comparison shows the delay in the Electrification Plan both in terms of power shortage and in years. In 1942, future demand for electric energy was forecast on the basis of 1940 consumption. As is usually the case, a growth rate was assumed for consumption within each area and for each period. The rate was very conservative, as experience has shown and was considered as such by the experts who revised the calculations.

Second method. *Deficit in the supply of power, estimated on the basis of consumption which could have been covered if energy had been available and of requests for service rejected or postponed owing to lack of generating facilities.*

It is difficult to define, *a priori*, the consequences of an energy shortage with its consequent restrictions and rationing in industrial development and the growth of electricity consumption.

It has repeatedly been proved in Chile that a permanent and stable supply of electricity creates and promotes consumption of this energy. The development of such consumption will be adequate and stable so long as prices are left untouched and undistorted, owing to considerations not based on sound economic principles, either by excessive rises or declines in tariffs.

A rough estimate follows of the probable consumption if power had been available. Consideration was also given to consumption requests which had to be rejected or postponed for lack of generating facilities. This is the second method followed to appraise the lack of progress in the country's electrification programme.

The estimate which appears in table B is only a rough calculation of the deficit of electric energy in the country, for the reasons indicated above.

CONCLUSIONS

The two methods utilized to calculate the deficit of energy supplies lead to similar results, notwithstanding the differences inherent in such diverse bases of estimation and of the varying methods used. The two calculations show that there is a large deficit in the power supply of the country, a fact which, moreover, is evident throughout the country.

The deficit of available generating capacity is evident and serious, the more so because existing power stations have inadequate reserves. These reserves should amount to 15 to 20 per cent of installed capacity in order to face any contingency or accident in a generating group. Without these reserves, the services are liable to serious exceptional or unforeseen restrictions, particularly in autumn and winter when the peak demand exists.

The delays already caused in supplying the country's energy requirements and in installing new generating stations have been so prejudicial to the national economy that too much insistence cannot be laid on the fact that the authorities should proceed to take all possible steps to achieve an adequate solution as quickly as possible.

UNFAVOURABLE EFFECT OF THE SHORTAGE OF ENERGY

The ECLA study already cited also stresses the importance of power supplies for a country's development. We reproduce the more important paragraphs in connexion with Chile:

"The preceding paragraph distinctly shows the strategic importance of the energy supply for economic development. An increase in its supply is almost always a pre-requisite for the economic use of new investments in the other productive sectors. On the other hand, if investment in energy lags behind and the supply of this service becomes inelastic, it is almost certain that idle capacity will develop in the other sectors of the economy. The existence of reserve capacity in the energy sector is thus a pre-

TABLE A

COMPARATIVE PROGRESS OF THE ELECTRIFICATION PLAN PREPARED BY THE CORPORACION DE FOMENTO AND ENDESA, 1942-56

(Public utilities)

Area	Consumption forecast (1) kW	Available generating capacity (2) kW	Rough estimate of delay in plan	
			kW	years (3)
(2) Serena to Illapel	19,000	(16,000 (5)	3,000	2
		(13,000 (6)	6,000	4
(3) Petorca to linares	630,000			
(4) Less (9)	15,000	(415,000 (5)	200,000	5
	615,000	(372,000 (6)	243,000	6
(4) Parral to Victoria	90,000			
(7) plus	20,000	(112,000 (5)	0	0
	110,000	(80,000 (6)	30,000	3
(5) Lautaro to Puerto Montt	70,000	33,000	37,000 (8)	6
Total	814,000	(576,000 (5)	238,000	
		(498,000 (6)	316,000	

(1) Consumption forecast for 1956 of the 1942 Electrification Plan of the Corporación de Fomento.

(2) Including reserves for emergencies.

(3) From the moment that forecast consumption exceeded available capacity.

(4) Discounting consumption required for electrification of the State Railways.

(5) Favourable hydrological conditions.

(6) Very unfavourable hydrological conditions.

(7) Additional consumption of the steelworks of the Compañía de Acero del Pacífico.

(8) The generating stations in the Temuco-Valdivia area were planned to enter operation in 1946. The deficit covers the area from Lanco-Temuco to Lautaro.

(9) Includes consumption of the Braden Copper Co. and its power stations at Coya and Pangal.

TABLE B

ESTIMATE OF PROBABLE, REJECTED OR POSTPONED CONSUMPTION

First Area - Arica to Vallenar

With the exception of Arica, Tocopilla, Calama and Vallenar, power supplies in the remaining towns are clearly deficient. New works are being undertaken in the towns inland from Arica, at Iquique, Taltal, Antofagasta and Copiapó, which will mean an additional 14,000 kW installed capacity. This work needs to be accelerated, expanded and extended to other sectors of the same region. Moreover, the Copiapó and Vallenar areas should be connected with the electric networks of the south in order to ensure regular supplies.

Second Area - Serena to Illapel

Deferred consumption in mining, industry and agriculture are estimated to be about 6,000 kW

Third Area - Petorca to Linares

The provision of power to new towns and industries, public transport, spraying and rural electrification will require about 70,000 kW

Consumption restrictions and decline in voltage and frequency which has affected this region since 1947 may be estimated at an additional unsatisfied demand of about 100,000 kW

It should be stressed that electric heating, promoted until 1945, has been banned in recent years.

Fourth Area - Parral to Victoria

New industries and expansion of existing enterprises, particularly steelmaking, pulp and paper and others require about 33,000 kW

Fifth Area - Lautaro to Puerto Montt

Lack of adequate supplies to the Temuco area, from Lautaro to Lanco accounts for a deficit of about 15,000 kW

Total deficit in the country 224,000 kW

Note: Present unsatisfied power demand should be added to that which will appear in future. Thus, ENDESA has plans to supply to the following future demand in the fourth area:

Cía. de Acero del Pacífico (CAP). Its expansion programme until 1962-63 will require an additional capacity of 50 to 55 thousand kW.

Corporación de Fomento de la Producción (CORFO). Its pulp and paper programme at Coelemu, Huépil, Lebu and Renaico call for an additional 30 thousand kW.

requisite for development to continue with a minimum waste of capital, which represents the scarcest factor.

Considering that, at the present stage of development of most of the Latin American countries, the demand for energy grows particularly strongly and that its supply fills a strategic role in all phases of economic development, the conclusion is inevitable that a dynamic policy in the energy sector is of prime importance for accelerating the rate of growth. It is equally evident that the chronic shortage of energy which exists in many countries of the region today represents a deterrent to economic growth".

Further on the ECLA study goes on to say:

"The shortage of energy is among the major obstacles hampering economic development in Latin America. The relative under-consumption of energy is one of the expressions of economic under-development and is reflected in the fact that the total *per capita* consumption is less than one-third of that of the countries of the world as a whole".

But an abundant energy supply is not the only requisite to promote economic development. It is also necessary to ensure that this supply will be regular. Thus ECLA says:

"The absence of any guarantee that future supply will expand is sufficient to hamper the development of many industries. In some parts of Latin America this type of deficit has been accentuated in recent years and in others a direct deficit has developed, forcing certain industries into under-utilization of installed capacity. Many enterprises in Sao Paulo and Buenos Aires, for example, had to introduce very irregular timetables and cut down daily hours of work because of electricity shortages, while rationing was very widespread in almost all countries and still continues in some".

It is extremely difficult to measure the various pernicious effects of a lack of energy supply on a country's activities. During the autumn and winter of 1947, the provinces of Santiago, Valparaiso and Aconcagua were severely rationed and there were interruptions in the service due to the deficit in power supplies. The first unit at Sauzal only started operations in 1948. The Instituto de Ingenieros de Chile calculated that *the damage caused by rationing during that period was greater than the cost of permanent electric facilities required to prevent them.*

RECOMMENDATIONS

On various occasions 2/ recommendations have been made to the effect that private enterprises, public utility companies and ENDESA should together install a minimum annual average of 70,000 kW in new generating plants. It is estimated that of this total between 20 and 25 thousand kW annually could be installed by mining and industrial concerns as well as by private utility companies, if the latter are given equitable treatment which will enable them to attract private capital, ENDESA should install a minimum average of 50 thousand kW annually at a cost (current prices) including lines and primary substations amounting to 4,000,000 dollars and about 5,000,000,000 additional investment in pesos.

Nevertheless, the normal and permanent building rate of new power stations, together with transmission lines and primary substations, should average a reasonable figure of 100,000 kW annually. 3/ Moreover, during some years an additional 20,000 kW should be installed in order to make up for the lag which has so seriously affected the country.

To this end, the investment quota assigned to ENDESA should be raised by more than 70 per cent, to about 7 million dollars plus 8,600 million pesos.

Countries such as the United States, France, Canada, Norway and others have been investing up to 1.4 per cent of their national income on electricity projects. In order to attain a similar rate, Chile should spend over 28 billion pesos annually as an average over the next 10 years.

The following measures are recommended to achieve an adequate power supply for the country:

1. Prompt acceptance by Congress of the modifications to the present Act on Electric Services, as an indispensable basis for the solution of the problem.
2. The provision of sufficient funds so that ENDESA may undertake the basic works already planned and in general to double the progress achieved in recent years when insufficient funds were available.

Such measures would also comprise the following: ensuring through reasonable rates a minimum profit-

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2/ *Letters sent by the General Management of ENDESA to the Executive Vice-President of the Corporación de Fomento: 1 September 1952, 30 March 1955 and particularly on 10 January 1956.*

3/ *The installed power in the country's generating stations amounts to 1 million kW and this figure should at least be doubled during the next ten years.*

ability of 8 to 10 per cent on capital, to be periodically revalued; placing among the public and particularly among users, the bonds and debenture bonds of ENDESA and obtaining long-term credit in the country and abroad. Moreover, the foregoing could be supplemented by State contributions which would be applied particularly for those installations which are uneconomic at the beginning but which have definite development purposes.

3) Finally, and as an immediate and urgent step, in connexion with the provinces of Santiago, Valparaíso and Aconcagua, the Government should come to an agreement with the Cía. Chilena de Electricidad Ltda. on the terms for the latter to proceed with the thermic installations which were programmed long ago and which are already much delayed.

Yours sincerely

Reinaldo Harnecker
General Manager
Empresa Nacional de Electricidad S.A.

APPENDIX V-B

LETTER FROM THE GENERAL MANAGER OF ENDESA TO A PRIVATE FIRM

Santiago, 9 March 1956

Ref: POWER SUPPLIES FOR A NEWSPRINT MILL IN THE CONCEPCION AREA

Dear Sir:

We refer to your letter of 21 January and to the conversation between (name withheld) and our Manager, Mr. Raul Saez, on the possibility of supplying power to a newsprint mill which is to be installed in the Concepción area.

In this connexion, we have revised our demand forecasts for the area and our power availabilities as from 1959 and we are sorry to state that at the present rate of installation of new generating stations by ENDESA we shall not be able to comply with the request. It has been impossible to accelerate the rate of plant construction owing to the permanent deficit in the financing of the Electrification Plan as a result of budget cuts which have affected the Corporación de Fomento and which have caused lower contributions from CORFO to ENDESA.

We believe however, that if the financial condition of ENDESA should improve either owing to greater contributions obtained from the Corporacion de Fomento in the near future or to the active participation of the customers who are interested in using appreciable amounts of power, such as is the case you represent, we would have no objection to supplying the power required for the newsprint mill in the period requested.

Financing of the generation facilities required for the newsprint mill could be effected by the customer's contribution in national or foreign currency to cover the purchase of equipment and accessory buildings to be constructed by ENDESA. This contribution would be partly compensated by the delivery of ENDESA shares.

With respect to transforming and transmission facilities from the power station to the primary substations, the client should finance the necessary works to reinforce present installations so that the required power may be transmitted. These installations would be financed by the customer but would remain ENDESA's property.

Finally, the construction of the transmission facilities from the primary substations to the place of consumption will be financed entirely by the customer, and will be his property if they are for his exclusive use. The operation of these facilities would also be the client's responsibility. If, however, the transmission facilities are so built as to serve other clients in future, ENDESA would retain

ownership and would return the value of financing these facilities through a 20 per cent discount in power bills for a term no greater than 5 years. If at the end of this period there is an unpaid balance, this will benefit ENDESA on account of the lack of profitability of the installation.

Supply conditions would be similar to those accorded other industries in the Concepcion area and would include:

Rates are to be fixed according to the usual practice of ENDESA and will be modified in similar proportions as those applied to other industries in the area. The average level of such rates at present stands at about 3.80 pesos per kWh. The agreement will also include a clause in which the customer commits himself to restricting demand during peakload hours, an obligation which will be compensated in the way of applying the rate. As is usual in this kind of agreement, there will also be a penalty for low power factor of consumption.

We are at your disposal for any further consultation in connexion with this matter.

Yours sincerely,

Reinaldo Harnecker
General Manager
Empresa Nacional de Electricidad S.A.

ANNEX VI

THE TRANSPORT PROBLEM

Both the volume and the nature of the raw materials and finished products which flow to and from the pulp and paper mills make a good transport system indispensable to ensure continuity and economy in the industrial operations. Table VI-1 illustrates the magnitude of the problem for a sulphate pulp mill with a daily production of 250 tons.

Table VI-1

MATERIALS TO BE TRANSPORTED AT SULPHATE PULP MILLS WITH A DAILY CAPACITY OF 250 TONS

(Tons daily)

	Unbleached pulp	Bleached pulp
Transport to mill:		
Pulpwood	1,175	1,325
Chemicals, etc.	40	70
Fuels (coal and fuel oil)	25	85
Total transport to mill:	1,240	1,480
Transport from mill:	250	250
Total transport	1,490	1,730

Since regular daily transport of the same tonnage is impossible to achieve, the transport system must be developed to cope with peak loads which may be considerably higher than the rates indicated in the table. This is particularly the case when the mill is operating on a year-round basis.

Needless to say, the transport problem varies considerably according to the particular mill site and can only be dealt with here in summary fashion. The observations and comments made in the following pages refer to the Pinus radiata zone, i.e. the southern part of the central area of Chile. (See map I at the beginning of this report.)

The transport situation in this area, as in most parts of the country, is far from satisfactory. Fortunately this position is today recognized by the responsible authorities, who realize that the State should provide the port, railway and most of the road facilities in order to ensure a sound economic development of the country. As a result, plans are now under way to solve the existing problems in a reasonable period of time.

1. The road network

In the area of Pinus radiata plantations, which possesses a relatively large road network, only 30 per cent of the roads have, according to recent estimates, an all-weather surface. Many of these "first class" roads are not, however, in a condition to carry heavy and intense traffic, owing to their surface, width or layout. In addition the by-roads are often narrow and insecure, which precludes the use of large trucks.

In order to solve this situation -which is not exceptional for the country as a whole- the Ministry of Public Works and Communications is carrying out a five-year road development programme for completion in 1958, whose targets for Chile as a whole are shown in table VI-2.

Table VI-2

MINISTRY OF PUBLIC WORKS AND COMMUNICATIONS: ROAD PLAN 1954-58

(Kilometres)

Roads	Construction	Improvement	Paving	
			Concrete	Asphalt
Main North-South Highroad to the North of Santiago	135.5	500.0	58.0	625.0
Main North-South Highroad to the South of Santiago	685.5	31.0	242.0	603.0
International roads	106.5	160.0	25.0	-
Local, East-West roads	2,312.2	2,893.3	604.3	328.0
Total	3,240.7	3,584.3	929.3	1,556.0

Source: Ministry of Public Works and Communications.

In addition to the funds allocated by the Government for this plan, there are two other sources of financing to supplement the planned work: the liquidation of sales made under the Agricultural Surplus Agreements and the Agricultural and Transport Development Plan.

The Agricultural Surplus Agreements enable Chile to purchase agricultural commodities in the United States for which there is a surplus in that country. The value of such sales, liquidated in pesos, is invested in development projects in Chile and is repaid to the United States as a long-term loan (30 years). According to this system, some 6,250,000 dollars (3,125 million pesos) will be available during 1956, in addition to other funds, for construction, improvement and paving of roads in the Pinus radiata plantation area.

The Agricultural and transport Development Plan, prepared in 1953-54 by the government, is aimed at raising the level of agricultural production and improving the means of transport so that they harmonize with the general economic level reached by the country. As to roads, this programme supplements the plan at present under way. The foreign exchange financing includes a recently-granted loan from the International Bank for Reconstruction and Development amounting to more than 200 million dollars.

It is estimated that if the plans and the funds available are used correctly and opportunely, the present road problem will be largely solved by 1959.

For the transport of finished products to port (or raw materials in the other direction) the best economy will be achieved by using the largest possible vehicles compatible with the road conditions. However, because of the present situation, the Ministry of Public Works and Transports has recommended that transport capacity of trucks should be limited. These recommendations are included in appendix VI-A.

Probable transport costs for finished products have been estimated and the calculations are included in appendix VI-B.

For the transport of pulpwood from forest to mill it is usually preferable to select lighter and more manageable trucks which will have no difficulty on forest roads; the loading capacity will depend mainly on the conditions of such roads and the average transport distance which for most of the mill locations will probably not exceed 50 kilometres. The calculations of pulpwood transport cost, included in annex II, are based on a maximum loading capacity of the trucks of 11 tons.

Average road construction costs are listed in appendix VI-C.

2. *Railways*

The present rail situation is somewhat similar to that of roads. There is a fairly complete network in the Pinus radiata plantation area and, with some improvement planned for the near future, it will be quite satisfactory. Restricted load capacity at present is almost entirely due to the shortage of freight stock. In the southern network (Santiago-Puerto Montt) this limitation is particularly marked in March, April and May, owing to the movement of wheat and other agricultural commodities at the end of summer.

The State Railways own all the lines in the southern network, and have undertaken an improvement programme for rail lines way, rolling stock and services which calls for an investment of 62 million dollars plus about 6 billion pesos. The first installment of the loan for the Agricultural and Transport Development Programme provides foreign exchange for the execution of planned works, including electrification of the Santiago-Chillán section -which will benefit the whole southern network by making communications with the capital easier and more speedy- and through the purchase of ordinary and exceptional replacement equipment. Moreover, according to the same plan, the Railway Department of the Ministry of Public Works will change the narrow gauge (1.00 metre) track on the Monte Aguila-Huépil branch for a wide-gauge track (1.697 metre); this is a line which serves an area of large forest plantations.

Appendix VI-D indicates current freight rates for car loads of various products. When a company has its own cars, the railway provides the tracks, engines, personnel, etc. and makes a 5 per cent discount of freight charges. Appendix VI-D shows prices for various kinds of railway cars. This appendix also includes a note on the cost of building sidings.

3. *Ports*

Talcahuano would be the most suitable port for the export of products manufactured by the pulp and paper mills located in the plantation area. The port has very favourable geographic location and excellent natural conditions, but does not yet possess facilities for docking vessels of deep draught, so that loading and unloading must be done by lighter. This procedure is complicated, expensive, and hampers the protection of pulp and paper products from the rain. For these reasons it is most unlikely that Talcahuano, in its present state, could be used as a main shipping port for pulp and paper exports.

The Department of Ports of the Ministry of Public Works, however, has plans under way to expand the existing pier to a length of 180 metres and a width of 120 metres with three berths for the mooring of deep-draught vessels. This enlargement will raise the export capacity by 600 thousand tons annually for mixed cargoes, a figure which will be much larger if part of the cargo is uniform.

The project is to be financed by funds from the Ministry of Public Works and from the "Agricultural Surplus Agreements". In the agreement for the present year, the equivalent of 2.8 million dollars (1,400 million pesos) has been allocated for this purpose. If there are no financial difficulties, the project should be finished by 1959.

At the Naval Base at Talcahuano there is a pier which can be used for deep-draught vessels and which occasionally has been made available for merchant shipping. This pier might be a temporary solution if the export of pulp and paper should begin shortly before the new commercial pier is completed.

Appendix VI-F indicates loading and shipping tariffs.

4. *Floating of pulpwood*

River floating of pulpwood may be contemplated in some cases, where road and rail systems are undeveloped or non-existent. The problems involved will of course be specific to each mill location and an analysis of the possible uses of this means of transport is therefore outside the scope of this report. It is believed, however, that only in exceptional cases will this transport method prove to be competitive.

Appendix VI-A

RECOMMENDATIONS BY THE MINISTRY OF PUBLIC WORKS AND COMMUNICATIONS CONCERNING LIMITATIONS IN TRUCK LOADING CAPACITY

The recommendations of the Ministry are as follows:

1) Width: No vehicle, loaded or unloaded, should exceed a total external width of 96 inches (2.44 metres).

2) Height: No vehicle, loaded or unloaded, should exceed a height of 12 feet 6 inches (3.81 metres).

3) Length: a) No truck, loaded or unloaded may have a length (including front and rear fenders) exceeding 35 feet (10.67 metres).

b) No combination of truck and trailer or semi-trailer, loaded or unloaded, may exceed a total length of 50 feet (15.24 metres) including front and rear fenders.

c) No other combination of vehicles may consist of more than two units nor have a total length exceeding 60 feet (18.29 metres) including front and rear fenders.

4) Permissible loads: a) No axle should support more than 18,000 pounds (8,165 kilogrammes). (An axle load can be defined as that transmitted to the road by all the wheels whose centres are found within two parallel and vertical transverse planes separated by 40 inches (1.02 metres) and which extend throughout the total width of the vehicle).

b) No group of axles should bear a heavier burden than that indicated in the following table, which indicates the lengthwise distance between extreme axles of the group rounded to the nearest value in feet.

Distance between extreme axles of any group of axles		Maximum load on any group of axles	
Feet	Metres	Pounds	Kilogrammes
4	(1.22)	32,000	(14,515)
5	(1.52)	32,000	(14,515)
6	(1.52)	32,000	(14,515)
7	(2.13)	32,000	(14,515)
8	(2.44)	32,610	(14,792)
9	(2.74)	33,580	(15,232)
10	(3.05)	34,550	(15,672)
11	(3.35)	35,510	(16,107)
12	(3.66)	36,470	(16,543)
13	(3.96)	37,420	(16,974)
14	(4.27)	38,360	(17,400)
15	(4.57)	39,300	(17,826)
16	(4.88)	40,230	(18,248)
17	(5.18)	41,160	(18,670)
18	(5.49)	42,080	(19,087)
19	(5.79)	42,990	(19,500)
20	(6.10)	43,900	(19,913)
21	(6.40)	44,800	(20,321)
22	(6.71)	45,700	(20,730)
23	(7.01)	46,590	(21,133)
24	(7.32)	47,470	(21,532)
25	(7.62)	48,350	(21,932)

Distance between extreme axles of any group of axles		Maximum load on any group of axles	
Feet	Metres	Pounds	Kilogrammes
26	(7.92)	49,220	(22,326)
27	(8.23)	50,090	(22,721)
28	(8.53)	50,950	(23,111)
29	(8.84)	51,800	(23,496)
30	(9.14)	52,650	(23,882)
31	(9.45)	53,490	(24,263)
32	(9.75)	54,330	(24,644)
33	(10.06)	55,160	(25,021)
34	10.36)	55,980	(25,393)
35	(10.67)	56,800	(25,764)
36	(10.97)	57,610	(26,132)
37	(11.28)	58,420	(26,499)
38	(11.58)	59,220	(26,862)
39	(11.89)	60,010	(27,221)
40	(12.19)	60,800	(27,579)
41	(12.50)	61,580	(27,933)
42	(12.80)	62,360	(28,286)
43	(13.11)	63,130	(28,636)
44	(13.41)	63,890	(28,981)
45	(13.72)	64,650	(29,325)
46	(14.02)	65,400	(29,665)
47	(14.33)	66,150	(30,006)
48	(14.63)	66,890	(30,341)
49	(14.94)	67,620	(30,672)
50	(15.24)	68,350	(31,004)
51	(15.54)	69,070	(31,330)
52	(15.85)	69,790	(31,657)
53	(16.15)	70,500	(31,979)
54	(16.46)	71,200	(32,296)
55	(16.76)	71,900	(32,614)
56	(17.07)	72,590	(32,927)
57	(17.37)	73,280	(33,240)

Conclusions

Since the length of truck and trailer should not exceed 60 feet and the total maximum load is 33 tons for the greatest distance between axles compatible with the maximum length of 60 feet, it will not be possible to transport a greater weight than 33 tons. This tonnage includes the tare of both truck and trailer so that when this is discounted (11 tons or one third of the weight), the total net load which can be transported does not exceed 22 tons for a combination truck-trailer.

The recommendations on maximum length, height and width limit the maximum useful volume and length of platform. Taking into account the loss for cabin space, junction of truck to trailer and fenders, the maximum of 60 feet allows a total length of platform (truck plus trailer) of 14 metres. The total admissible height and width limit the useful volume to 5.86 cubic metres per lineal metre of platform, which gives a total maximum volume of 82 cubic metres.

This volume will easily allow in the case of pulp and paper for a maximum load of 22 tons.

Appendix VI-B

COST OF TRANSPORTING FINISHED PRODUCTS FROM PLANT TO PORT

A. *Basis for the calculations:*

Type of truck — Truck with trailer, with total transport capacity of 22 tons. Price: 11,600,000 pesos.

Diesel and oil consumption

Consumption of petroleum has been estimated at 0.67 litres per Km., and oil at 1.15 litres per 100 km. Current price: Diesel oil: 33.80 pesos per litre; lubricating oil: 370 pesos per litre.

Inner tubes and tires

A Set of inner tubes and tires is estimated to last 30,000 Km. The price of a set is 1,170,000 pesos.

Labour

Each truck will be operated by two drivers, who will travel together, in seven hour shifts each. Total work per team and year: 2,100 hours, which is 4,200 man-hours. Monthly salaries are 50,000 pesos per driver but each earns 2 and a half times this amount since overtime is paid with a 50 per cent surcharge. Therefore, including 26 per cent for social security, the annual cost of the two drivers is 3,780,000 pesos.

Lubrication

Is is estimated that this will amount to double the figure estimated for the 11 ton trucks used for wood transport.

Repairs and maintenance

The cost has been estimated at 40 per cent of the total of aperation costs plus amortization.

Amortization

The amortization period is 5 years, at the end of which the truck and trailer will have a recovery value of 20 per cent of the initial value.

In order to calculate costs of operation per kilometre, it has been assumed that the average speed will be 40 kilometres per hour, that loading and unloading will take one hour and that 30 additional minutes will be lost through stopping on the way. It is estimated that to load and unload 22 tons in one hour, 6 men will be required (3 in the plant and 3 in the port) in the case of pulp and 3 men in the case of newsprint. On the basis of monthly salaries of 40,000 pesos and 2,100 work hours annually, including 26 per cent for social security, loading and unloading costs are 78.50 pesos per ton for pulp and 39.30 pesos per ton for newsprint. Depreciation for the necessary equipment has been included in the mill cost.

Table VI-B-1

DISTANCE OF TRIPS AND TRANSPORT CAPACITY OF TRUCKS, ANNUALLY

Distance with load (km)	Total time of round trip (min)	N° of trips annually a/ (-)	Total distance with load (km/year)	Annual capacity of truck (tons)
50	240	962.5	48,100	21,150
60	270	825	49,500	18,150
70	300	687.5	48,100	15,130
80	330	687.5	55,000	15,130
90	360	550	49,500	12,100
100	390	550	55,000	12,100
120	450	412.5	49,500	9,075
140	510	412.5	57.750	9,075
160	570	412.5	66,000	9,075
180	630	275	49,500	6,050
200	690	275	55,000	6,050
230	780	275	63,250	6,050
250	840	275	68,750	6,050
270	900	275	74,250	6,050
300	990	275	82,500	6,050

a/ Owing to the nature and conditions of transport, daily trips have been rounded to the lower units or half units, so that there is an irregular regression of the annual number as distance increases.

B. Costs of operation

Transport costs have been calculated, with the basic data indicated above, and are shown in table VI-B-2.

Table VI-B-2

TRANSPORT COSTS FOR FINISHED PRODUCTS, INCLUDING LOADING AND UNLOADING

(Pesos per kilometre and freight of 22-ton truck and trailer)

	Transport distance - single trip (km)					
	50	70	100	140	180	250
Cost of operation a/						
1. Diesel oil	45.00	45.00	45.00	45.00	45.00	45.00
2. Lubricating oil	11.00	11.00	11.00	11.00	11.00	11.00
3. Lubrication	3.20	3.20	3.20	3.20	3.20	3.20
4. Inner tubes and tires	78.00	78.00	78.00	78.00	78.00	78.00
5. Labour	78.40	78.40	68.60	65.30	76.00	54.80
6. Repairs and maintenance b/	101.70	101.70	95.70	93.80	100.20	87.60
7. Loading and unloading						
Pulp	34.50	24.70	17.30	12.30	9.60	6.90
Paper	17.20	12.40	8.60	6.20	4.80	3.40
Total pulp: pesos	351.80	342.00	318.80	308.60	323.00	286.50
dollars	0.704	0.684	0.638	0.617	0.646	0.573
Total pulp: pesos	334.50	329.70	310.10	302.50	318.20	283.00
dollars	0.669	0.659	0.620	0.605	0.636	0.566
Capital costs c/						
8. Amortization trucks d/	38.60	38.60	33.80	32.20	37.50	27.00
9. Amortization housing e/	2.30	2.30	2.00	1.90	2.30	1.60
Total : pesos	40.90	40.90	35.80	34.10	39.80	28.60
dollars	0.082	0.082	0.072	0.068	0.080	0.057
Total c/ pulp: pesos	392.70	382.90	354.60	342.70	362.80	315.10
dollars	0.786	0.766	0.710	0.685	0.726	0.630
Total c/ paper: pesos	375.40	370.60	345.90	336.60	358.00	311.60
dollars	0.751	0.741	0.692	0.673	0.716	0.623
Interest f/	60.20	60.20	52.60	50.10	58.50	42.10
Total pulp: pesos	452.90	443.10	407.20	392.80	421.30	357.20
dollars	0.906	0.886	0.814	0.786	0.843	0.714
Total paper: pesos	435.60	430.80	398.50	386.70	416.50	353.70
dollars	0.871	0.862	0.797	0.773	0.833	0.707

a/ Maintenance of housing is included in community expenditure for workers and employees.
b/ 40 per cent of items 1-5 and 8.
c/ Excluding interest.
d/ 5 years with 20 per cent residual value.
e/ 20 years.
f/ 10 per cent of book value that is, 6 per cent average interest of investment in trucks and 5 per cent for housing.

If these figures are expressed in pesos per ton for the total distance, the following table is obtained:

Table VI-B-3

TRANSPORT COSTS FOR FINISHED PRODUCTS, INCLUDING LOADING AND UNLOADING
(Pesos per ton and total distance)

	Transport distance - Single trip (Km)					
	50	70	100	140	180	250
Cost of operation (pulp)	1,600	2,176	2,900	3,926	5,285	6,511
Cost of operation (paper)	1,520	2,097	2,818	3,850	5,204	6,432
Capital cost, excluding interest	186	261	327	433	655	648
Total pulp, excluding interest	1,786	2,437	3,227	4,359	5,940	7,159
Total paper, excluding interest	1,706	2,358	3,145	4,283	5,859	7,080
Interests	273	382	500	636	982	909
Total pulp	2,059	2,819	3,727	4,995	6,922	8,068
Total paper	1,979	2,740	3,645	4,919	6,841	7,989

Table VI-B-4

HOUSING COSTS

Investment required:

Number of workers		Square metres of construction	Cost: 1,000 pesos
Single:	3	24 a/	576
Married	5	350	8,400
Total	8	374	8,976

Annual costs per truck:	1,000 pesos
Repayment period, 20 years	112.2
Interest, 10 per cent of book value	112.2

Cost per kilometre:

Transport distance with freight, Km	50	70	100	140	180	250
Annual distance with freight, 1,000 Km	48.1	48.1	55.0	57.8	49.5	68.8
Depreciation, pesos per Km	2.30	2.30	2.00	1.90	2.30	1.60
Interest, pesos per Km	2.30	2.30	2.00	1.90	2.30	1.60

a/ Additional area required for community facilities for industrial workers.

Appendix VI-C

COST OF ROAD-BUILDING 1/

Present road-building costs in the central-southern region of Chile are as follows:

	Millions of pesos per kilometre
6-metre gravel road	5
6-metre concrete road a/ b/	12
7-metre road:	
Building and levelling	8
Concrete surface a/	10
Total	18

a/ Road surface 18 cm. deep.
b/ Favourable topographical conditions.

The square metre of concrete 18 centimetres deep costs 1,450 pesos. There are no recent data on paving with asphalt since this procedure has not been used for some time, but it is estimated at 70 per cent of concrete, that is about 1,000 pesos per square metre.

1/ *Source: Ministry of Public Works and Comunications.*

Appendix VI-D

RAILWAY FREIGHT RATES BY CARLOADS

1. NEWSPRINT ROLLS

Distance (kilometre)	Freight charges per ton (pesos)	Freight charges per ton-km (pesos)
5	186	37.20
10	256	25.60
20	395	19.75
30	526	17.53
40	650	16.25
50	774	15.48
60	878	14.63
70	982	14.03
80	1,087	13.59
90	1,191	13.23
100	1,295	12.95
120	1,465	12.21
140	1,635	11.68
160	1,797	11.23
180	1,951	10.84
200	2,105	10.52
230	2,429	10.56
250	2,645	10.58
270	2,853	10.57
300	3,165	10.55
350	3,685	10.53
400	4,205	10.51
450	4,610	10.24
500	5,015	10.03
550	5.340	9.71
600	5.665	9.44
650	5,990	9.22
700	6,315	9.02
750	6,640	8.85
800	6,945	8.68

Source: Empresa de Ferrocarriles del Estado.

2. KRAFT PULP

Distance (kilometre)	Freight charges per ton (pesos)	Freight charges per ton-km (pesos)
5	160	32.00
10	218	21.80
20	335	16.75
30	447	14.90
40	553	13.82
50	649	12.98
60	749	12.48
70	839	12.00
80	929	11.61
90	1,019	11.32
100	1,109	11.09
120	1,253	10.44
140	1.397	9.98
160	1,534	9.59
180	1,664	9.25
200	1,794	8.97
230	2,144	9.32
250	2,379	9.52
270	2,551	9.45
300	2,809	9.36
350	3,239	9.25
400	3,669	9.15
450	4,019	8.93
500	4,369	8.74
550	4,649	8.45
600	4,929	8.22
650	5,209	8,01
700	5,489	7.84
750	5,769	7.69
800	6,039	7.55

3. COMMON SALT, LIMESTONE, KAOLIN AND SODIUM CARBONATE

Distance (kilometre)	Freight charges per ton (pesos)	Freight charges per ton-km (pesos)
5	115	23.00
10	157	15.70
20	242	12.10
30	323	10.77
40	400	10.00
50	480	9.60
60	542	9.03
70	607	8.67
80	672	8.40
90	737	8.19
100	802	8.02
120	902	7.52
140	1,002	7.16
160	1,101	6.88
180	1,209	6.72
200	1,297	6.48
230	1,627	7.07
250	1,847	7.39
270	1,983	7.35
300	2,187	7.29

4. PINE ROUNDWOOD

Distance (kilometre)	Freight charges per ton (pesos)	Freight charges per ton-km (pesos)
5	136	27.20
10	185	18.50
20	285	14.25
30	380	12.67
40	470	11.75
50	552	11.04
60	636	10.60
70	714	10.20
80	790	9.88
90	866	9.62
100	942	9.42
120	1,065	8.88
140	1,187	8.48
160	1.304	8.15
180	1,415	7.86
200	1,525	7.62

5. SALT CAKE AND ALUM

Distance (kilometre)	Freight charges per ton (pesos)	Freight charges per ton-km (pesos)
5	135	27.00
10	186	18.60
20	287	14.35
30	383	12.77
40	473	11.82
50	563	11.26
60	638	10.63
70	713	10.19
80	788	9.85
90	863	9.60
100	938	9.38
120	1,060	8.83
140	1,182	8.44
160	1,299	8.12
180	1,411	7.84
200	1,523	7.62
230	1,862	8.10
250	2,088	8.35
270	2,242	8.30
300	2.473	8.24

ANNEX VII

INVESTMENTS AND CAPITAL REQUIREMENTS

1. Basis for estimates of investments *

The figures submitted by Karlstads Mekaniska Verkstad A.B., Sweden to the Pulp and Paper Conference in Buenos Aires 1954 have been used for the pulp mills and integrated pulp and paper mills. 1/ As a general rule these figures have been increased by 20 per cent, which is the price increment indicated by the Company for the period from April 1954 to the beginning of 1956.

Investments in newsprint mills are estimated by the Advisory Group, partly from data submitted by Parsons & Whittemore Inc., New York and Karlstads Mekaniska Verkstad, partly from private information by other sources. (See table VII-3). The cost of newsprint machines varies widely according to the make and country of origin. The prices used in the present estimate are European prices.

The following cost items have been revised because of differences in the equipment specifications and local costs in Chile:

(a) Pulp mills

Item 17: The investment has been increased by 35 per cent over the Karlstad figures for bleached qualities, since fresh water is likely to be of poorer quality in Chile and will require more elaborate treatment.

Item 18: To obtain self-sufficiency in power for the production of bleached qualities this item has been increased as follows:

Mill capacity, tons/day	50	100	200	300
Additional power, kW.	675	1,350	2,700	4,000
Additional invest. for boiler, dollars	16,500	27,500	38,500	43,500
Additional invest. for turbine generators	27,500	54,500	97,500	134,500
Total add. investment	44,000	82,000	136,000	178,000

Item 23: Revised according to local labour costs.

Item 24: 7.5 to 10 per cent of total cost of equipment depending on mill size.

Item 25: The costs have been depreciated in relation to the estimates by Karlstads because of low cost of local labour. Estimates correspond to approximately 3.5 per cent of the c.i.f. cost of machinery.

Item 27: Local construction costs of industrial buildings are 15,000-17,000 pesos per square metre and 28,000 pesos per square metre for offices, which correspond to approximately 8.00 and 17.50 dollars respectively per cubic metre. Volume of buildings are recorded in table VII-4.

Item 28: Based on a cost of 30,000 dollars per km., including junctions.

Item 29: Estimated at 7 per cent of mill investment.

1/ *See Pulp and Paper Prospects in Latin America: op.cit., page 150.*

* (See tables VII-1 and VII-2).

Item 31: See tables VII-7 and VII-8, and figure VII-VI.

(b) Integrated paper mills

Same basis as for pulp mills except for Item 7, which is estimated according to footnote in the investment table. Building volumes in table VII-5.

Item 20: See figure VII-VI.

(c) Newsprint mills

Item 3: Estimates by Parsons & Whittemore Inc.

Item 5: For mills of 100 and 200 tons daily capacity, one paper machine. For mills of 300 and 400 tons 2 paper machines.

Item 11: Estimates made as follows: (See also table VIII-3).

Mill capacity, tons/day	100	200	300	400
Steam requirement, tons/hr.	15.8	31.6	47.5	63.5
Power requirement, kW	7,600	15,200	22,750	30,400
Power purchased, kW	5,900	11,800	17,650	23,400
Turbine/generator, kW	1,700	3,400	5,100	7,000
Investments, 1,000 dollars				
Steam plan	300	425	600	770
Turbine generator	170	290	400	500
Main transformers, sub-stations and switchgear	230	450	570	760
Total investment	700	1,165	1,570	2,030

Items 23 and 24: See table VII-6.

Item 27: See figure VII-VI.

Table VII-1

INVESTMENTS: PULP MILLS

(Thousands of dollars)

	Mill size							
	50 tons/day		100 tons/day		200 tons/day		300 tons/day	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
1. Logyard	125	125	135	135	150	150	280	280
2. Wood prep. dept. & chip silos	370	370	525	525	650	650	880	880
3. Digester & diffuser depts.	455	455	525	525	830	830	1,160	1,160
4. First screening dept.	250	250	425	425	610	610	790	790
5. Bleaching dept.	-	300	-	430	-	565	-	695
6. Electrolytic plant & bleach. liq. prep.	-	625	-	765	-	880	-	995
7. Salt store	-	5	-	6	-	7	-	8
8. Second screening dept.	-	95	-	145	-	190	-	255
9. Pulp drying machine dept	330	330	540	540	990	990	1,435	1,435
10. Pulp store	15	15	18	18	20	20	23	23
11. Evaporation plant & soda recovery	950	950	1,205	1,205	1,460	1,460	2,200	2,200
12. Sulphate store	15	15	18	18	20	20	23	23
13. Causticizing dept.	255	255	485	485	690	690	910	910
14. Piping between different buildings	70	81	93	110	130	145	150	170
15. Electrical motors & cables	140	175	230	280	395	450	535	600
16. Insulation material & woodwork	21	25	28	31	36	41	43	43
17. Water purification plant & pump station	115	150	170	220	310	400	405	525
18. Steam & power station	600	670	720	835	810	995	880	1,115
19. Machinery in repair shop	185	185	210	210	230	230	255	255
20. Machinery in fire station	28	28	28	28	28	28	28	28
21. Laboratory equipment	17	17	23	23	23	23	23	23
22. Office equipment	23	23	28	28	35	35	46	46
23. Excavation & planning of site.	125	130	170	180	235	250	310	330
24. Cost of freight	375	420	495	550	665	740	960	1,070
25. Cost of erection	150	190	205	275	280	365	420	535
26. Administration during erection	75	75	120	120	170	170	190	190
27. Cost of buildings, chests, etc.	1,010	1,255	1,175	1,415	1,595	1,910	2,175	2,545
28. Railway lines on mill site	90	90	120	120	150	150	180	180
29. Engineering fees	401	511	549	673	738	911	999	1,211
30. Total mill investment	6,190	7,815	8,410	10,320	11,250	13,905	15,300	18,520
31. Investment in housing and community	620	700	740	840	930	1,060	1,170	1,330
32. Grand total	6,810	8,515	9,150	11,160	12,180	14,965	16,470	19,850

Table VII-2

INVESTMENT: INTEGRATED MILLS

(Thousands of dollars)

Mill capacity	50 tons/day		100 tons/day	
	Unbl.	Bl.	Unbl.	Bl.
1. Pulp mill machinery	2,435	3,460	3,336	4,682
2. Paper mill machinery	2,220	2,220	3,360	3,360
3. Electric motors and cables	290	325	465	510
4. Piping between buildings	105	115	140	155
5. Insulation material and woodwork	40	45	50	55
6. Water purification plan and pump station	170	210	305	380
7. Steam and power plant	765	835	890	990
8. Machinery in repair shop	210	210	230	230
9. Machinery in fire station	30	30	30	30
10. Laboratory equipment	23	23	25	25
11. Office equipment	30	30	35	35
12. Freights	520	615	725	850
13. Administration during erection	125	125	215	215
14. Cost of erection	225	280	310	400
15. Engineering fees	609	718	859	1,005
16. Buildings, sheds, etc.	1,248	1,519	1,722	2,050
17. Excavation and planning of site	155	170	195	220
18. Railway lines on site	100	110	140	155
19. Mill investment:	9,300	11,040	13,050	15,360
20. Housing and community	860	1,035	1,135	1,360
Total investment:	10,160	12,075	14,185	16,720

Note: Basis of estimate same as for pulp mills.
To obtain self-sufficiency in power, item 7 has been increased as follows:

Mill capacity	50 tons per day		100 tons per day	
	Unbl.	Bl.	Unbl.	Bl.
Additional effect required MM	625	1,300	1,259	2,600
Additional heat per hr. required: Mcal	4.04	7.20	8.08	14.40
Estimated cost: turbine/generator	26.0	52.0	49.0	94.0
Estimated cost: boiler	20.0	29.0	31.0	40.0
Add. investment required	46.0	81.0	80.0	134.0

Table VII-3

INVESTMENTS: NEWSPRINT MILLS

(Thousands of dollars)

Newsprint mill capacity Sulphite pulp section Capacity	100 tons/day 20 tons/day		200 tons/day 40 tons/day		300 tons/day 60 tons/day		400 tons/day 80 tons/day	
1. Logyard equipment	130		150		170		210	
2. Barking department	140		190		290		370	
3. Chemical pulp section	900		1,540		2,150		2,750	
4. Mechanical pulp section, incl. first screening dept.	760	1,950	1,250	3,130	1,740	4,350	2,200	5,530
Paper mill								
5. Paper machines, incl. drives reelers and rewinders	2,750		4,450		7,000		8,800	
6. Stock prep. equipment	190		305		440		560	
7. Finishing dept.	25		40		60		75	
8. Motors, cables & intruments	150		200		300		380	
9. Pipings	60	3,175	90	5,085	120	7,920	160	9,975
10. Water purification & pump station	170		310		405		530	
11. Steam and power station incl. transformer station	700		1,165		1,570		2,030	
12. Piping between buildings	140		200		240		280	
13. Machinery in repair shop	200		300		350		390	
14. Machinery in fire station	30		30		30		30	
15. Laboratory equipment	25		25		30		35	
16. Office equipment	30	1,295	35	2,065	45	2,670	50	3,345
17. Freights, and export packing equipment	810	810	1,280	1,280	1,870	1,870	2,350	2,350
18. Total C.i.f.		2,230		11,560		16,810		21,200
19. Cost of erection	250		395		580		730	
20. Adm. during erection	130		200		290		360	
21. Engineering fees	630	1,010	1,000	1,595	1,470	2,340	1,830	2,920
22. Excavation and planning of site	130		180		225		280	
23. Buildings, chests, etc.	1,050		1,400		1,800		2,150	
24. Buildings, offices	70		80		85		90	
25. Railway lines on mill site	140	1,390	170	1,830	190	2,300	210	2,730
26. Mill investment		9,630		14,985		21,450		26,850
27. Cost of housing and community	930	930	1,105	1,105	1,445	1,445	1,680	1,680
28. Grand total		10,560		16,090		22,895		28,530

Table VII-4

BUILDING VOLUMES : PULPMILLS

(Thousands of cubic metres)

	Mill size, tons per day							
	50		100		200		300	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Wood prep. dept. and chip silos	9.7	9,700	11,600	11,600	15,600	15,600	21,000	21,000
Digester and diffusser dept.	15,0	15,000	23,000	23,000	40,000	40,000	55,000	55,000
First screening dept.	9.2	9,200	12,100	12,100	16,600	16,600	20,500	20,500
Bleaching dept.		11,200		13,500		15,200		17,500
Electrolytic plant and bleach. liq. prep.		8,900		9,500		11,100		13,200
Salt store		900		1,000		1,100		1,200
Second screening dept.		6,900		8,000		10,800		14,500
Pulp drying machine dept.	7.9	7,900	10,000	10,000	12,500	12,500	20,100	20,100
Pulp store	6.0	6,000	8,000	8,000	13,000	13,000	18,000	18,000
Evaporation plant and soda recovery	19.5	19,500	21,1000	21,100	28,500	28,500	38,500	38,500
Sulphate store	1.1	1,100	1,300	1,300	1,500	1,500	1,700	1,700
Causticising dept.	6.8	6,800	12,600	12,600	16,500	16,500	25,300	25,300
Water purification plant and pump station	10.4	10,400	11,000	11,000	14,800	14,800	20,000	20,000
Laboratory	2.0	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Steam and power station	12.6	12,600	12,900	12,900	17,400	17,400	28,500	28,500
Repair shop	16.8	16,800	16,800	16,800	16,800	16,800	16,800	16,800
Fire station	0.3	300	300	300	300	300	300	300
Total industrial bulding	117.3	145,200	142,700	172,700	195,500	234,700	267,700	314,100
Offices	4.0	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Total construction	121.3	149,200	146,700	176,700	199,500	238,700	271,700	318,100
	COST OF CONSTRUCTION (1,000 dollars)							
Industrial	938	1,154	1,142	1,382	1,564	1,878	2,142	2,513
Offices	70	70	70	70	70	70	70	70
Total	1,008	1,224	1,212	1,452	1,634	1,948	2,212	2,583

Table VII-5

BUILDING VOLUMES: INTEGRATED MILLS

(Thousands of cubic metres)

Mill capacity	50 tons/day		100 tons/day	
	Unbleached	Bleached	Unbleached	Bleache
Wood prep. dept. and chip silos	9.7	9.7	11.6	11.6
Digester and diffuser dept.	15.0	15.0	23.0	23.0
First screening dept.	9.2	9.2	12.1	12.1
Bleaching dept.		11.2		13.5
Electrolytic plant and bleach liq. prep.		8.9		9.5
Salt store		0.9		1.0
Second screening dept.		6.9		8.0
Evaporation dept. and soda recovery	19.5	19.5	21.1	21.1
Sulphate store	1.1	1.1	1.3	1.3
Causticizing dept.	6.8	6.8	12.6	12.6
Beater room and size prep. dept.	3.6	3.6	6.7	6.7
Paper machine room	25.0	25.0	49.0	49.0
Sorting and finishing dept.	10.0	14.0	18.0	25.0
Paper store	3.8	3.8	5.0	5.0
Water purification plant & pump station	10.	10.4	11.0	11.0
Laboratory	2.0	2.0	2.0	2.0
Steam and power plant	14.0	16.0	16.0	18.0
Repair shop	16.8	16.8	16.8	16.8
Fire station	0.3	0.3	0.3	0.3
Total industrial building	147.2	181.1	206.5	247.5
Offices	4.0	4.0	4.0	4.0
Total	151.2.	185.1	210.5	251.5

COST OF CONSTRUCTION

(1,000 dollars)

Industrial buildings	1,178	1,449	1,652	1,980
Offices	70	70	70	70
Total building cost	1,248	1,519	1,722	2,050

Table VII-6

ESTIMATE OF BUILDING VOLUMES: NEWSPRINT MILLS

(Thousands of cubic metres)

Mill capacity, tons/day	100	200	300	400
Sulphite pulp section	25.0	30.0	37.0	45.0
Mechanical pulp section	15.0	19.2	22.2	26.2
Paper mill	50.0	68.0	94.0	108.8
Paper store	5.0	7.0	9.2	11.2
Steam and power plant	7.5	10.0	12.5	15.0
Water purification and pump station	8.0	12.0	16.0	20.0
Repair shop	20.0	25.0	30.0	35.0
Laboratory	2.0	2.0	2.0	2.5
Total industrial buildings	132.5	173.2	222.9	263.7
Offices	4.0	4.5	4.8	5.0
Total	136.5	177.7	127.7	267.7

COST OF CONSTRUCTION

(Thousands of dollars)

Industrial buildings	1,050	1,400	1,800	2,150
Offices	70	80	85	90
Total	1,120	1,480	1,885	2,240

2. Community costs for workers and employees

Bases:

(a) 65 per cent of workers and employees aged from 18 to 59 years are married.

(b) Employers:

Houses of 140 m^2 (average).
Community building with 15 m^2 per inhabitant.
Cost per m^2 plus urbanization 30,000 pesos.

(c) Workers:

Houses of 70 m^2 (average).
Community building with 8 m^2 per inhabitant.
Cost per m^2 plus urbanization, 24,000.

(d) Store: 1.5 per cent of the sum of areas of houses and community buildings.

Hospital: 1.5 per cent of the sum of areas of houses and community buildings.

Club: 2.0 per cent of the sum of areas of houses and community buildings.

Church: 1.5 per cent of the sum of areas of houses and community buildings.

Unit cost per m^2:		
	store	24,000 pesos
	church and hospital	30,000 pesos
	school and club	26,000 pesos

Table VII-7

COSTS OF COMMUNITY SERVICES AND HOUSING FOR EMPLOYEES AND WORKERS IN PULP MILLS

	50 tons/day						100 tons/day					
	Unbleached			Bleached			Unbleached			Bleached		
	Nº	Area m2	1,000 pesos	Nº	Area m2	1,000 pesos	Nº	Area m2	1,000 pesos	Nº	Area m2	1,000 pesos
Employees												
Single	13	195		13	195		14	210		14	210	
Married	22	3,060		22	3,060		25	3,500		25	3,500	
Total	35	3,275	98,250	35	3,275	98,250	39	3,710	111,300	39	3,710	11,300
Workers												
Single	60	480		73	584		73	584		87	696	
Married	101	7,070		123	8,610		124	8,680		149	10,430	
Total	161	7,550	181,200	196	9,194	220,656	197	9,264	222,336	236	11,126	267,024
School	-	216	5,616	-	250	6,500	-	260	6,760	-	297	7,722
Store	-	162	3,888	-	187	4,488	-	195	4,680	-	223	5,352
Hospital	-	162	4,860	-	187	5,610	-	195	5,850	-	223	6,690
Club	-	216	5,616	-	250	6,500	-	260	6,760	-	297	7,722
Church	-	162	4,860	-	187	5,610	-	195	5,850	-	223	6,690
Sport, fields, green, areas, etc.	-	-	4,000	-	-	4,000	-	-	5,000	----	-	5,000
Houses for community staff	-	-	2,700	-	-	2,700	-	-	4,000	-	-	4,000
Total, 1,000 pesos	-	-	310,990	-	-	354,314	-	-	372,536	-	-	421,500
Total, 1,000 dollars			620			710			750			840

Table VII-7 (continued)

COST OF COMMUNITY SERVICES AND HOUSING FOR WORKERS AND EMPLOYEES IN PULP MILLS

Production capacity	200 tons/day						300 tons/day					
	Unbleached			Bleached			Unbleached			Bleached		
	N°	Area m2	1,000 pesos	N°	Area m2	1,000 pesos	N°	Area m2	1,000 pesos	N°	Area m2	1,000 pesos
Employees												
Single	18	270		18	270		22	330		22	330	
Married	31	4,340		31	4,340		38	5,320		38	5,320	
Total	49	4,610	138,300	49	4,610	138,300	60	5,650	169,500	60	5,650	169,500
Workers												
Single	91	728		111	888		118	944		142	1,136	
Married	156	10,920		190	13,300		202	14,140		241	16,870	
Total	247	11,648	279,552	301	14,188	340,512	320	15,084	362,016	383	18,006	432,144
School	-	325	8,450	-	376	9,776	-	415	10,790	-	473	12,298
Store	-	244	5,856	-	282	6,768	-	311	7,464	-	355	8,520
Hospital	-	244	7,320	-	282	8,460	-	311	9,330	-	355	10,650
Club	-	325	8,450	-	376	9,776	-	415	10,790	-	473	12,298
Church	-	244	7,320	-	282	8,460	-	311	9,330	-	355	10,650
Sport fields, green areas, etc.	-	-	6,000	-	-	6,000	-	-	7,000	-	-	7,000
Houses for community staff	-	-	5,100	-	-	5,100	-	-	7,500			7,500
Total, 1,000 pesos	-	-	466,358	-	-	533,152	-	-	593,720			670,560
Total, 1,000 dollars			930			1,070			1,190			1,340

Table VII-8

COST OF COMMUNITY SERVICES AND HOUSING FOR WORKERS AND EMPLOYEES IN INTEGRATED MILLS

Size of mill	50 tons/day						100 tons/day					
	Unbleached			Bleached			Unbleached			Bleached		
	Nº	m2	1,000 pesos	Nº	m2	1,000 pesos	Nº	m2	1,000 pesos	Nº	m2	1,000 pesos
Employees												
Single	15	225		15	225		20	300		20	300	
Married	29	4,060		30	4,200		36	5,040		37	5,180	
Total	44	4,285	128,550	45	4,425	132,750	56	5,340	160,020	57	5,480	164,400
Workers												
Single	78	625		99	795		103	825		132	1,060	
Married	145	10,150		183	12,810		192	13,440		244	17,080	
Total	223	10,775	258,600	282	13,605	326,500	295	14,265	342,360	376	18,140	435,360
School		300	7,800		451	11,725		490	14,700		590	17,700
Store		226	5,425		270	6,480		294	7,060		354	8,500
Hospital		226	6,780		270	8,100		294	8,820		354	10,620
Club		300	7,800		451	11,725		490	14,700		590	17,700
Church		226	6,780		270	8,100		294	8,820		354	10,620
Parks, recreations, etc.			5,00			6,000			6,000			7,000
Housing for community staff			4,000			5,000			5,1000			7,500
Total 1,000 pesos			430,735			516,380			567,580			679,400
1,000 dollars			860			1,035			1,135			1,360

Table VII-9

ESTIMATE OF WORKING CAPITAL REQUIREMENTS

1. Pulp mills

(Thousands of dollars)

Mill capacity, tons/day	50		100		200		300	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Prod. value per ton, dollars	94.78	117.47	74.38	91.99	62.14	77.52	59.67	74.19
Value of 4 months' prod.	553	685	867	1,073	1,450	1,809	2,088	2,594
Value of spare parts, mill	218	281	305	384	418	517	562	685
Value of spare parts, forest dept.	9	9	18	23	42	49	70	81
Total	780	975	1,190	1,480	1,910	2,375	2,720	3,360
Annual interest, US$ 1,000	78.00	97.50	119.00	148.00	191.00	237.50	272.00	336.00
Interest per ton, dollars	4.45	5.57	3.40	4.23	2.73	3.39	2.59	3.20

2. Integrated mills

Produc. value per ton, doll.	140.50	168.42	112.68	135.13
Value of 4 months' prod.	820	982	1,313	1,577
Value of spare parts, mill	346	419	488	575
Value of spare parts, forest department	9	9	19	23
	1,175	1,410	1,820	2,175
Annual interest, US$ 1,000	117.5	141.0	182.0	217.5
Interest per ton, dollars	6.71	8.06	5.20	6.21

3. Newsprint Mills

Mill capacity, tons/day	100	200	300	400
Prod. value per ton, dollars	92.83	79.78	77.89	75.53
Value of 4 month's prod.	1,083	1,862	2,726	3,525
Value of spare parts, mill	380	608	895	1,115
Value of spare parts, forest dept.	12	27	45	64
Total	1,475	2,497	3,666	4,704
Annual interest, US$ 1,000	147.5	249.7	366.6	470.4
Interest per ton, dollars	4.21	3.57	3.49	3.36

Note: Capital required is estimated to equal the value of 4 months' production, exclusive of interest on capital investment, plus value of spare parts, 5 per cent of the c.i.f. value of machinery and 10 per cent of the cost of trucks in the Forest Department. The working capital is estimated to cover also the needs of the Transport Department. Rate of interest is estimated at 10 per cent, since working capital may be considered as a short term loan and interest on security investments is 8 per cent.

Table VII-10

FOREST INVESTMENT

Product	Production capacity of factory a/		Annual demand for wood b/	Average forest area of supply c/	Average value of supply area d/	
	(ton/day)	(ton/year)	(solid m3)	(ha.)	1,000 pesos	1,000 dls.
Kraft pulp	50	17,500	82,250	5,480	665,820	1,332
	100	35,000	164,500	10,970	1,332,855	2,666
	200	70,000	329,000	21,930	2,664,495	5,329
	300	105,000	493,500	32,900	3,997,350	7,995
Bleached pulp	50	17,500	92,750	6,180	750,870	1,502
	100	35,000	185,500	12,370	1,502,955	3,006
	200	70,000	371,000	24,730	3,004,695	6,009
	300	105,000	556,500	37,100	4,507,650	9,015
Kraft paper	50	17,500	85,750	5,720	694,980	1,390
	100	35,000	171,500	11,430	1,388,745	2,777
White papers	50	17,500	92,750	6,180	750,870	1,502
	200	70,000	231,000	15,400	1,871,100	3,742
	300	105,000	346,500	23,100	2,806,650	5,613
	400	140,000	462,000	30,800	3,742,200	7,484

a/ 350 working days annuallly

b/ Equivalents used:

Kraft pulp	4.7 solid m3 per ton.
Bleached pulp	5.3 solid m3 per ton.
Kraft paper	4.9 solid m3 per ton.
White paper	5.3 solid m3 per ton.
Newsprint	3.3 solid m3 per ton.

c/ Average forest yield when cutting at the age of maximum economic yield: 15.0 solid m3 per hectare.

d/ Average value (including land) by site classes:

Site class	area	Age	average value per hectare	
	(percent)	(years)	(pesos)	(dols.)
I and II	1.86	1-20	201,600	403.2
III	18.08	1-18	142,000	284.0
IV	38.52	1-18	125,000	250.0
V	41.54	1-16	105.800	211.6
Weighted averages			121,500	243.0

Table VII-11

CAPITAL REQUIREMENTS PULPMILLS

(Thousands of dollars)

	Mill size							
	50 tons/day		100 tons/day		200 tons/day		300 tons/day	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Mill:								
Machinery, freight, erection	4,564	5,829	6,396	7,932	8,532	10,684	11,636	14,254
Engineering fees	401	511	549	673	738	911	999	1,211
Railway lines on mill site	90	90	120	120	150	150	180	180
Subtotal	5,065	6,430	7,065	8,725	9,420	11,745	12,815	15,645
Buildings, chests, etc.	1,135	1,385	1,345	1,595	1,830	2,160	2,485	2,875
Housing & community	620	710	750	840	930	1,070	1,190	1,340
Subtotal	1,755	2,095	2,085	2,435	2,760	3,230	3,685	4,215
Working capital a/	780	985	1,190	1,480	1,910	2,375	2,755	3,360
Total	7,600	9,510	10,350	12,640	14,090	17,350	19,245	23,220
Forest Department:								
Transport b/	85	85	180	230	420	485	700	810
Housing b/	85	90	150	180	290	325	460	525
Total	170	175	330	410	710	810	1,160	1,335
Transport department								
Transport trucks c/	45	45	92	92	187	187	255	255
Housing c/	10	10	18	18	43	43	50	50
Total	55	55	110	110	230	230	305	305
Capital cost during construction d/	1,205	1,495	1,635	1,980	2,225	2,715	3,035	3,640
Grand total	9,030	11,235	12,425	15,140	17,255	21,105	23,745	28,500
of which foreign exchange	6,212	7,828	8,757	10,778	12,046	14,895	16,570	20,084
Percent foreign exchange of total	68.8	69.7	70.5	71.2	69.8	70.6	69.8	70.5

a/ See table VII-9.
b/ See figure VII-VII which gives investments in trucks and housing calculated from basic data in annex II.
c/ Based on basic data in annexes VI and VII (Section 2).
d/ See figure VII-VIII. 65 per cent of the capital cost during construction and 30 per cent of the working capital is estimated to be foreign exchange.

Table VII-12

CAPITAL REQUIREMENTS: INTEGRATED MILLS

(Thousands of dollars)

	Mill size			
	50 tons/day		100 tons/day	
	Unbleached	Bleached	Ubleached	Bleached
Mill:				
Machinery, freight, erection	7,188	8,523	10,134	11,935
Engineering fees	609	718	859	1,005
Railway lines on mill site	100	110	140	150
Subtotal	7,897	9,351	11,133	13,090
Buildings, chests, etc.	1,403	1,689	1,917	2,270
Housing and community	860	1,035	1,135	1,360
Subtotal	2,263	2,724	3,052	3,630
Working capital a/	1,175	1,410	1,820	2,175
Total	11,335	13,485	16,005	18,895
Forest department				
Transport trucks b/	85	85	190	230
Housing b/	85	90	150	180
Total	170	175	340	410
Transport department:				
Transport trucks c/	45	45	92	92
Housing c/	10	10	18	18
Total	55	55	110	110
Capital cost during construction d/	1,775	2,105	2,495	2,930
Grand total:	13,315	15,820	18,950	22,345
of which foreign exchange	9,535	11,272	13,583	15,970
percent foreign exchange of total	71.6	71.3	71.7	71.5

a/ See table VII-9.
b/ See figure VII-VII which gives investments in trucks and housing calculated from basic data in annex II.
c/ Based on basic data in annexes VI and VII (Section 2).
d/ See figure VII-VIII. 65 per cent of the capital cost during construction and 30 per cent of working capital is estimated to be foreign exchange.

Table VII-13

CAPITAL REQUIREMENTS; NEWSPRINT MILLS
(Thousands of dollars)

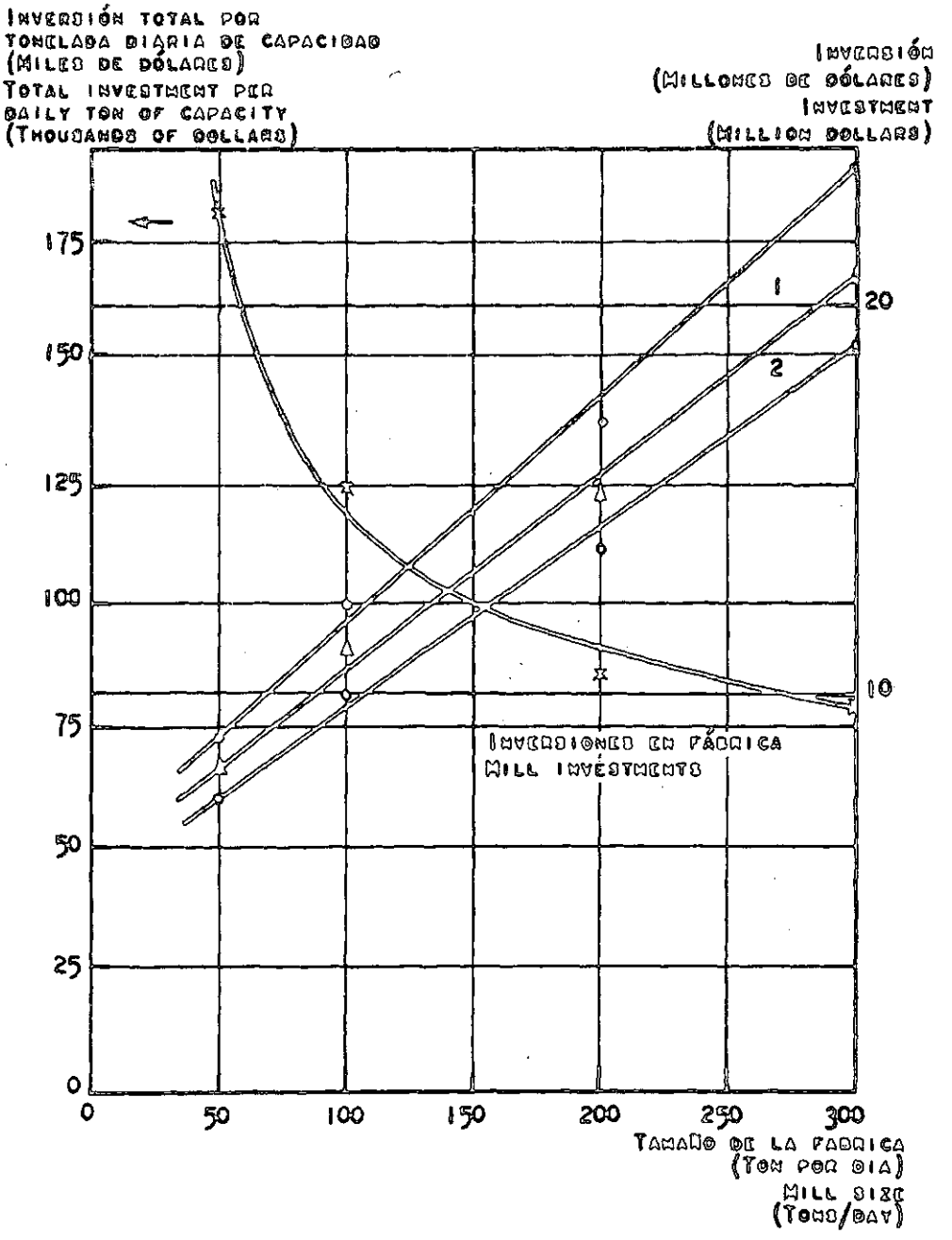
	Mill size, tons/day			
	100	200	300	400
Mill:				
Machinery, freight, erection	7,610	12,155	17,680	22,290
Engineering fees	630	1,000	1,470	1,830
Railway lines on mill site	140	170	190	210
Sub-total	8,380	13,325	19,340	24,330
Buildings, chests, etc.	1,250	1,660	2,110	2,520
Housing and community	930	1,105	1,445	1,680
Sub-total	2,180	2,765	3,555	4,200
Working capital a/	1,475	2,495	3,665	4,700
Total	12.035	18,585	26,560	33,230
Forest department:				
Transport trucks b/	120	270	450	640
Housing b/	105	200	305	420
Total	225	470	755	1,060
Transport department:				
Transport trucks c/	92	187	255	370
Housing c/	18	43	50	70
Total	110	230	305	440
Capital cost during construction d/	1,860	2,870	4,090	5,130
Grand total	14.230	22,155	31,710	39,860
of which foreign exchange	9,994	15,367	22,284	28,175
percent foreign exchange of total	70.2	69.4	70.3	70.7

a/ See table VII-9.
b/ See figure VII-VII which gives investments in trucks and housing calculated from basic data in annex II.
c/ Based on basic data in annexes VI and VII (Section 2).
d/ See figure VII-VIII. 65 per cent of the capital cost during construction and 30 per cent of the working capital is estimated to be foreign exchange.

FIGURA VII - 1
FIGURE VII - 1

INVERSION EN FUNCION DEL TAMAÑO DE LA FABRICA
PASTA NO BLANQUEADA

INVESTMENT AS FUNCTION OF MILL SIZE
UNBLEACKED PULP



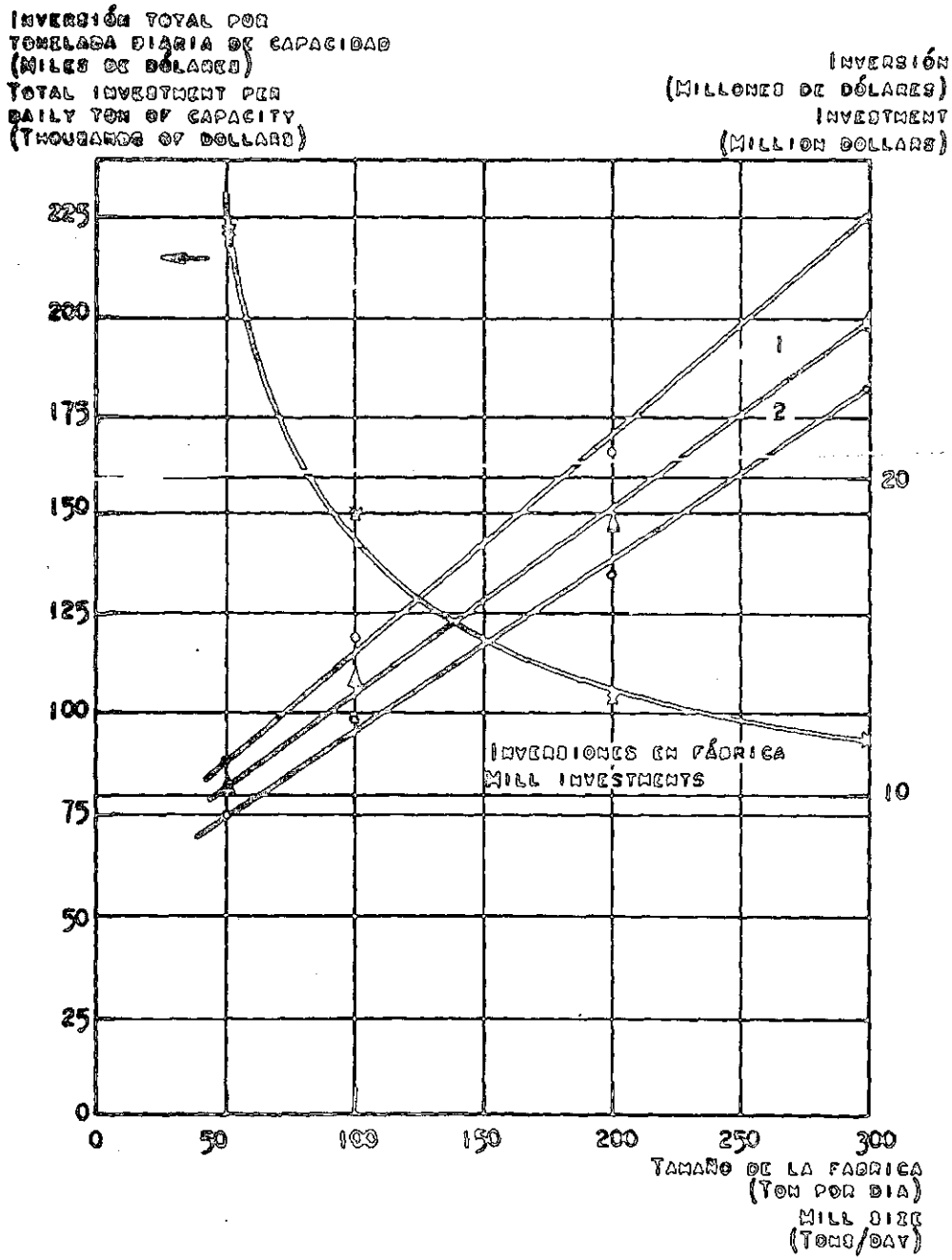
1 - CAPITAL DE TRABAJO
WORKING CAPITAL

2 - INVERSIONES NO INDUSTRIALES
OFFSITE INVESTMENTS

FIGURA VII - 11
FIGURE VII - 11

INVERSION EN FUNCION DEL TAMAÑO DE LA FABRICA
PASTA BLANQUEADA

INVESTMENT AS FUNCTION OF MILL SIZE
BLEACHED PULP



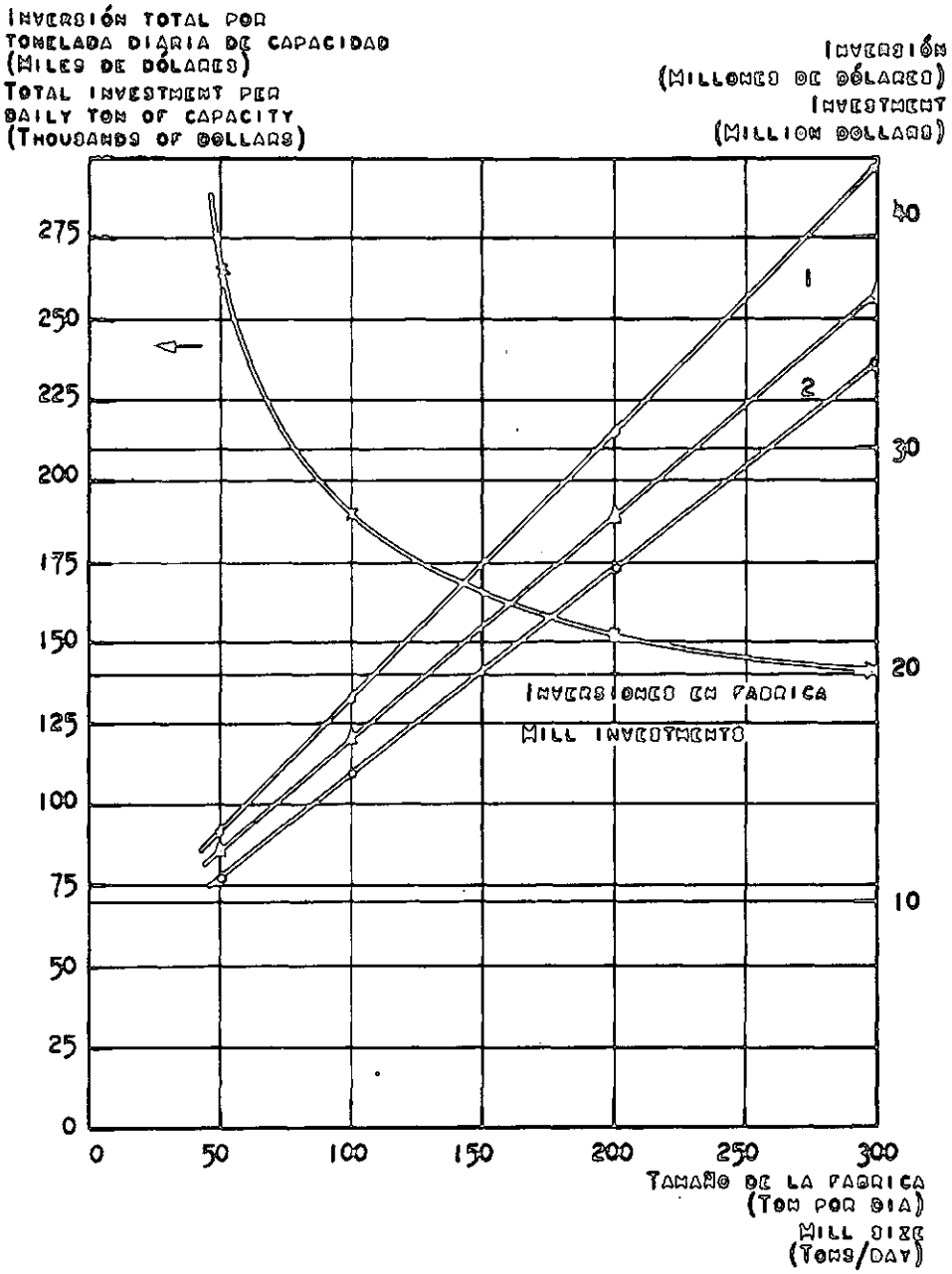
1 - CAPITAL DE TRABAJO
WORKING CAPITAL

2 - INVERSIONES NO INDUSTRIALES
OFFSITE INVESTMENTS

FIGURA VII - III
FIGURE VII - III

INVERSION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPELES NO BLANQUEADOS

INVESTMENT AS FUNCTION OF MILL SIZE
UNBLEACHED PAPERS



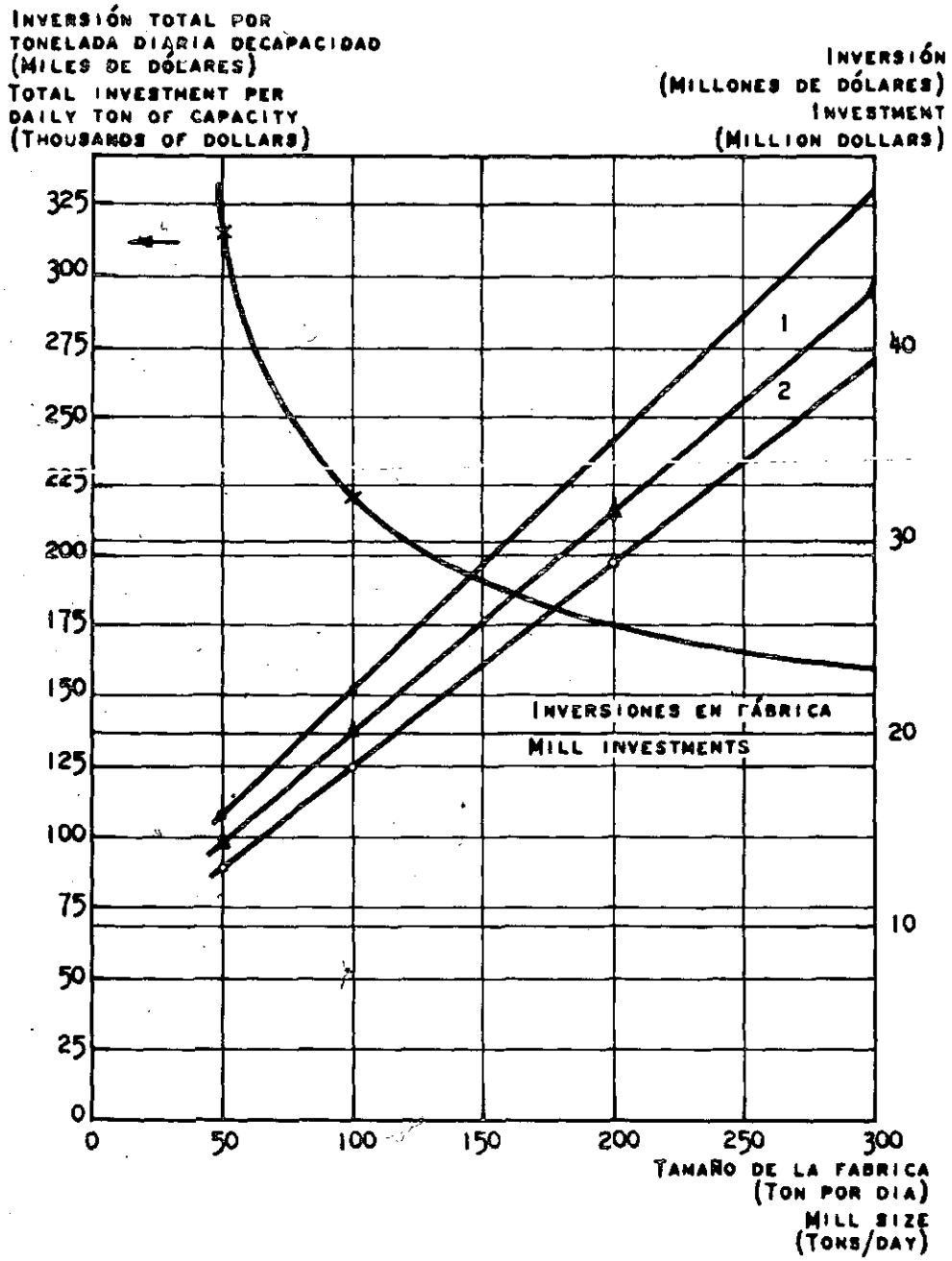
1 - CAPITAL DE TRABAJO
WORKING CAPITAL

2 - INVERSIONES NO INDUSTRIALES
OFFSITE INVESTMENTS

FIGURA VII - IV
FIGURE VII - IV

INVERSION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPELES BLANCOS

INVESTMENT AS FUNCTION OF MILL SIZE
BLEACHED PAPERS



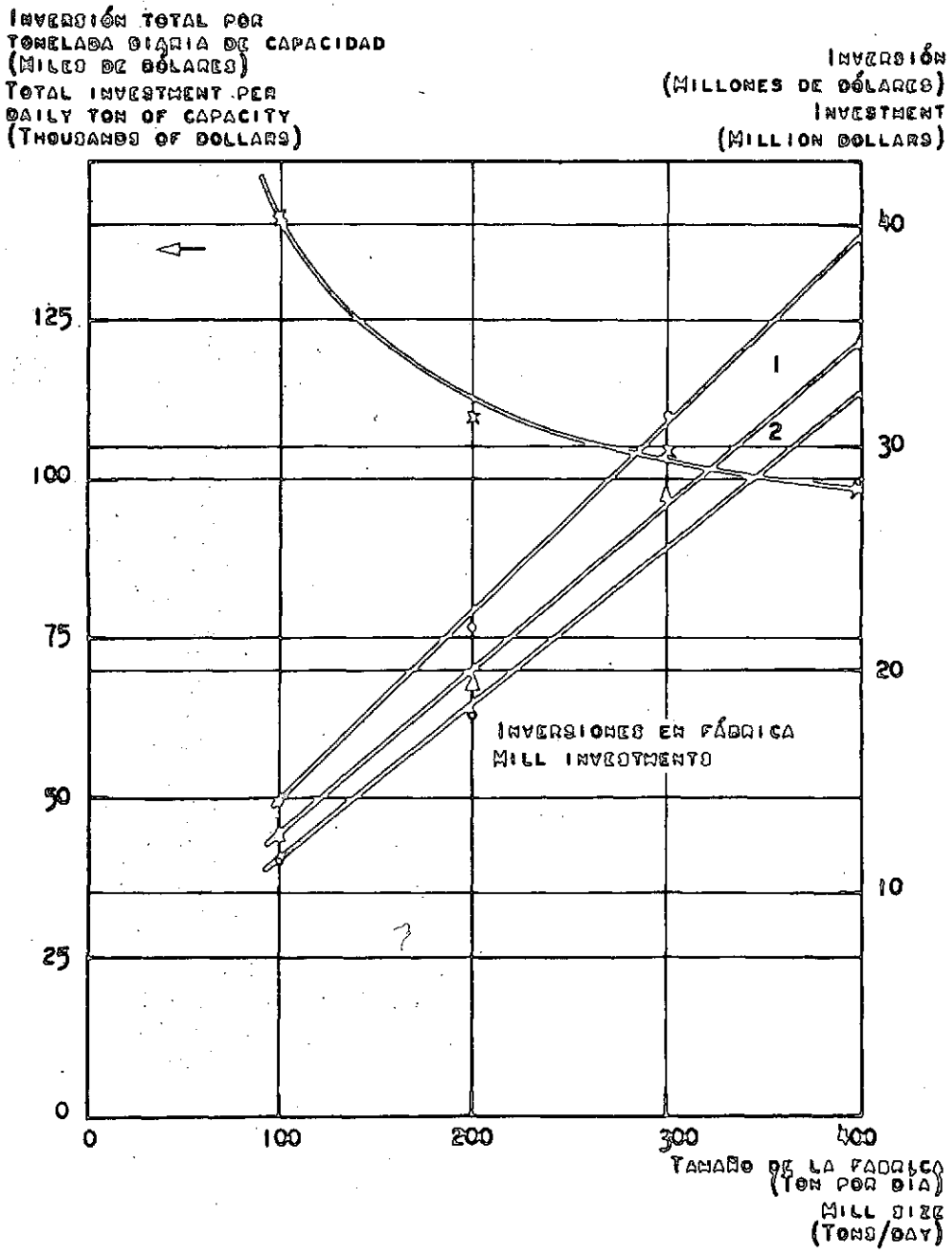
1 - CAPITAL DE TRABAJO
WORKING CAPITAL

2 - INVERSIONES NO INDUSTRIALES
OFFSITE INVESTMENTS

FIGURA VII - V
FIGURE VII - V

INVERSION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPEL DE DIARIO

INVESTMENT AS FUNCTION OF MILL SIZE
NEWSPRINT



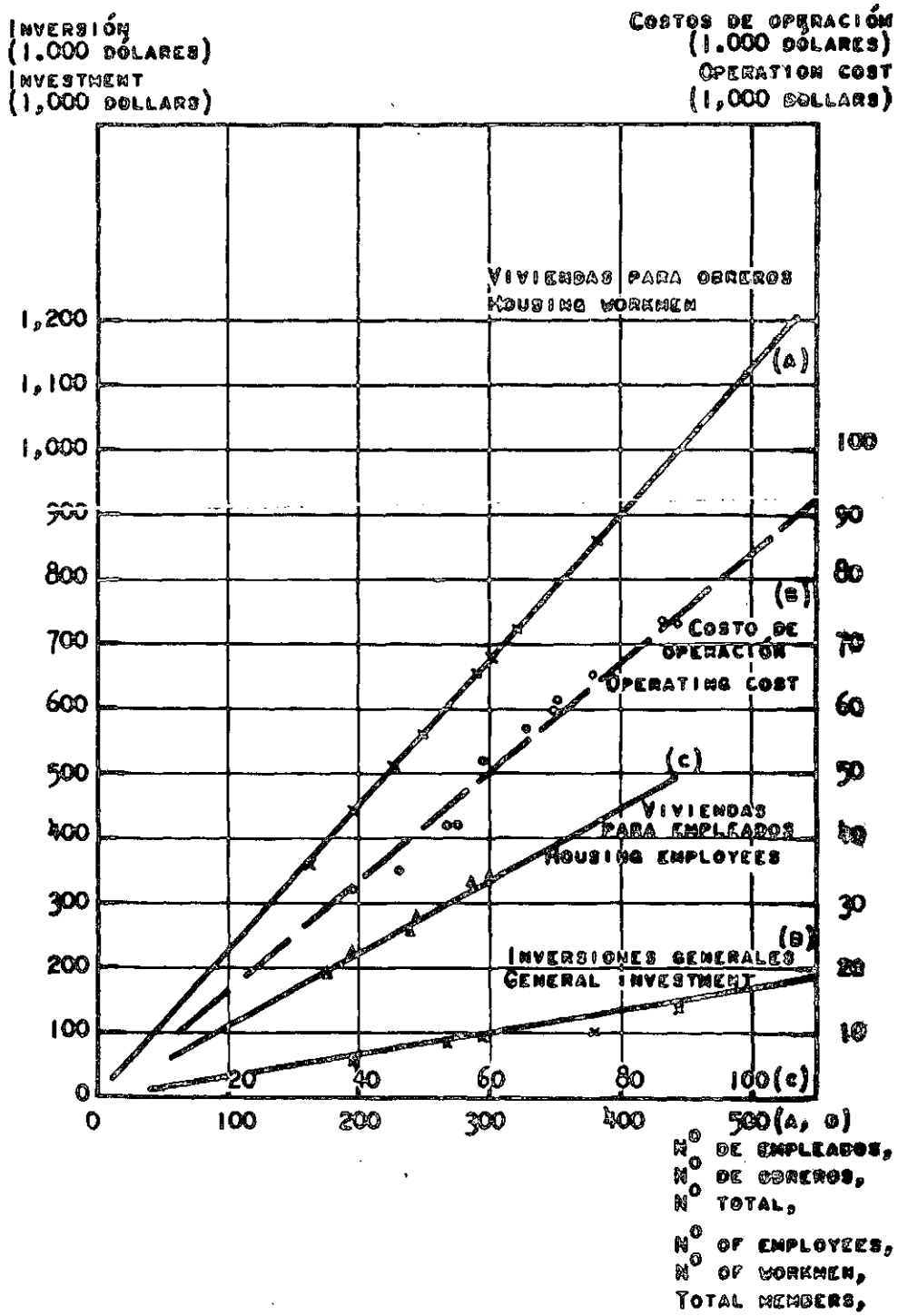
1 - CAPITAL DE TRABAJO
WORKING CAPITAL

2 - INVERSIONES NO INDUSTRIALES
OFFSITE INVESTMENTS

FIGURA VII - VI
FIGURE VII - VI

INVERSIONES EN VIVIENDAS Y POBLACION Y COSTOS DE OPERACION
EN FUNCION DEL NUMERO DE OBREROS Y EMPLEADOS

HOUSING AND COMMUNITY INVESTMENT AND OPERATING COST
AS FUNCTION OF NUMBER OF WORKMEN AND EMPLOYEES



NOTA : LOS COSTOS DE OPERACIÓN Y LAS INVERSIONES GENERALES COMPUTANSE CONTRA EL TOTAL DE EMPLEADOS Y OBREROS.

NOTE : OPERATING COST AND GENERAL INVESTMENT ARE COMPUTED AGAINST TOTAL EMPLOYEES AND WORKMEN.

FIGURA VII - VII
FIGURE VII - VII

INVERSION; DEPARTAMENTO FORESTAL

INVESTMENT; FOREST DEPARTMENT

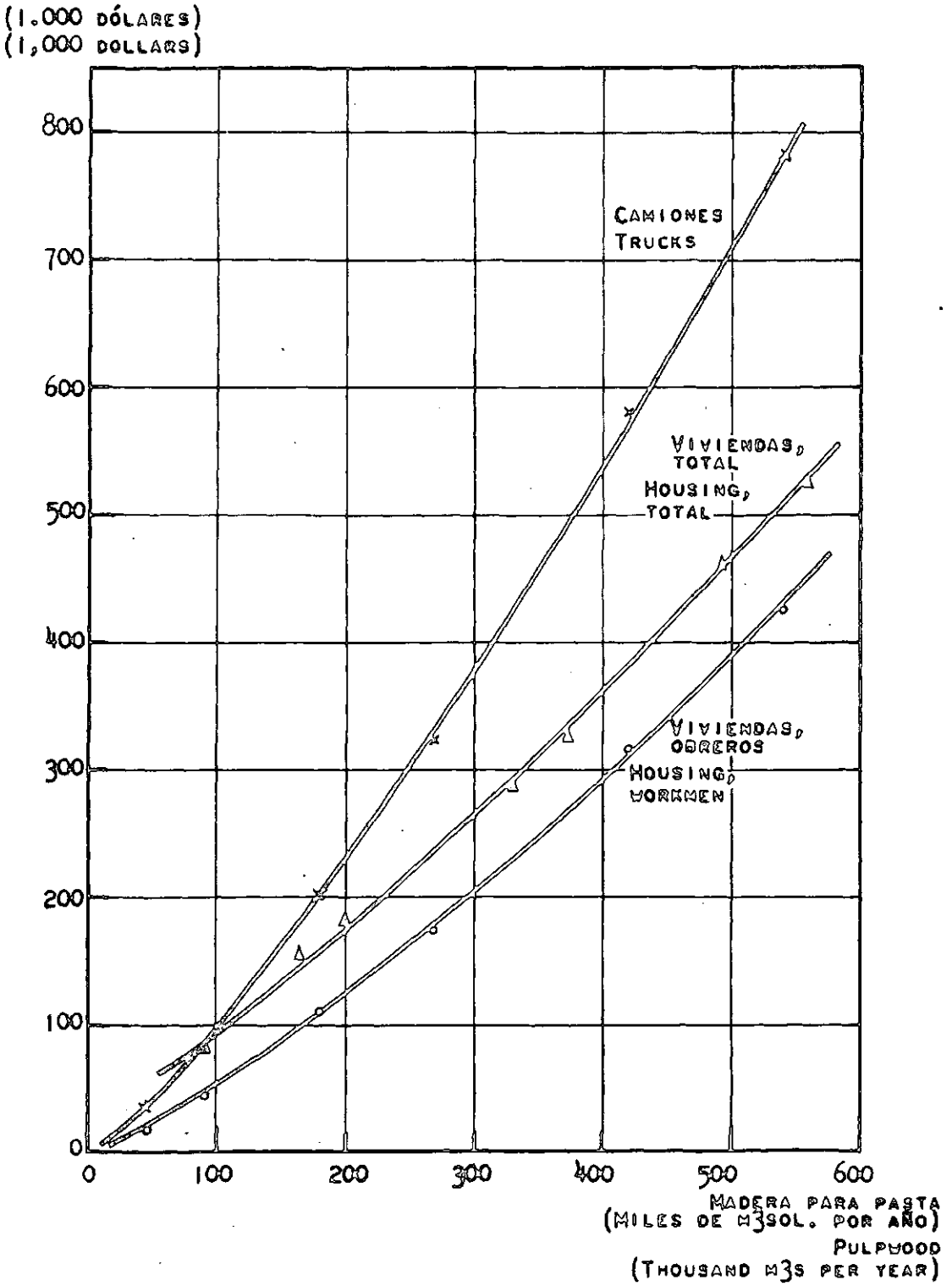
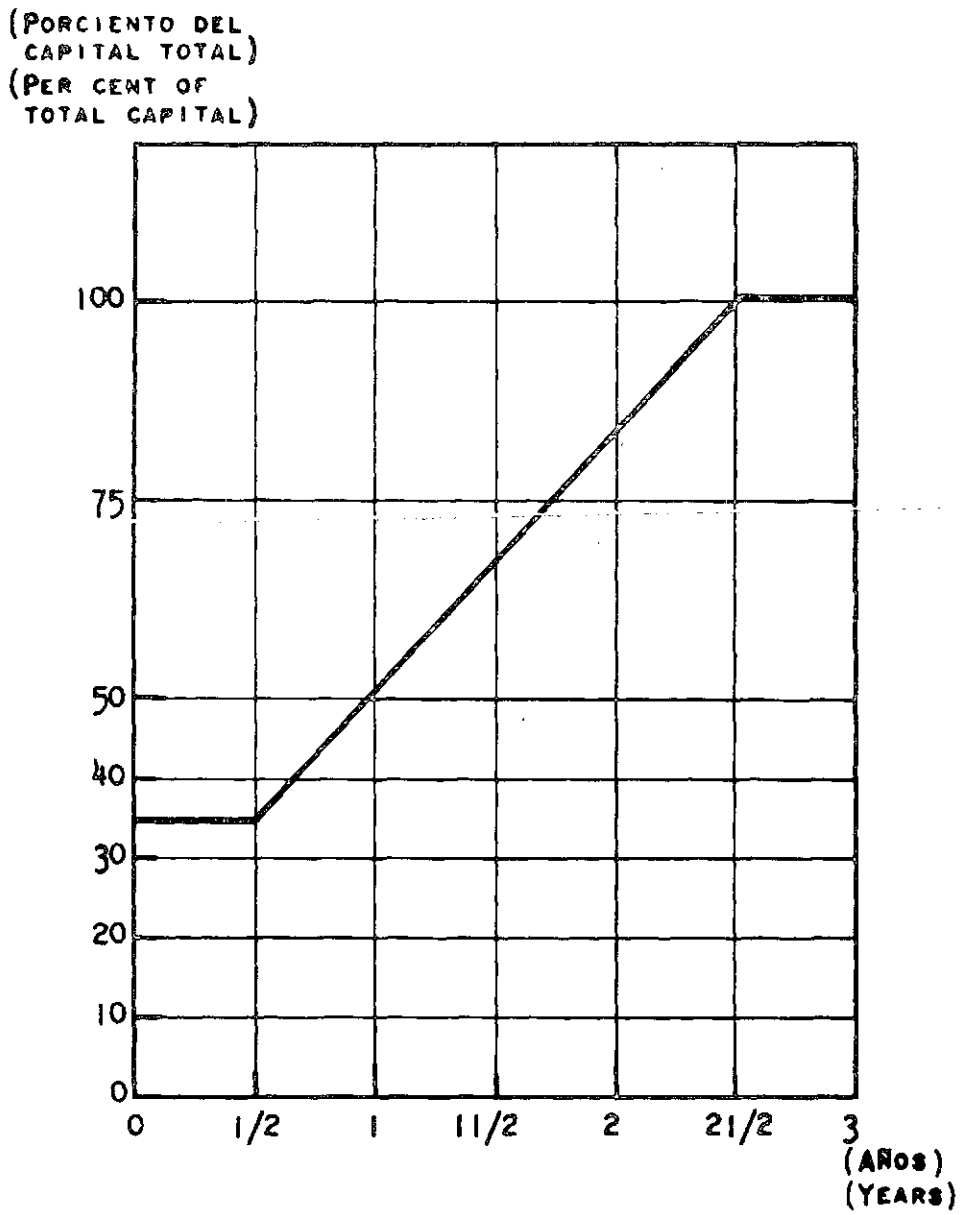


FIGURA VII - VIII
FIGURE VII - VIII

CAPITAL NECESARIO DURANTE EL PERIODO DE CONSTRUCCION
CAPITAL REQUIREMENTS DURING CONSTRUCTION PERIOD

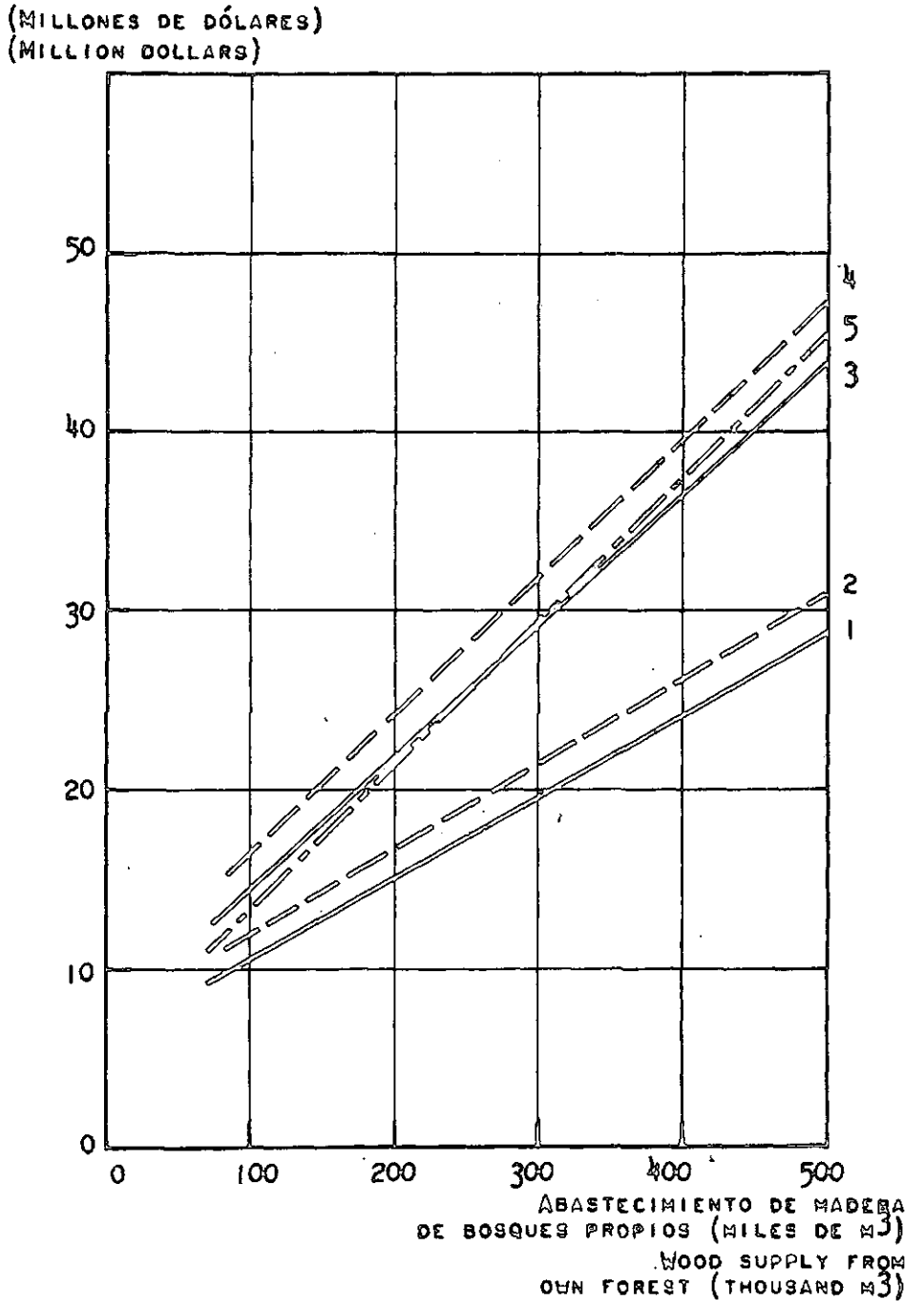


EL COSTO DE CAPITAL TOTAL AL CABO DEL TERCER AÑO ES DE 17,1 POR CIENTO CON UNA TASA DE INTERÉS ACUMULATIVO ANUAL DEL 8 POR CIENTO.

TOTAL CAPITAL COST AT THE END OF THE 3 — YEAR PERIOD IS 17,1 PER CENT WITH ACCUMULATED ANNUAL INTEREST RATE OF 8 PER CENT.

FIGURA VII - IX
FIGURE VII - IX

INVERSIONES EN EL PROYECTO EN FUNCION DEL ABASTECIMIENTO DE MADERA
100/100 BOSQUES PROPIOS
PROJECT INVESTMENT AS FUNCTION OF WOOD SUPPLY
100/100 FOREST OWNERSHIP

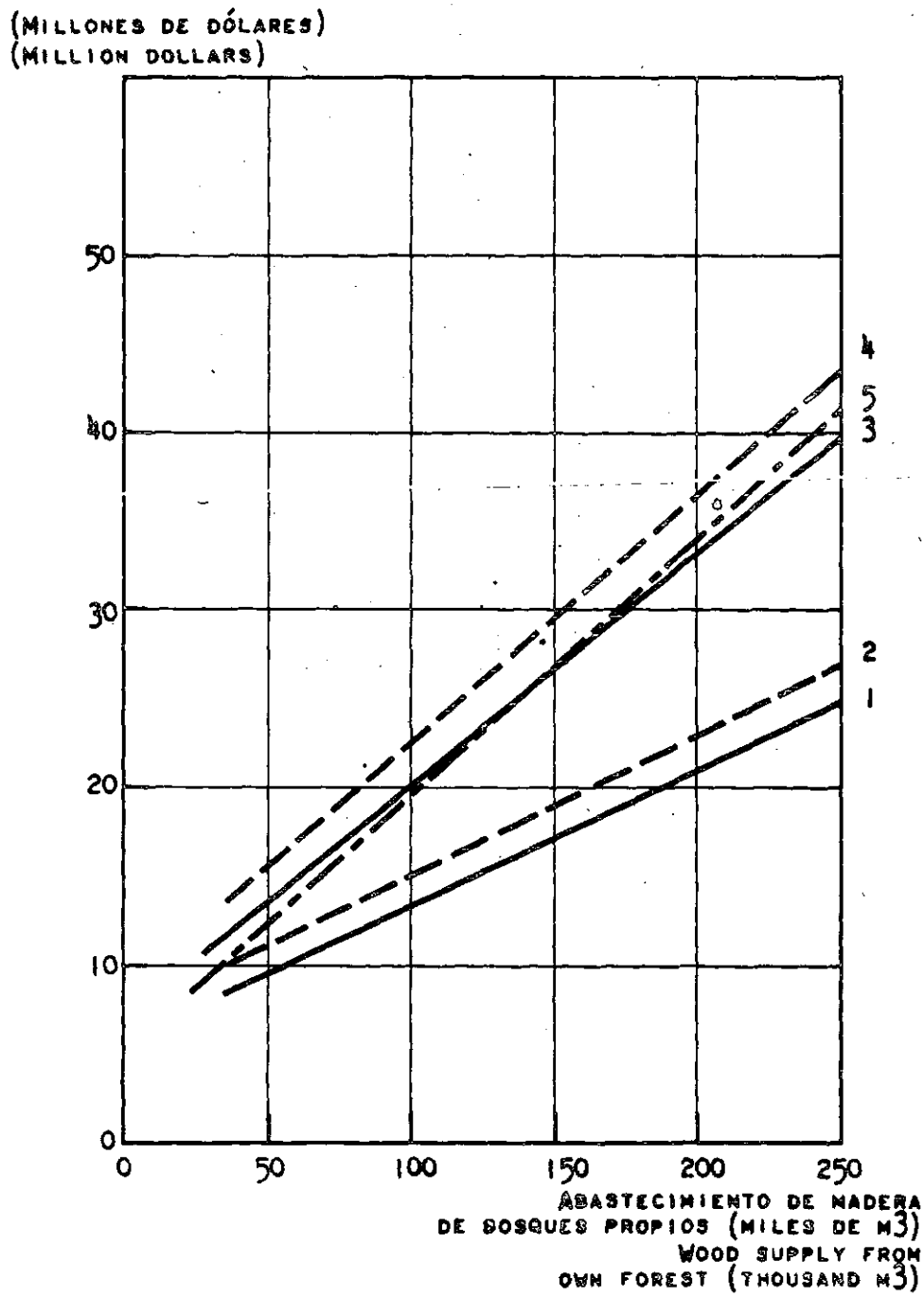


1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

FIGURA VII - X
FIGURE VII - X

INVERSIONES EN EL PROYECTO EN FUNCION DEL ABASTECIMIENTO DE MADERA
50/100 BOSQUES PROPIOS
PROJECT INVESTMENT AS FUNCTION OF WOOD SUPPLY
50/100 FOREST OWNERSHIP



1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

ANNEX VIII

PRODUCTION COST ESTIMATES

Table VIII-1

REBURNING OF LIME SLUDGE a/

Item	Amount	Unit cost (pesos)	Total cost (pesos/ton quicklime)
Lime sludge		-	-
Limestone	110 kg.	6.38	702
Fuel oil	200 kg.	15.57	3,114
Power	25 kWh	3.50	88
Repair materials			250
Total b/			4,154
Labour	1.40 man/hrs.		328
Depreciation and interest c/			1,227
Total cost per ton of lime d/			5,709

a/ Calculations based on production of 7,500 tons annually.

b/ Since labour, depreciation and interest costs are computed for the mill as a whole in the calculations of pulp production costs, this total represents the cost which should be assigned to quicklime within that calculation.

c/ 10 years and 12 per cent respectively, on the basis of c.i.f. value of equipment, which amounts to 115,000 dollars or 57,500,000 pesos.

d/ The kiln and supplementary equipment are of the minimum size manufactured and correspond to a production of 100 tons of pulp daily. In the case of a mill producing 50 tons daily, therefore, only half of the equipment's capacity will be utilized, so that labour, depreciation and interest costs are twice as high, standing at a total of 7,264 pesos.

Table VIII-2

HEAT AND POWER BALANCE

(Per ton of product)

	Bleeding pressure kg/cm2	Pulp mills				Integrated mills			
		Unbleached		Bleached		Unbleached		Bleached	
		1,000 kcal.	kWh	1,000 kcal	kWh	1,000 kcal	kWh	1,000 kcal	kWh
Heat for evaporation	2.6	720		720		720		720	
Heat for cooding	8.5	900		1,100		900		1,100	
Heat for bleaching	2.0	-		800		-		800	
Heat for drying	2.0	860		860		1,750		1,750	
Heat for miscellaneous	2.0	200		100		250		150	
Total power required			485		910		900		1,375
Turbine bleeding		495	430	675	585	695	605	870	755
Turbine condensing		145	55	845	325	765	295	1,610	620
Total heat consumption		3,320		5,100		5,080		7,000	
Produced by recovery unit		2,770		3,130		2,770		3,130	
Produced by bark burning a/		370		415		370		415	
Produced by add. fuel		180		1,555		1,940		3,455	
Additional fuel required b/									
Fuel oil c/, kg		25		195		245		430	
or coal d/, kg		35		290		360		645	
or wood fuel e/, kg.		100		845		1,055		1,875	

a/ From barking operation. Estimated quantity: 200 and 220 kg per ton of unbleached and bleached pulp, respectively.

b/ Excludes fuel oil required for reburning lime sludge. Efficiency of boiler estimated at 80 per cent.

c/ Calorific value; 10,000 kcal per kg.

d/ Calorific value; 6,700 kcal per kg.

e/ Calorific value; 2,300 kcal per kg.

Table VIII-3

HEAT AND POWER BALANCE, NEWSPRINT MILLS

Note: It is assumed that the mills will produce electricity by bleeding turbines in a quantity corresponding to the consumption of steam in the chemical pulp and newsprint sections.

(Per ton of newprint)

0.20 tons sulphite pulp per ton of newprint

	Bleeding pressure kg/cm2	1,000 kcal	kWh
Heat for cooking	8.0	200	
Heat for groundwood section	3.0	250	
Heat for paper machine	3.0	1,800	
Heat for miscellaneous	3.0	200	
Total power required			1,820
Turbine bleeding		665	405
Purchased power			1,415
Total heat consumption		2,915	
Produced by bark burning a/		185	
Produced by add. fuel		2,730	
Additional fuel required: coal kgs. b/		410	

a/ Estimated quantity, 100 kgs. per ton of newprint. Calorific value 1,850 kcal/kg.

b/ Calorific value 6,700 kcal per kg.

Table VIII-4

HEAT CONSUMPTION AND POWER GENERATED IN STEAM TURBINE OPERATION

Original steam pressure; 40 kg/cm2

" " temperature; 400°C

Pressure after turbine kg/cm2	Heat content of steam 1,000 kcal per ton	Heat loss in turbine 1,000 kcal per ton	kWh per ton of original steam a/	kWh per 1,000,000 in original steam
40	768.5	-	-	-
10	688.5	80.0	70	90
8	678.5	90.0	78	102
6	663.5	105.0	91	119
4	648.5	120.0	104	136
3	643.5	125.0	109	142
2	632.5	136.0	118	154
1	613.5	155.0	135	176
Condens.	100.0	668.5	257	335

a/ Based on experience values in middle size turbines with an over-all efficiency of 75 per cent, which require 1,150 kcal per kWh in bleeding and 2,600 kcal in the condensing operation.

Table VIII-5

LABOUR FORCE IN PULP MILLS

(Numbers employed)

(Daily production capacity of the mill tons)	By shift								Total in mill							
	50 ton		100 t.		200 t.		300 t.		50 t.		100 ton		200 ton		300 ton	
	Un-bl.	Bl.	Un bl.	Bl.	Un bl.	Bl.	Un bl.	Bl.	Un bl.	Bl.	Un bl.	Bl.	Un bl.	Bl.	Un. bl.	Bl.
1. Log yard a/	6	6	6	6	8	8	10	10	16	16	16	16	19	19	23	23a/
2. Wood preparation dept.a/	3	4	4	5	4	8	5	10	8	11	11	13	11	21	13	27a/
3. Digester dept.	3	3	3	3	3	3	4	4	12	12	12	12	12	12	16	16
4. Diffuser dept.	1	1	1	1	2	2	3	3	4	4	4	4	8	8	12	12
5. First screening dept.	1	1	2	2	3	3	4	4	4	4	8	8	12	12	16	16
6. Bleaching dept.	-	1	-	1	-	1	-	1	-	4	-	4	-	4	4	4
7. Electrolytic plant and preparation of bleaching liquour	-	4	-	5	-	6	-	8	-	16	-	20	-	24	-	32
8. Second screening dept.	-	1	-	1	-	1	-	1	-	4	-	4	-	4	-	4
9. Pulp drying machine	4	4	5	5	8	8	12	12	16	16	20	20	32	32	48	48
10. Pulp store	2	2	3	3	4	4	4	4	8	8	12	12	16	16	16	16
11. Causticizing dept.	1	1	2	2	2	2	3	3	4	4	8	8	8	8	12	12
12. Evaporation plant	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4	4
13. Soda recovery	3	3	3	3	3	3	5	5	12	12	12	12	12	12	20	20
14. Lime recovery	1	1	1	1	1	1	2	2	4	4	4	4	4	4	8	8
15. Chemical stores									1	2	1	2	1	2	1	2
16. Water purification plant and pump station	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4	4
17. General services									11	13	16	20	21	27	27	33
18. Transport workers									14	15	20	20	27	27	33	33
19. Repair workshop									27	31	33	37	40	45	47	53
20. Boiler house	2	2	2	2	3	3	3	3	8	8	8	8	12	12	12	12
21. Power station	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4	4
Total									161	196	197	236	247	301	320	383
Of which																
skilled workers									68	82	74	93	91	112	100	125
unskilled workers									93	114	123	143	156	189	220	258

Items 1 to 14: operation; Item 19: repairs; Items 15 to 18 and 20 and 21: services.

a/ Two shifts, with additional workers to make a total work week of 42 hours.

Table VIII-6

LABOUR FORCE: INTEGRATED MILLS

(Numbers employed)

Mill capacity, tons/day	Per shift				Total in mill			
	50		100		50		100	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Pulpmill, excl. drying and services					69	97	80	111
Beater room	1	1	2	2	4	4	8	8
Size preparation dept.	1	1	2	2	4	4	8	8
Paper machine	6	9	6	9	24	36	24	36
Re-reelers	3	3	6	6	12	12	18	18
Duplex cutter a/	2	2	4	4	6	8	12	16
Baling					3	4	4	6
Reel packers					4	3	8	6
Re-reelers for small reels					1	1	2	2
Sorters					15	25	25	20
Oilers	1	1	2	2	4	4	8	8
Water purification & pump station	1	1	1	1	4	4	4	4
Steam and power plant	4	4	4	4	16	16	16	16
Repair shop					30	35	40	45
Total					223	282	295	376
of which skilled workers					98	124	112	146
unskilled workers					125	158	183	230

Item 1 - 10 and 13: operation
" 11 - 12 and 14 - 15: services
" 16: repair

a/ For unbleached papers operation in 2 shifts only but with one swing shift.

Table VIII-7

LABOUR FORCE: NEWSPRINT MILLS

(Numbers employed)

Mill capacity, tons/day	By shift				Total in mill			
	100	200	300	400	100	200	300	400
1. Log yard a/	6	6	8	8	16	16	19	19
2. Barking and chipping	7	10	17	20	28	40	68	80
3. Chemical pulp section	10	12	14	16	40	48	56	64
4. Mechanical pulp section	5	6	7	10	20	24	28	40
Paper mill								
5. Stock preparation dept.	2	3	4	4	8	12	16	16
6. Size preparation dept.	1	2	2	3	4	8	8	12
7. Paper machine	6	6	12	12	24	24	48	48
8. Re-reelers	3	3	6	6	12	12	24	24
9. Reel packers					2	4	6	8
10.					20	25	30	35
11. General services, community, etc.					15	20	25	30
12. Oilers	2	2	4	4	8	8	16	16
13. Water purification and pump station	1	1	1	1	4	4	4	4
14. Steam and power plant	3	4	6	8	12	16	24	32
15. Repair shop					40	45	50	50
Total					253	306	422	478
of which: skilled workers					96	116	144	164
unskilled workers					157	190	278	314

Items 1 - 9 operation; items 10-14 services, item 15 repair.

a/ Two shift operation with additional workers to make a total work week of 42 hours.

Labour costs per hour have been calculated on the following basis (See tables VIII-8 to VIII-10).

a) 2,100 working hours a year per workers, that is 42 hours weekly. To this end, the operations will be handled by 4 teams of workers, in three shifts; operations done in two shifts will be handled by two teams of workers plus the number of men required for replacement (33 per cent).
b) Social security 26 per cent of wages.
c) Annual paid holidays: 15 days.
d) Weekly wages:

Unskilled worker: 5,000 pesos; Skilled worker: 7,500 pesos; Foreman: 9,000 pesos. Cost per hour of effective work.- Unskilled worker: 156 pesos; Skilled worker: 234 pesos; Foreman: 281 pesos; Annual cost.- Unskilled worker: 328,000 pesos; Skilled worker: 491,000 pesos; Foreman: 590,000 pesos.

Table VIII-8

LABOUR COST: PULPMILLS

Mill capacity	50 tons/day				100 tons/day			
	Unbleached		Bleached		Unbleached		Bleached	
	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton
Operation								
Skilled	41	1,151	53	1,488	44	618	61	856
Unskilled	51	955	66	1,236	67	627	80	749
Subtotal	92	2,106	119	2,724	111	1,245	141	1,605
Man-hours/ton	11.04		14.28		6.66		8.46	
Services								
Skilled	14	393	14	393	14	197	14	197
Unskilled	28	524	32	599	39	365	44	412
Subtotal	42	917	46	992	53	562	58	609
Man-hours/ton	5.04		5.52		3.18		3.48	
Maintenance								
Skilled	13	365	15	421	16	225	18	253
Unskilled	14	262	16	300	17	159	19	178
Subtotal	27	627	31	721	33	384	37	431
Man-hours/ton	3.24		3.72		1.98		2.22	
Total	161	3,650	196	4,437	197	2,191	236	2,645
Man-hours/ton	19.32		23.52		11.82		14.16	

	200 tons/day				300 tons/day			
Operation								
Skilled	53	372	72	505	58	271	80	374
Unskilled	85	398	108	505	134	418	162	505
Subtotal	138	770	180	1,010	192	689	242	879
Man-hours/ton	4.14		5.40		3.84		4.84	
Services								
Skilled	18	126	18	126	19	89	19	89
Unskilled	51	239	58	271	62	193	69	215
Subtotal	69	365	76	397	81	282	88	304
Man-hours/ton	2.07		2.28		1.62		1.76	
Maintenance								
Skilled	20	140	22	154	23	108	26	122
Unskilled	20	94	23	108	24	75	227	84
Subtotal	40	234	45	262	47	183	53	206
Man-hours/ton	1.20		1.35		0.94		1.06	
Total	247	1,369	301	1,669	320	1,154	393	1,389
Man-hours/ton	7.41		9.03		6.40		7.66	

Table VIII-9

LABOUR COST: INTEGRATED MILL

Mill capacity	50 tons per day				100 tons per day			
	Unbleached		Bleached		Unbleached		Bleached	
	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton
Operating:								
Skilled	69	1,938	97	2,723	81	1,207	108	1,516
Unskilled	77	1,441	101	1,816	116	1,086	151	1,413
Subtotal	146	3,379	198	4,539	197	2,293	259	2,929
Man-hours	17.52		23.76		11.82		15.54	
Mill services:								
Skilled	15	421	16	449	16	225	17	239
Unskilled	32	599	33	618	42	393	45	421
Subtotal	47	1,020	49	1,067	58	618	62	660
Man-hours	5.64		5.88		3.48		3.72	
Repair:								
Skilled	15	421	16	449	18	253	20	281
Unskilled	15	281	19	356	22	206	25	234
Subtotal	30	702	35	805	40	459	45	515
Man-hours	3.60		4.20		2.40		2.70	
Total pesos/ton	(223)	5,101	(282)	6,411	(295)	3,370	(366)	4,104
Dls./ton		10.20		12.82		6.74		8.21
Man hrs.	26.76		33.84		17.70		21.96	

Table VIII-10

LABOUR COST: NEWSPRINT MILLS

Mill capacity, tons/day	100		200		300		400	
	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton	N°	Pesos/ton
Operating:								
Skilled	62	870	74	520	90	421	102	358
Unskilled	92	861	114	534	183	571	209	489
Subtotal	154	1,731	188	1,054	273	992	311	847
Man hrs. per ton		9.24		5.64		5.46		4.67
Mill services:								
Skilled	16	225	22	155	32	150	40	140
Unskilled	43	402	51	239	67	209	77	180
Subtotal	59	627	73	394	99	359	117	320
Man hours per ton		3.54		2.19		1.98		1.76
Repair:								
Skilled	18	253	20	140	22	103	22	77
Unskilled	22	206	25	117	28	87	28	65
Subtotal	40	459	45	257	50	190	50	142
Man hours per ton		240		1.35		1.00		0.75
Total Pesos/ton	(253)	2,817	(306)	1,705	(422)	1,541	(478)	1,309
dollars/ton		5.63		3.41		3.08		2.62
Man/hrs/ton		15.18		99.18		8.44		7.18

Table VIII-11

ADMINISTRATION AND SUPERVISION: PULPMILLS

(Thousands of pesos annually)

	Mill capacity							
	50 tons/day		100 tons/day		200 tons/day		300 tons/day	
	N°	Salaries	N°	Salaries	N°	Salaries	N°	Salaries
Managing director	1	4,800	1	5,400	1	6,000	1	6,600
Mill manager	-	-	-	-	1	4,800	1	5,280
Mill superintendent	1	3,240	1	3,600	1	3,960	1	4,320
Assistant superintendent	-	-	-	-	1	3,480	1	3,840
Chief chemist	1	2,400	1	2,760	1	3,120	1	3,480
Superintendent, mech. workshop	1	2,160	1	2,400	1	2,640	1	2,880
Superintendent, electr. workshop	-	-	-	-	1	2,400	1	2,640
Shift foremen, production	4	6,720	4	6,720	4	6,720	8	13,440
Foreman, mech. workshop	1	980	1	980	1	980	2	1,960
Foreman, power plant	1	980	1	980	1	980	1	980
Foreman, boiler house	-	-	-	-	1	1,320	1	1,320
Foreman, wood yard	1	980	1	1,200	1	1,320	1	1,480
Foreman, transport	1	980	1	1,200	1	1,320	1	1,480
Shift chemists	4	3,360	4	3,360	4	3,360	4	3,360
Laboratory assistants	2	1,200	2	1,200	3	1,800	4	2,400
Draughtsmen	1	720	2	1,440	3	2,160	4	2,880
Adm. assistant	1	2,400	1	2,760	1	3,120	1	3,480
Chief accountant	1	1,920	1	2,160	1	2,400	1	2,640
Typists and clerks	5	2,400	8	3,840	10	4,800	12	5,760
Store keeper	1	420	1	420	1	420	1	420
Assistant store keeper and clerks	2	720	2	720	3	1,080	4	1,440
Porters	4	1,440	4	1,440	4	1,440	4	1,400
Messengers	2	648	2	648	3	972	4	1,296
Subtotal	35	38,468	39	43,228	49	60,592	60	74,816
Social security payments and bonuses, a/		25,477		28,630		40,130		49,551
Annual total; 1,000 pesos		63,945		71,858		100,722		124,367
dollars		127,890		143,718		201,444		248,734
Dollars per ton		7.30		4.10		2.88		2.36

a/ 32.9 per cent social security and bonus equivalent to 4 months salary.

Table VIII-12

ADMINISTRATION AND SUPERVISION: INTEGRATED MILLS
(Thousands of pesos annually)

Mill capacity	50 tons/day		100 tons/day	
	Nº	Salaries	Nº	Salaries
Managing director	1	6,000	1	6,600
Mill manager	1	4,800	1	5,280
Mill superintendent			1	3,960
Asst. mill superintendent	1	3,480	1	3,840
Chief chemist	1	3,120	1	3,480
Superintendent, workshops	1	2,640	1	2,880
Shift foremen, production	8	13,440	12	20,160
Foreman, mech. workshop	1	980	1	980
Foreman, electr. workshop	1	980	1	980
Foreman, steam & power plant	1	1,320	1	1,320
Foreman, wood yard	1	1,320	1	1,320
Foreman, transport	1	1,200	1	1,320
Shift chemists	4	3,360	4	3,360
Laboratory assistants	2	1,200	3	1,800
Draughtsmen	2	1,440	3	2,160
Adm. assistant	1	2,760	1	3,120
Chief accountant	1	2,400	1	2,640
Typists and clerks	6	2,880	10	4,800
Storekeeper	1	420	1	420
Asst. storekeeper and klerks	2	720	3	1,080
Porters	4	1,440	4	1,440
Messengers	3	972	3	972
Subtotal	44	56,872	56	73,912
Social security and bonuses		37,666		48,952
Annual total, 1,000 pesos		189,076		254,728
dollars		189,076		254,728
Dollars per ton:		10.80		7.02
Note: For bleached qualities one a additional foreman required (incl. sec. and bonus)	1	2,793	1	2,793
Total for bleached paper				
1,000 pesos	(45)	97,331	(57)	125,657
Dollars		194,662		251,314
Dollars per ton		11.12		7.18

Table VIII-13

ADMINISTRATION AND SUPERVISION: NEWSPRINT MILLS

(Thousands of pesos annually)

Mill capacity, tons/day	100		200		300		400	
	N°	Salaries	N°	Salaries	N°	Salaries	N°	Salaries
Managing director	1	6,600	1	6,600	1	6,600	1	7,200
Mill manager	1	5,280	1	5,280	1	5,280	1	5,280
Mill superintendent			1	4,320	1	4,320	1	4,320
Assist. superintendent	1	3,960	1	3,480	2	3,480	2	3,840
Chief chemist	1	3,480	1	3,480	1	3,480	1	3,840
Superintendents, workshop	1	2,880	1	2,880	2	5,280	2	5,760
Shift foremen, production	12	20,160	12	20,160	12	20,160	16	26,880
Foreman, mech. workshop	1	980	1	980	2	1,960	2	1,960
Foreman, electr. workshop	1	980	1	980	1	980	1	980
Foreman, steam & power plant	1	1,320	2	2,300	2	2,300	2	2,640
Foreman, wood yard	1	980	1	980	1	1,200	1	1,200
Foreman, transport	1	980	1	980	1	1,200	1	1,200
Shift chemists	4	3,360	4	3,360	8	6,720	8	6,720
Laboratory assistants	2	1,200	2	1,200	3	1,800	4	2,400
Draughtsmen	1	720	2	1,440	3	2,160	4	2,880
Adm. assistant	1	2,400	1	2,760	1	3,120	1	3,480
Chief accountant	1	2,400	1	2,640	1	2,760	1	2,760
Typists and clerks	5	2,400	8	3,840	10	4,800	12	5,760
Storekeepers	1	480	1	480	2	840	2	840
Asst. storekeepers & clerks	2	720	3	1,080	3	1,080	4	1,440
Porters	4	1,440	4	1,440	4	1,440	4	1,440
Messengers	3	972	3	972	4	1,296	4	1,296
Subtotal	46	63,962	52	71,632	66	82,256	75	94,116
Social security and bonuses		42,362		47,442		54,478		62,333
Annual total 1,000 pesos		106,324		119,074		136,734		156,449
dollars		212,648		238,148		273,468		312,898
Dollars per ton		6.08		3.40		2.60		2.23

Table VIII-14

ANNUAL COMMUNITY MAINTENANCE COSTS IN PULP MILLS a/

(1,000 pesos)

Mill capacity, tons/day	50		100		200		300	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Maintenance materials and insurance	6,200	7,300	7,400	8,400	9,200	10,600	11,700	13,200
Electricity	300	400	400	500	500	600	700	800
Water	50	70	70	80	80	100	120	130
Salaries, doctors, etc.	8,000	8,000	8,000	10,000	14,000	16,000	17,000	19,000
Unforeseen expenditure	1,450	1,530	1,530	1,920	2,320	2,700	2,980	3,370
Total maintenance cost	16,000	17,300	17,400	20,900	26,100	30,000	32,500	36,500
Id. (1,000 dollars)	32.0	34.6	34.8	41.8	52.2	60.0	65.0	73.0
Id. per ton of pulp (dollars)	1.83	1.98	0.99	1.19	0.75	0.86	0.62	0.70

Table VIII-15

ANNUAL COMMUNITY MAINTENANCE COSTS IN INTEGRATED PULP AND PAPER MILLS a/

(1,000 pesos)

Mill capacity, tons/day	50		100	
	Unbl.	Bl.	Unbl.	Bl.
Maintenance materials and insurance	8,600	10,300	11,300	13,600
Electricity	450	550	600	750
Water	75	90	100	130
Salaries, doctors, etc.	10,000	15,000	16,000	19,000
Unforeseen expenditure	1,875	2,560	2,900	3,320
Total maintenance cost	21,000	28,500	30,800	36,800
Id. (1,000 dollars)	42.0	57.0	61.6	73.6
Id. per ton of pulp (dollars)	22.40	3.26	1.76	2.10

a/ See also figure VII-VI.

Table VIII-16

CAPITAL COSTS: PULPMILLS.

(Depreciation and insurance) a/

	Mill capacity							
	50 tons/day		100 tons/day		200 tons/day		300 tons/day	
	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.	Unbl.	Bl.
Capital requirement	1,000 dollars							
Mill investment b/	6,185	7,810	8,470	10,430	11,520	14,240	15,820	19,150
Offsite investments c/	795	890	1,020	1,140	1,370	1,545	1,830	2,045
Capital costs during construction d/	1,205	1,495	1,635	1,980	2,225	2,715	3,035	3,640
Total	8,185	10,195	11,125	13,550	15,115	18,500	20,685	24,835
Depreciation	1,000 dollars per year							
Mill investment	921.8	1,164	1,262	1,554	1,717	2,122	2,358	2,854
Offsite investment	92.9	104	119	133	160	181	214	239
Capital costs during construction	179.6	223	244	295	332	405	452	542
Total	1,194.3	1,491	1,625	1,982	2,209	2,708	3,024	3,635
Dollars per ton:	68.25	85.20	46.43	56.63	31.56	38.70	28.80	34.62
Insurance e/								
1,000 dollars per year	63.30	80.15	86.10	106.00	115.25	142.90	157.00	190.50
Dollars per ton	3.60	4.60	2.45	3.05	1.65	2.05	1.50	1.80

a/ Depreciation according to sinking fund method (the depreciation quota amortizes capital plus the interest that it could have earned) whith 8 per cent interest and the following capital recovery periods;
Mill investments; 10 years
Offsite " 15 years
Capital costs during constr. 10 years

b/ Includes machinery, buildings, engineering fees, forest transport trucks.

c/ Housing and community, railway lines on mill site and housing for forest workmen.

d/ See figure VII-VIII

e/ Insurance calculated at 1 per cent annual rate on value of machinery, ouildings, engineering fees and spare parts, the value of which is calculated at 5 per cent of machinery value.
Insurance on housing and community investment is charged to separate cost item

Table VIII-17

CAPITAL COSTS: INTEGRATED MILLS

(Depreciation and insurance) a/

	Mill capacity			
	50 tons/day		100 tons/day	
	Unbl.	Bl.	Unbl.	Bl.
Capital requirements, 1,000 dollars				
Mill investment	9,285	11,015	13,100	15,440
Offsite investments	1,045	1,235	1,465	1,690
Capital costs during construction	1,775	2,105	2,495	2,930
Total	12,105	14,355	17,060	20,060
Depreciation, 1,000 dollars per year				
Mill investment	1,384	1,642	1,952	2,301
Offsite investments	122	144	171	197
Capital costs during construction	265	314	372	437
Total	1,771	2,100	2,495	2,935
Dollars per ton	101.20	120.00	71.29	83.86

a/ See footnotes table VIII-16.

Table VIII-18

CAPITAL COSTS: NEWSPRINT MILLS

(Depreciation and insurance) a/

	Mill capacity			
	100 tons/ day	200 tons/ day	300 tons/ day	400 tons/ day
Capital requirements, 1,000 dollars				
Mill investment	9,610	15,085	21,710	27,280
Offsite investments	1,175	1,475	1,940	2,310
Capital costs during construction	1,860	2,870	4,090	5,130
Total	12,645	19,430	27,740	34,720
Depreciation 1,000 dollars per year				
Mill investment	1,432	2,248	3,235	4,066
Offsite investments	137	172	227	270
Capital costs during construction	277	428	610	765
Total	1,846	2,848	4,072	5,101
Dollars per ton	52.74	40.69	38.78	36.41
Insurance; 1,000 dollars per year	98.70	154.23	221.44	277.55
Dollars per ton	2.82	2.20	2.11	1.98

a/ See footnotes table VIII-16.

Table VIII-19

PRODUCTION COST ESTIMATE; UNBLEACHED PULP

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 50 tons per day		Quantity	Unit cost (dollars)	Mill capacity 100 tons per day	
Raw materials									
Pulpwood	m3	4.7	4.50	21.15		4.7	4.58	21.53	
Saltcake	kg	100	0.0387	3.87		100	0.0387	3.87	
Limestone	kg	47	0.0128	0.60	25.62	47	0.0128	0.60	26.00
Operating costs									
Fuel oil	kg	52	0.0312	1.62		52	0.0312	1.62	
Coal (culm)	kg	35	0.0136	0.48	2.10	35	0.0136	0.48	2.10
Labour: operating	man hrs.	11.04		4.21		6.66		2.49	
mill services	"	5.04		1.83		3.18		1.12	
repair	"	3.24		1.25	7.29	1.98		0.77	4.38
Repair and maintenance materials				3.50				3.50	
Clothing, felts, wires				2.25				2.25	
Lubricating oil				0.50	6.25			0.50	6.25
Overheads									
Adm. and supervision				7.30				4.10	
Insurance				3.60				2.45	
Community expenses				1.83				0.99	
Interest on working capital				4.45	17.18			3.40	10.94
Production cost, excl. depr. and interest					58.44				49.67
Depreciation, sinking fund method					68.25				46.63
Total production cost					126.69				96.30

Table VIII-19 (continued)

PRODUCTION COST ESTIMATE; UNBLEACHED PULP

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 200 tons/day		Quantity	Unit cost (dollars)	Mill capacity 300 tons/day	
Raw materials:									
Pulpwood	m3	4.7	4.74	22.98		4.7	4.89	22.98	
Saltcake	kg	100	0.0387	3.87		100	0.0387	3.87	
Limestone	kg	47	0.0128	0.60	26.75	47	0.0128	0.60	27.45
Operating costs:									
Fuel oil	kg	52	0.0312	1.62		52	0.0312	1.62	
Coal (culm)	kg	35	0.0136	0.48	2.10	35	0.0136	0.48	2.10
Labour: operating	man/hr	4.14		1.54		3.84		1.38	
mill services	"	2.07		0.73		1.62		0.56	
repair	"	1.20		0.47	2.74	0.94		0.37	2.31
Repair and maintenance materials				3.25				3.00	
Clothing, felts, wires				2.25				2.25	
Lubricating oil				0.50	6.00			0.50	5.75
Overheads:									
Administration and supervision				2.88				2.37	
Insurance				1.65				1.50	
Community expenses				0.75				0.62	
Interest on working capital				2.73	8.01			2.59	7.08
Production cost, excluding depreciation and interest					45.60				44.69
Depreciation; sinking fund method					31.56				28.80
Total production cost:					77.16				73.49

Table VIII-20

PRODUCTION COST ESTIMATE; BLEACHED PULP

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 50 tons per day		Quantity	Unit cost (dollars)	Mill capacity 100 tons per day	
Raw materials									
Pulpwood	m3	5.3	4.50	23.85		5.3	4.58	24.27	
Salt	kg	150	0.0276	4.14		150	0.0276	4.14	
Limestone	kg	100	0.0128	1.28		100	0.0128	1.28	
Sulphur	kg	25	0.0659	1.65	30.92	25	0.0659	1.65	31.34
Operating costs									
Fuel oil	kg	58	0.0312	1.81		58	0.0312	1.81	
Coal (culm)	kg	290	0.0136	3.94	5.75	290	0.0136	3.94	5.75
Labour: operating	man hrs	14.28		5.45		8.46		3.21	
mill services	"	5.52		1.98		3.48		1.22	
repair	"	3.72		1.44	8.87	2.22		0.86	5.29
Repair and maintenance materials				4.00		3.75		4.00	
Clothing, felts, wires				2.25				2.25	
Lubricating oil				0.50	6.75			0.50	6.75
Overheads									
Adm. and supervision				7.30				4.10	
Insurance				4.60				3.05	
Community expenses				1.98				1.19	
Interest on working capital				5.57	19.46			4.16	12.50
Production cost, excl. depr. & interest					71.75				61.63
Depreciation; sinking fund method					85.20				56.63
Total production cost					156.95				118.26

Table VIII-20 (continued)

PRODUCTION COST ESTIMATE; BLEACHED PULP

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 200 tons/day		Quantity	Unit cost (dollars)	Mill capacity 300 tons per day	
Raw materials									
Pulpwood	m3	5.3	4.79	25.39		5.3	4.94	26.18	
Salt	kg	150	0.0276	4.14		150	0.0276	4.14	
Limestone	kg	100	0.0128	1.28		100	0.0128	1.28	
Sulphur	kg	25	0.0659	1.65	32.46	25	0.0659	1.65	33.25
Operating costs									
Fuel oil	kg	58	0.0312	1.81		58	0.0312	1.81	
Coal (culm)	kg	290	0.0136	3.94	5.75	290	0.0136	3.94	5.75
Labour: operating	man hrs	5.40		2.02		4.84		1.76	
mill services	"	2.28		0.79		1.76		0.61	
repair	"	1.35		0.52	3.33	1.06		0.41	2.78
Repair and maintenance materials				3.75				3.50	
Clothing, felts, wires				2.25				2.25	
Lubricating oil				0.50	6.50			0.50	6.25
Overheads									
Administration and supervision				2.88				2.37	
Insurance				2.05				1.80	
Community expenses				0.86				0.70	
Interest on working capital				3.39	9.18			3.20	8.07
Production cost, excl. depr. and interest					57.22				56.10
Depreciation; sinking fund method					38.70				34.62
Total production cost					95.92				90.72

Table VIII-21

PRODUCTION COST ESTIMATE; UNBLEACHED KRAFT PAPERS

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 50 tons per day		Quantity	Unit cost (dollars)	Mill capacity 100 tons per day	
Raw materials									
Pulpwood	m3	4.9	4.50	22.05		4.9	4.58	22.44	
Saltcake	kg	104	0.0387	4.02		104	0.0387	4.02	
Limestone	kg	49	0.0128	0.63		49	0.0128	0.63	
Rosin	kg	20	0.340	6.80		20	0.340	6.80	
Alum	kg	30	0.063	1.89	35.39	30	0.063	1.89	35.78
Operating costs									
Fuel oil	kg	54	0.0312	1.68		54	0.0312	1.68	
Coal (culm)	kg	360	0.0136	4.90	6.58	360	0.0136	4.90	6.58
Labour: operating	man hrs	17.52		6.76		11.82		4.59	
mill services	"	5.64		2.04		3.48		1.24	
repair	"	3.60		1.40	10.20	2.40		0.92	6.75
Repair and maintenance materials				3.75				3.75	
Clothing, felts, wires				3.00				2.75	
Lubricating oil				0.75	7.50			0.75	7.25
Overheads									
Administration and supervision				11.50				7.18	
Insurance				5.45				3.85	
Comunity expenses				2.40				1.76	
Interest on working capital				6.71	26.06			5.20	17.99
Production cost, excl. depr. and interest					85.73				74.35
Depreciation; sinking fund method					101.20				71.29
Total production cost					186.93				145.64

Table VIII-22

PRODUCTION COST ESTIMATE; BLEACHED KRAFT PAPERS

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 50 tons/day		Quantity	Unit cost (dollars)	Mill capacity 100 tons/day	
Raw materials									
Pulpwood	m3	5.3	4.50	23.85		5.3	4.58	24.27	
Salt	kg	150	0.0276	4.14		150	0.0276	4.14	
Limestone	kg	100	0.0128	1.28		100	0.0128	1.28	
Sulphur	kg	25	0.0659	1.65		25	0.0659	1.65	
Rosin	kg	20	0.340	6.80		20	0.340	6.80	
Alum	kg	30	0.063	1.89		30	0.063	1.89	
Caolin	kg	60	0.065	3.90	43.51	60	0.065	3.90	43.93
Operating costs									
Fuel oil	kg	58	0.0312	1.81		58	0.0312	1.81	
Coal (culm)	kg	645	0.0136	8.77	10.58	645	0.0136	8.77	10.58
Labour: operating	man hr	23.76		9.08		15.54		5.86	
mill services	"	5.88		2.13		3.72		1.32	
repair	"	4.20		1.61	12.82	2.70		1.03	8.21
Repair and maintenance materials				4.00				4.00	
Clothing, felts, wires				3.00				2.75	
Lubricating oil				0.75	7.75			0.75	7.50
Overheads									
Administration and supervision				11.12				7.18	
Insurance				6.50				4.50	
Community expenses				3.26				2.10	
Interest on working capital				8.06	28.94			6.21	19.99
Production cost, excl. depr. & int.					103.60				90.21
Depreciation; sinking fund method					120.00				83.86
Total production cost					223.60				174.07

Table VIII-23

PRODUCTION COST ESTIMATE: NEWSPRINT

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 100 tons/day		Quantity	Unit cost (dollars)	Mill capacity 200 tons/day	
Raw materials									
Pulpwood	m3	3.3	4.51	14.88		3.3	4.65	15.35	
Limestone	kg	30	0.0128	0.38		30	0.0128	0.38	
Sulphur	"	24	0.0659	1.58		24	0.0659	1.58	
Rosin	"	3	0.340	1.02		3	0.340	1.02	
Alum	"	15	0.063	0.95		15	0.063	0.95	
Caolin	"	20	0.065	1.30	20.11	20	0.065	1.30	20.58
Operating costs									
Coal (sulp)	kg.	410	0.0136	5.58		410	0.0136	5.58	
Electricity	kWh	1,415	0.0076	10.75	16.33	1,415	0.0076	10.75	16.33
Labour: operating	man hr	9.24		3.46		5.64		2.11	
mill services	"	3.54		1.25		2.19		0.79	
repair	"	2.40		0.92	5.63	1.35		0.51	3.41
Repair and maintenance materials				3.75				3.50	
Clothing, felts, wires, grinding stones				3.50				3.25	
Lubricating oil				0.75	8.00			0.75	7.50
Overheads									
Administration and supervision				6.08				3.40	
Insurance				2.82				2.20	
Community expenses				1.43				0.87	
Interest on working capital				4.21	14.54			3.57	10.04
Production cost: Excl. depres. & int.					64.61				57.86
Depreciation: sinking fund method					52.74				40.69
Total production cost					117.35				98.55

Table VIII-23 (continued)

PRODUCTION COST ESTIMATE: NEWSPRINT

(Dollars per ton)

	Unit	Quantity	Unit cost (dollars)	Mill capacity 300 tons/day		Quantity	Unit cost (dollars)	Mill capacity 400 tons/day	
Raw materials									
Pulpwood	m3	3.3	4.76	15.71		3.3	4.87	16.07	
Limestone	kg	30	0.0128	0.38		30	0.0128	0.38	
Sulphur	kg	24	0.0659	1.58		24	0.0659	1.58	
Rosin	kg	3	0.340	1.02		3	0.340	1.02	
Alum	kg	15	0.063	0.95		15	0.063	0.95	
Caolin	kg	20	0.065	1.30	20.94	20	0.065	1.30	21.30
Operating costs									
Coal (culm)	kg	410	0.0136	5.58		410	0.0136	5.58	
Electricity	kWh	1,415	0.0076	10.75	16.33	1,415	0.0076	10.75	16.33
Labour: operating	man hr	5.46		1.98		4.67		1.69	
mill services	"	1.98		0.72		1.76		0.64	
repair	"	1.00		0.38	3.08	0.75		0.28	2.61
Repair and maintenance materials				3.25				3.25	
Clothing, felts, wires, grinding stones				3.25				3.25	
Lubricating oil				0.75	7.25			0.75	7.25
Overheads									
Adm. and supervision				2.60				2.23	
Insurance				2.11				1.98	
Community expenses				0.79				0.67	
Interest on working capital				3.49	9.01			3.36	8.24
Production cost; excl. depr. & int.					56.61				55.73
Depreciation; sinking fund method					38.78				36.44
Total production cost					95.39				92.17

FIGURA VIII - 1
FIGURE VIII - 1

COSTO DE PRODUCCION EN FUNCION DEL TAMAÑO DE LA FABRICA
CELULOSA SIN BLANQUEAR

PRODUCTION COST AS FUNCTION OF MILL SIZE UNBLEACHED PULP

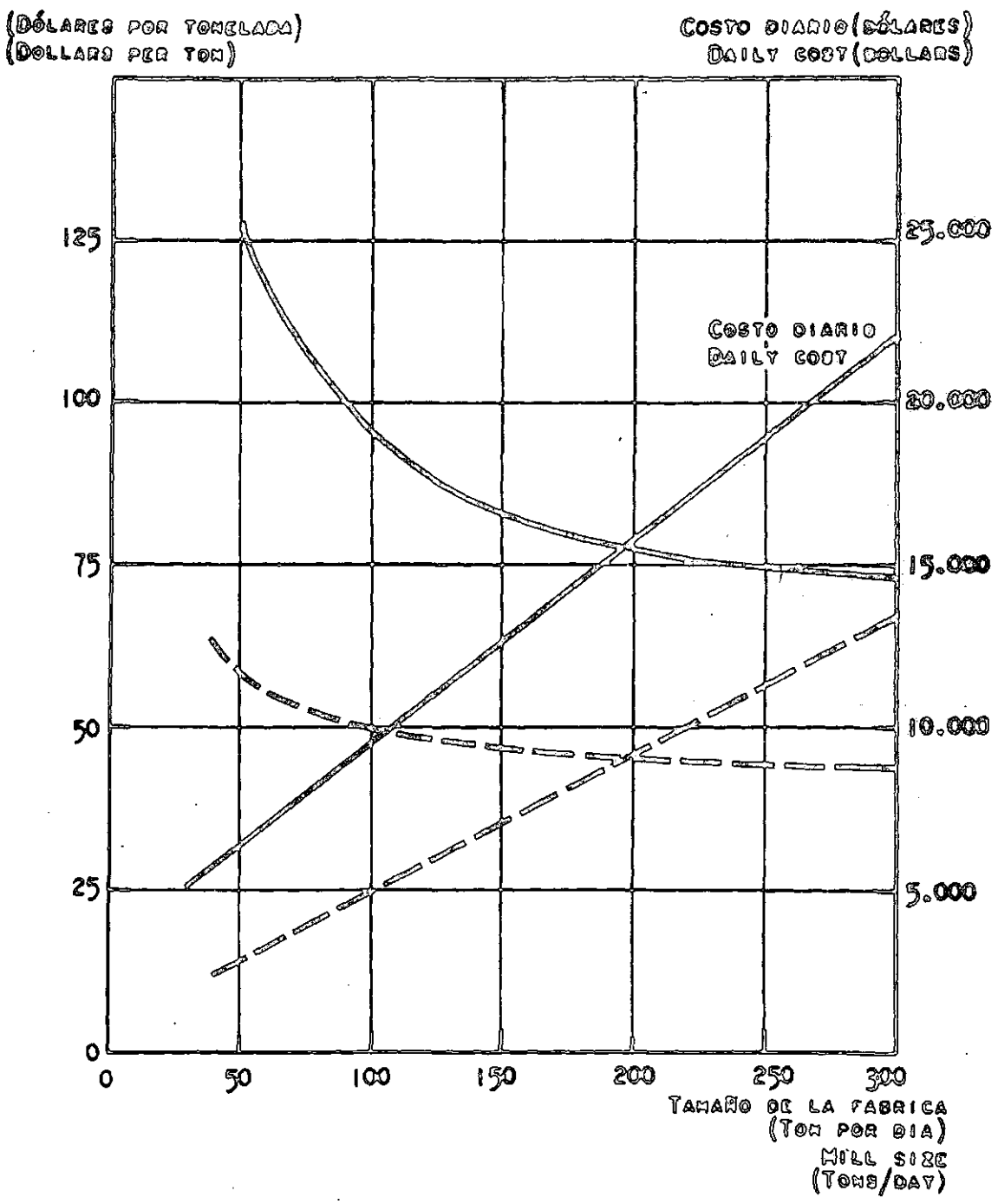


FIGURA VIII - II
FIGURE VIII - II

COSTO DE PRODUCCION EN FUNCION DEL TAMAÑO DE LA FABRICA
CELULOSA BLANQUEADA

PRODUCTION COST AS FUNCTION OF MILL SIZE BLEACHED PULP

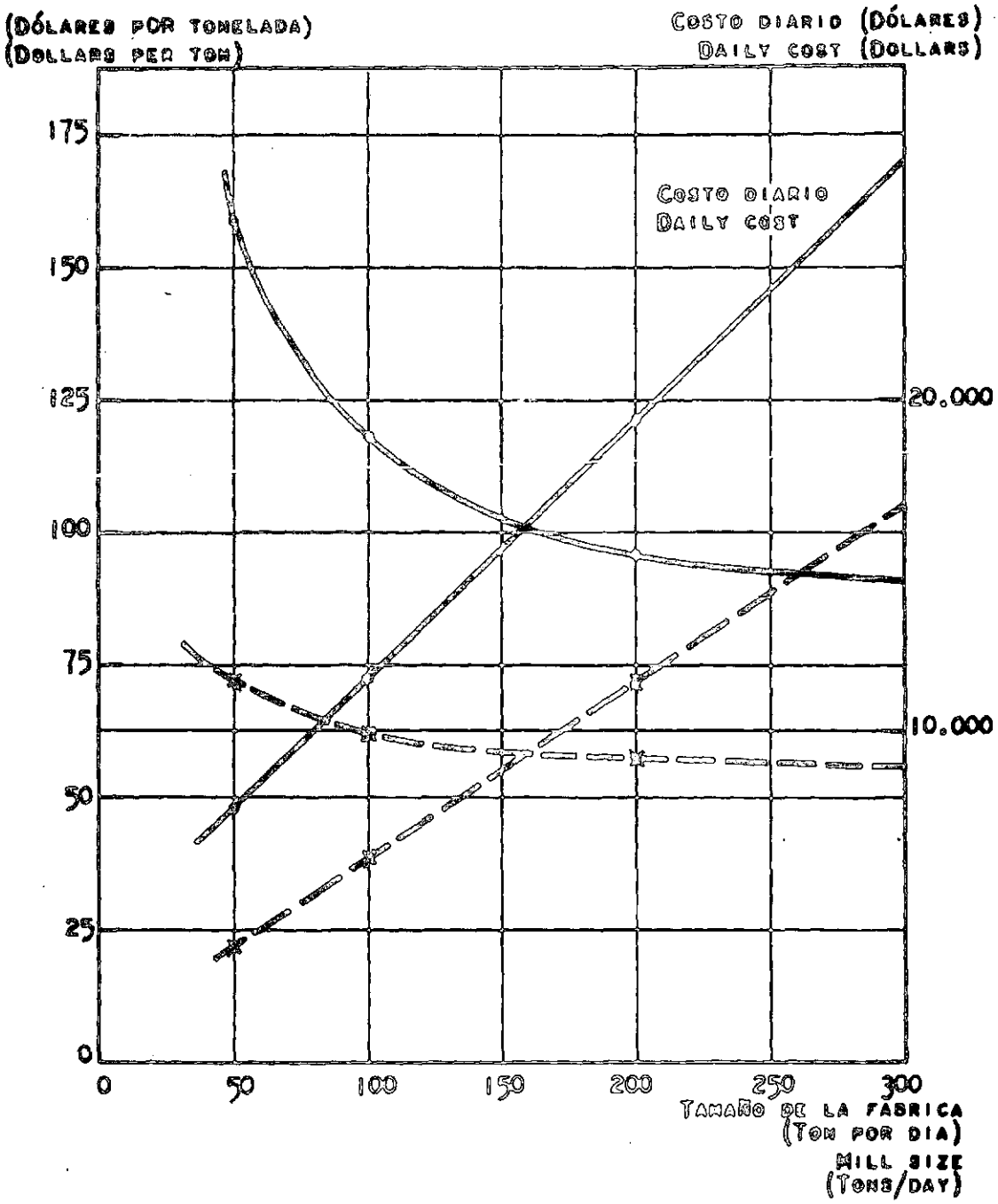
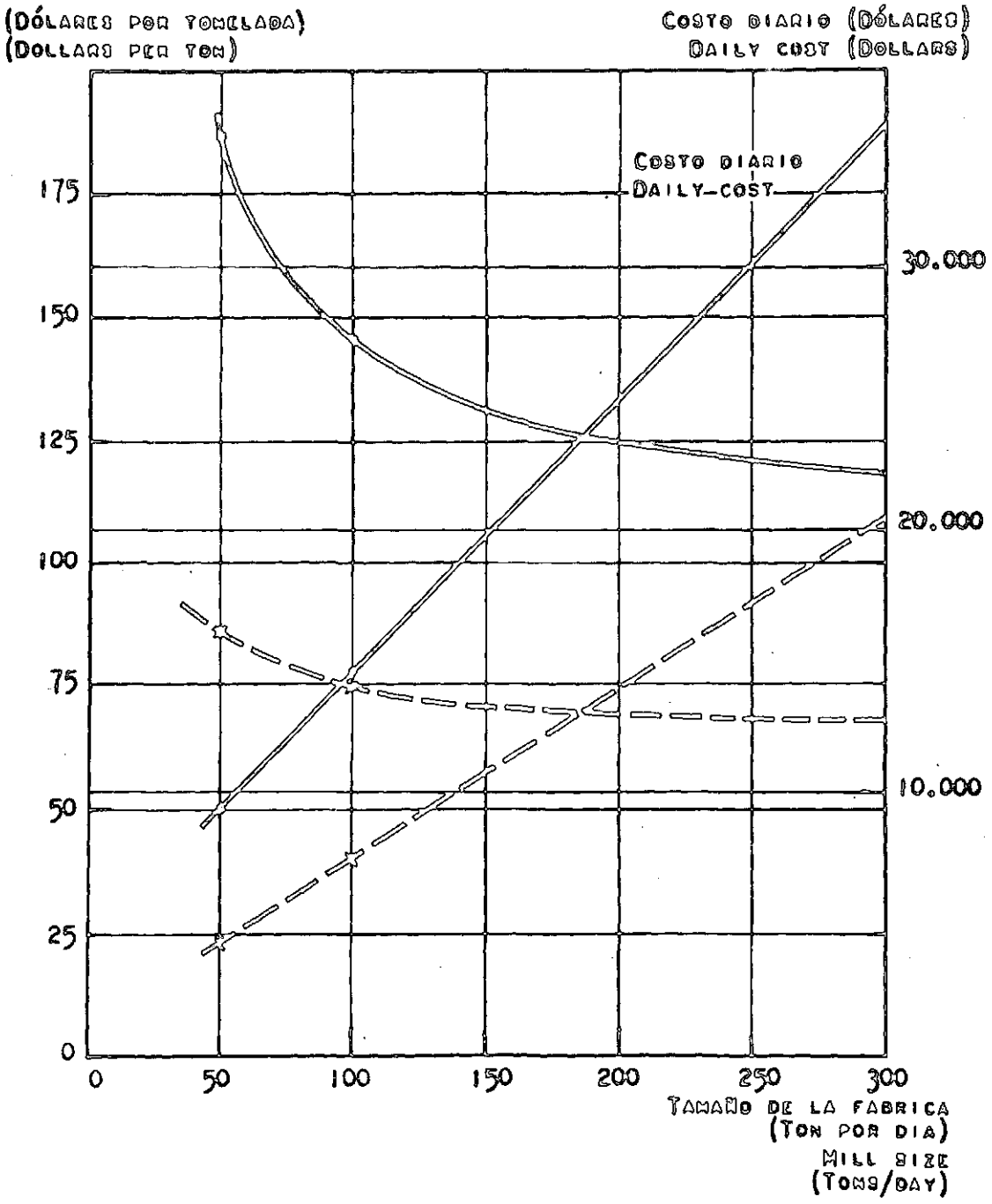


FIGURA VIII - III
FIGURE VIII - III

COSTO DE PRODUCCION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPELES KRAFT NO BLANQUEADOS

PRODUCTION COST AS FUNCTION OF MILL SIZE UNBLEACHED KRAFT PAPERS



COSTO DE PRODUCCIÓN EXCLUYENDO LA DEPRECIACIÓN
PRODUCTION COST EXCLUDING DEPRECIATION

COSTO DE PRODUCCIÓN INCLUYENDO LA DEPRECIACIÓN
PRODUCTION COST INCLUDING DEPRECIATION

FIGURA VIII - IV
FIGURE VIII - IV

COSTO DE PRODUCCION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPELES KRAFT BLANCOS

PRODUCTION COST AS FUNCTION OF MILL SIZE BLEACHED KRAFT PAPERS

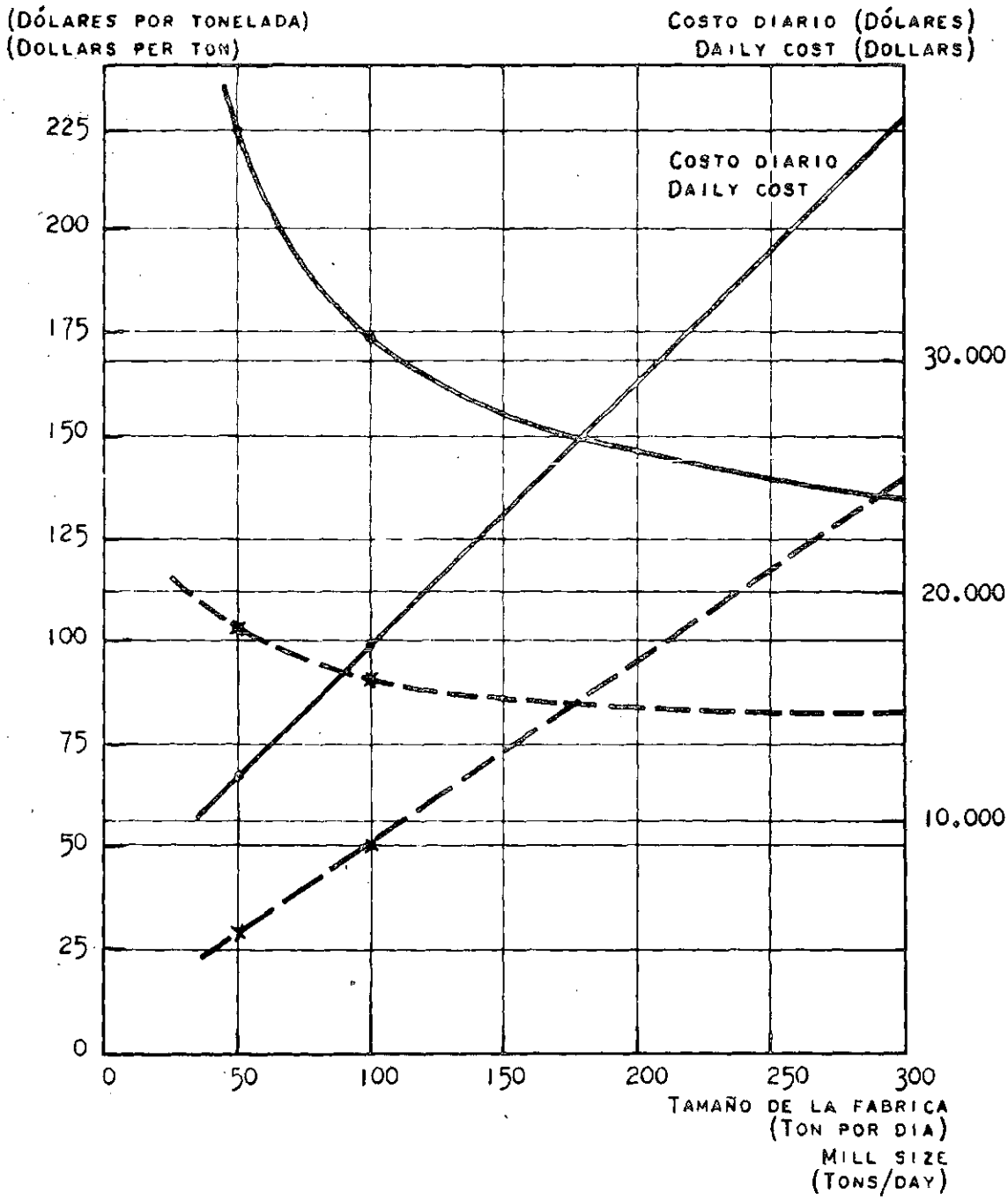
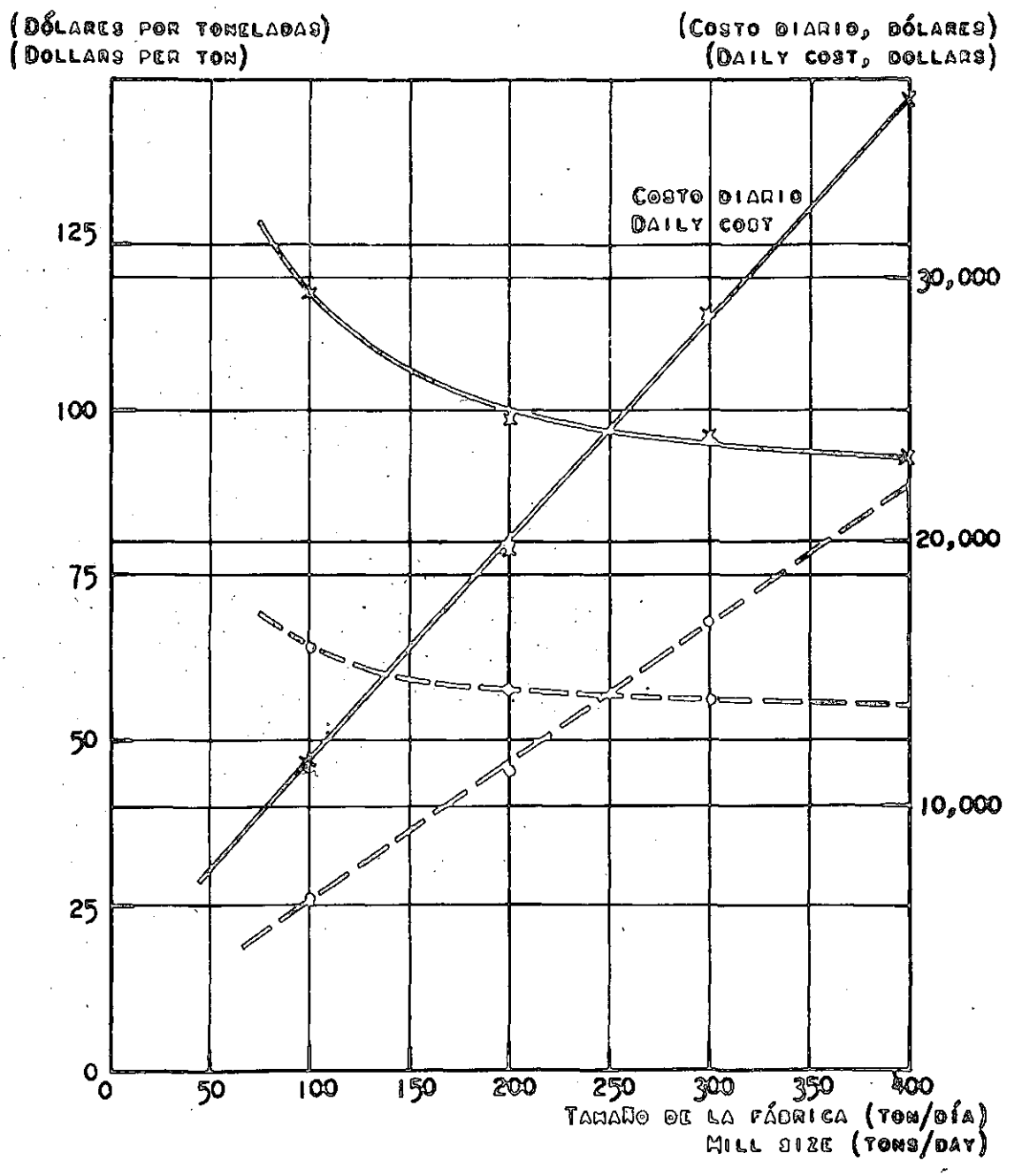


FIGURA VIII - V
FIGURE VIII - V

COSTO DE PRODUCCION EN FUNCION DEL TAMAÑO DE LA FABRICA
PAPEL DE DIARIO

PRODUCTION COST AS FUNCTION OF MILL SIZE
NEWSPRINT



ANNEX IX

ECONOMIC EVALUATION OF THE PROJECTS

The system used for the economic evaluation of the different projects is essentially the "venture profitability" method as described by Happel 1/ and by Aries and Newton. 2/

Venture profit is in this study defined as the excess profit over and above the minimum acceptable profit after taxation. The minimum acceptable profit differs for the different fractions of the total investment and is determined by two factors: the minimum acceptable rate of interest, (equal to the rate of interest on securities), and the estimated lifetime of the investment, which is the number of years in which the capital should be fully recovered.

On this basis the total investment in a project has been divided into three different groups:

a) Mill investments, i.e. investments in mill production facilities (including pulpwood transport equipment). Capital recovery time for this investment has been fixed at 10 years.

b) Offsite investments in community, housing, railway lines etc. which can generally be fully salvaged in case of an early business failure. The capital recovery time for these investments is 15 years.

c) Forest investments, which can be completely salvaged at any date in case of business failure since the capital requirement includes an annual expenditure for establishing new plantations; i.e. there is no depletion of the forest capital. (See annex II, section B).

1. Calculation of minimum acceptable profit

The following nomenclature is used throughout the study:

I = capital investment as defined above.
i = safe annual interest rate (fraction), i.e. interest rate as may be obtained on security investments.
n = number of years in which the different fractions of total investment are recovered.
t = income tax rate (fraction).
y = probability of success. May also be considered as a safety factor to be used for projects where processes, markets, etc. are untried or doubtful. The factor is 1 for established processes and markets.
Pg = gross annual earnings as a fraction of investment.
PG = gross annual earnings, total.
Pgm = minimum acceptable gross annual earnings, fraction of investment.
Pv = venture profit after taxation, fraction of investment.
PV = total venture profit after taxation; i.e. $PV = Pv.I$
T = payout time in years; i.e. capital investment divided by gross annual earnings.

The annual depreciation of fixed capital investments according to the sinking fund method is:

$$D = \left[\frac{i}{(1+i)^n - 1}\right] . I . y$$

Taxable income is equal to probable gross annual earnings minus depreciation, or:

$$y . P_G - y \left[\frac{i}{(1+i)^n - 1}\right] . I = y \frac{I}{T} - y \left[\frac{i}{(1+i)^n - 1}\right] I$$

1/ *John Happel, 'New Approach to Payout Calculations', Chemical Engineer, New York, October 1951.*

2/ *Robert S. Aries and Robert D. Newton, 'Chemical Cost Engineering', McGraw Hill, New York, 1955.*

Net annual income after taxes is thus:

$$y \frac{I}{T} - t \left\{ y \frac{I}{T} - y \left[\frac{i}{(1+i)^n - 1} \right] I \right\} = P_N$$

The net assets of these annual earnings after n years is:

$$P_G \frac{(1+i)^n - 1}{i} \text{ or; } y \frac{I}{T} (1-t) \times \frac{(1+i)^n - 1}{i} + I.t.y;^{3/}$$

An alternative investment in securities will yield an asset after n years of; $I (1+i)^n$.

Applying the criterion that the total asset of net annual earnings must at least equal the asset produced by investment in securities in order to make the project financially interesting, we have:

$$I (1+i)^n = y \frac{I}{T_m} (1-t) \frac{(1+i)^n - 1}{i} + I.t.y$$

Solving for T_m gives:

$$T_m = \frac{y (1-t) [(1+i)^n - 1]}{i [(1+i)^n - ty]}$$

Since $T_m = \frac{1}{P_{gm}}$

$$P_{gm} = \frac{i [(1+i)^n - ty]}{y (1-t) [(1+i)^n - 1]}$$

According to prevailing conditions in Chile, the interest rate on security investments may be estimated at 8 per cent per annum and the income tax rate is 17.25 per cent. Employing these values and assuming that the probability of success is 1, the minimum acceptable gross annual earnings are as follows:

Capital recovery time	*10 years*	*15 years*
Minimum acceptable earnings, fraction	0.1657	0.1335

2. Venture profit

Since, according to the definition, the venture profit is:

$P_v - (P_g - P_{gm}) (1-t)$, in fraction of the investment, the annual venture profit (P_v) will be the following;

3/ For the purposes of this study, it is assumed that the project will be the only business activity of the operating company, i.e., it will not be possible to use any tax credits if the project fails.

$$P_v = 0.8275\ (P_g Itot - 0.1657\ I_1 - 0.1335\ I_2 - 0.0967\ I_3)$$ [4] where;

I_{tot} = total capital investment

I_1 = mill investment

I_2 = offsite investments in housing, community etc.

I_3 = investment in forests.[5]

To calculate the venture profit it is thus necessary to assess the gross annual earnings and the separate fractions of the total investment. Gross annual earnings have been determined on the assumption that aggregate production will be sold on export markets in Latin America, and that the prices received are equivalent to the current c.i.f. prices in Latin American countries for pulp and paper products exported from North America and Europe. The prices have been determined from the f.o.b. sales values listed in the United States' export statistics and the OEEC statistical bulletins for Canada and Sweden for the year 1955 by adding an estimated price increase between 1955 and 1956 of 5 dollars per ton of pulp and newsprint and 10 dollars for other paper grades, as well as an average ocean freight to Latin America of 25 dollars for pulp and 35 dollars for paper. The prices are listed in appendix IX-A, which also gives an estimate of the net sales values at the mill in Chile, obtained by deducting from the c.i.f. prices an average ocean freight from Chile to the Latin American countries (See appendix VI-F), inland freights to port, sales expenses and discounts.

Gross annual earnings -equal to the net sales value minus production costs- are recorded together with the investments in appendix VI-B as are also the venture profits calculated from these data according to the mathematical expression derived above.

In assessing the relative economic attraction of the different projects the relation of venture profits to capital requirements and pulpwood availability are compared; i.e. the projects are judged against limitations in capital and pulpwood supply. [6]

For this purpose, venture profits are recorded graphically as functions of;

(i) total mill investment,

(ii) total project investment, including capital required for complete ownership of plantations large enough to cover the pulpwood needs,

(iii) pulpwood requirements, and are included as figures IX - I to III.

As production cost, mill investment and wood supply are all straight-line functions of mill size, it follows that gross and venture profits must be straight-line functions of both investment and wood requirements.

Since it is the usual current practice in the less developed regions to finance the purchase of production machinery through deferred payments, the projects are also evaluated by their capacity to liquidate such payments. This may be measured by the number of years in which the foreign exchange share of the total investment can be repaid by the gross annual profits after taxation.

The repayment time is calculated as follows:

Gross annual profit after taxation is equal to -

$$P_G - t\ (P_G - D),$$ where D is the annual depreciation.

4/ The value of the forest investment has been calculated with 10 per cent accumulative interest. For strict comparison the value should have been calculated with an interest of 9.67 per cent to yield 8 per cent net profit after taxation.

5/ In the case of industrial operation alone the factor including I_3 will disappear.

6/ There is also an obvious limitation set by the prospective markets for the different products. In the case of bleached paper and maybe also pulp this limit is probably reached before the limits set by either capital availability or wood supply, whereas, in the case of newsprint and unbleached pulp, markets will not be the limiting factor. (See annex I).

The gross annual profits will after n years produce a total asset of:

$$[\, P_G - t\,(P_G - D)] \;\frac{(1+i)^n - 1}{i}$$

which at the end of the period should equal the value of the foreign exchange investment I_f.

Thus, for an income tax rate of 17.25 per cent and an interest of 8 per cent we have;

$$[\, P_G - 0.1725\,(P_G - D)] \;\frac{1.08^n - 1}{0.08} = I_f\, 1.08^n$$

The repayment periods have been calculated according to this equation and are recorded in figures and graphically in appendix IX-D and figure IX-VI.

The assessments outlined above refer to single projects; i.e. they reflect the relative attraction of alternative investments in pulp and paper projects as judged by the private investor or the enterprise.

An equally important evaluation is of the economic benefits, which may be obtained for the country as a whole from the alternative investment possibilities. This benefit may be measured in terms of foreign exchange earning capacity, which -as in the case of profits from a single project- must also be judged against limitations set by capital availability and raw material resources. The foreign exchange earnings by different products and mill capacities are listed in appendix IX-C and graphically represented in figures IX-IV and V.

3. Assessment on profit basis – the investors point of view

(a) Limitation of capital

A comparison of the venture profits in industrial operations (as distinct from combined industrial and forest operations) as functions of capital requirements (figures IX-I) shows that if the investment alternatives are judged from the capital limitations point of view the order of attractiveness is the following: 7/

Unbleached pulp - Bleached pulp - Bleached papers - Unbleached papers - Newsprint 8/

By way of illustration two examples will be given;

(i) Assuming that the available capital is 25 million dollars, the following annual venture profit will be obtained:

Table IX-1

ANNUAL VENTURE PROFITS OBTAINED FROM A MILL INVESTMENT OF 25 MILLION DOLLARS

Order of attractiveness	Product	Approx. mill size; tons per day	Annual venture profit, 1,000 dollars	Annual venture profit as percentage of profit for unbl. pul
1	Unbleached pulp	400	4,700	100
2	Bleached pulp	300	4,470	95
3	Bleached papers	145	3,225	69
4	Unbleached papers	180	2,315	49
5	Newsprint	270	2,330	50

7/ *In this and the following comparisons the most attractive alternative is listed first.*

8/ *The venture profit is approx. the same for unbl. papers and newsprint with a slight advantage for newsprint at a lower investment level and vice-versa for larger investments.*

Table IX-1 shows that the venture profits for unbleached and bleached pulps are roughly twice as high as for unbleached papers and newsprint and about 40-45 per cent higher than for bleached papers (at this level of investment).

(ii) In order to obtain an annual profit of 10 per cent on the mill investment the following capital is required:

Table IX-2

MILL INVESTMENT REQUIRED TO OBTAIN AN ANNUAL VENTURE PROFIT OF 10 PER CENT ON CAPITAL

Product	Approx. mill size, tons per day	Investment, 1,000 dollars	Per cent investment of requirements for unbl. pulp
Unbleached pulp	165	13,890	100
Bleached pulp	155	16,305	117
Bleached papers	110	21,220	153
Unbleached papers	200	26,810	193
Newsprint	300	27,580	199

To obtain a venture profit of 10 per cent on mill and offsite investments, the minimum capital requirement will thus be double for newsprint and unbleached papers and for bleached papers one and a half times as high as for unbleached pulp. This explains why newsprint mills are generally built in larger units than kraft pulp mills and will require heavier investments to offer equal economic attraction.

The annual venture profits from combined industrial and forest operations are the same as from industrial operations alone, since pulpwood stumpage values are calculated with a profit on forest investments which, after taxation, yields a net asset equal to the interest on securities. But, because pulpwood consumption per ton is not the same for the different products and consequently the forest capital part of total project investment varies, it follows that the relation between venture profits in the different operations will not be the same as for industrial projects alone.

Figure IX-II shows the venture profit which may be expected from fully combined operations as functions of the total project investment. The figure shows that the order of attractiveness remains unchanged, whereas the relative magnitude of the venture profits is different. In the range of investments between 30 and 40 million dollars, two distinct groups of operations may be distinguished; i) unbleached and bleached pulp and bleached papers, and ii) unbleached kraft papers and newsprint. The first group gives a venture profit of about 13 per cent and the second about 8 per cent on the investment.

(a) Limitations in wood suply

When the project size is determined by pulpwood availability and not by capital restrictions, the maximum venture profits which may be obtained from different operations, will change their order of attractiveness. This will be seen by comparing figure IX-III -showing the relation between venture profits and wood supply- anf figure IX-I, showing venture profits versus investment. The order is thus in the case of wood supply limitation:

Bleached papers - Unbleached papers - Newsprint - Bleached pulp - Unbleached pulp.

This order of attractiveness is natural since, in the case of wood scarcity, maximum profits would be expected from those products which require the most elaborate treatment. The attractiveness may be measured in terms of venture profit per cubic metre of wood. (See table IX-3).

Table IX-3

VENTURE PROFIT PER CUBIC METRE OF WOOD AT AN ANNUAL SUPPLY LEVEL OF 400,000 CUBIC METRES

Order of attractiveness	Product	Dollars per m3	Per cent of profit for bl. papers
1	Bleached papers	14.0	100
2	Unbleached papers	8.38	59.9
3	Newsprint	8.25	58.9
4	Bleached pulp	6.88	49.1
5	Unbleached pulp	6.38	45.6

(c) Repayment of foreign exchange investment

At a foreign exchange investment level of 17.5 million dollars -corresponding to example i) of capital limitation- the repayment periods for the different products fall into two distinct groups. The first group comprises unbleached and bleached pulp which have a repayment period of about 2.6 years and the second group unbleached and bleached papers and newsprint with a repayment time of between 3.3 and 3.9 years. (See figure IX-VI). To these periods must, of course, be added that part of the project construction time during which foreign exchange is required and which may be estimated at approximately two years.

From figure IX-VI it will thus be seen that -if judged by their capacity to liquidate deferred payments in the shortest possible time- the different products will maintain the same order of attractiveness as in the case of capital limitation.

4. Evaluation on the basis of foreign exchange earning capacity – the national viewpoint

(a) Limitations in capital

When foreign exchange earnings are assessed against the limitation in capital (foreign exchange share of the mill investment), a somewhat similar picture is obtained as in the case of venture profits versus mill investment. This may be seen by comparing the figures in figures IX-IV and I. The most attractive operations are in both cases the production of unbleached and bleached pulp. On the other hand, it should be noted that newsprint has a higher foreign exchange earning capacity than kraft papers; the order of attractiveness for these products is thus reversed to its position in the case of venture profits.

The attractiveness may be measured in terms of foreign exchange recovery time; i.e. the annual period in which the foreign exchange share of the mill investment is recovered by net foreign exchange earnings. This time is listed below for a foreign exchange requirement of 17.5 million dollars, which approximately corresponds to a total investment of 25 million dollars.

Table IX-4

CAPITAL RECOVERY TIME FOR A FOREIGN EXCHANGE PART OF MILL INVESTMENT OF 17.5 MILLION DOLLARS

Order of attractiveness	Product	Foreign exchange recovery time, years	Recovery time in per cent of time for unbl. pulp
1	Unbleached pulp	1.51	100
2	Bleached pulp	1.58	105
3	Bleached papers	2.27	150
4	Newsprint	2.33	154
5	Unbleached papers	2.57	170

Table IX-4 emphasizes that the foreign exchange recovery time is unusually short -varying from approximately one and a half years for unbleached and bleached pulp to about two and a half years in the case of newsprint and kraft paper.

Limitations in wood supply.

In the case of wood supply limitations, the maximum foreign exchange earnings are obtained from the more highly refined products - in accordance with expectations. (See figures IX-V), In this case, as in that of capital limitation, newsprint production yields higher foreign exchange earnings than kraft paper and is -next to the production of bleached papers- the most attractive operatiois as demonstrated in table IX-5 which shows foreign exchange earnings per cubic metre of wood.

Table IX-5

FOREIGN EXCHANGE EARNINGS PER CUBIC METRE OF WOOD AT AN ANNUAL SUPPLY LEVEL OF 400,000 CUBIC METRES

Order of attractiveness	Product	Dollars per cubic metre	Per cent of earnings on bl. papers
1	Bleached papers	33.8	100
2	Newsprint	29.4	87.0
3	Unbleached papers	25.8	76.3
4	Bleached pulp	21.0	62.1
5	Unbleached pulp	19.3	57.1

Summary.

The economic attractiveness of a new pulp or paper project is judged from two different aspects;

(i) The private investor's viewpoint, which presupposes a maximum return on the invested capital at a minimum risk, and

(ii) the national viewpoint, according to which a maximum earning of foreign exchange should be obtained from available capital and raw material resources.

In each of the two cases limitations in capital or raw material supply will affect the relative attractiveness of one operation over the other. This is to be expected and only reflects the general fact, that capital limitations will favour the production of intermediate and less refined products whereas in the case of raw material limitations maximum profits will be obtained from the more refined products.

The order of attractineness of the different pulp and paper products -as judged from the angle of the investor and the nation- is shown below.

Table IX-6

ORDER OF ECONOMIC ATTRACTIVENESS FOR DIFFERENT PULP AND PAPER PROJECTS

Order of attractiveness	Investors viewpoint		National viewpoint	
	Capital limitation	Raw material limitation	Capital limitation	Raw material limitation
1	Unbl. pulp	Bl. papers	Unbl. pulp	Bl. papers
2	Bl. pulp	Unbl. papers	Bl. pulp	Newsprint
3	Bl. papers	Newsprint	Bl. papers	Unbl. papers
4	Unbl. papers	Bl. pulp	Newsprint	Bl. pulp
5	Newsprint	Unbl. pulp	Unbl. papers	Unbl. pulp

As may be seen from table IX-6, private and national interests coincide, except in the case of newsprint which has a higher priority from the national viewpoint than from the private angle.

Since capital availability in the less industrially developed countries is generally the limiting factor when a new export industry is created, a natural sequence is to start with projects for unbleached and bleached pulp and later- when pulpwood supply is the limiting factor- to integrate paper or newsprint sections with the pulp mills by re-investing the profits.

Appendix IX-A

ESTIMATE OF PULP AND PAPER SALES VALUES FROM MILLS IN CHILE

(Dollars per metric ton)

	US export price 1955 FOB.	Estimated US export price 1956.	Estimated ocean freight to L.A. average	Estimated CIF. value in L.A.	Estimated average freight rate, Chile-L.A.	Freight to port sales expenses and discounts	Estimated sales value from mill in Chile
Unbleached sulphate pulp	125.00	130.00	25.00	155.00	30.00	9.95	115.05
Bleached sulphate pulp	155.00	160.00	25.00	185.00	30.00	10.55	144.45
Unbleached kraft papers	205.00	215.00	35.00)	235.00	45.00	12.47	177.53
Kraft sack papers	170.00	180.00	35.00				
Bleached kraft papers a/	260.00	270.00	35.00	305.00	45.00	14.87	245.13
Newsprint	146.00	151.00	35.00	186.00	45.00	10.49	130.51

Source: Export prices FOB. port are obtained from the following sources:

Unbleached sulphate pulp: U.S. Export Statistics 1955 and Wood Pulp Statistics 1955.
Bleached " " : Wood Pulp Statistics 1955.
Unbleached kraft papers : U.S. Export Statistics 1955, OEEC Statistical Bulletins on Foreign Trade of Sweden and Canada.
Kraft sack papers : U.S. Export Statistics 1955.
Bleached papers : " " " ".
Newsprint : " " " ", OEEC Statistical Bulletins on Foreign Trade of Sweden and Canada. (Figures for export to L.A. countries)

a/ Price estimated equivalent to that of "Book paper, printing and converting".

Appendix IX-B

VENTURE PROFITS IN INDUSTRIAL OPERATIONS

(Thousands of dollars)

	Mill size, tons/day				
	50	100	200	300	400
Unbleached pulp					
Mill investments	7,400	10,105	13,745	18,855	
Offsite investments	795	1,020	1,370	1,830	
Gross annual earnings	1,003	2,282	4,841	7,400	
Venture profit per year	-272	391	1,969	3,336	
Venture profit in per cent of total investment	-3.32	3.50	13.03	16.61	
Bleached pulp					
Mill investments	9,305	12,410	16,955	22,790	
Offsite investments	890	1,140	1,545	2,045	
Gross annual earnings	1,287	2,887	6,088	9,289	
Venture profit per year	-309	562	2,543	4,336	
Venture profit in per cent of total investment	-3.03	4.15	13,75	17.46	
Unbleached papers					
Mill investments	11,060	15,595	24,665	33,735	
Offsite investments	1,045	1,425	2,185	2,945	
Gross annual earnings	1,614	3,619	7,629	11,639	
Venture profit per year	-297	699	2,689	4,680	
Venture profit in per cent of total investment	-2.45	4.11	10.01	12.76	
Bleached papers					
Mill investments	13,120	18,370	28,870	39,370	
Offsite investments	1,235	1,690	2,600	3,510	
Gross annual earnings	2,477	5,422	11,313	17,204	
Venture profit per year	114	1,781	5,116	8,450	
Venture profit in per cent of to total investment	0.79	8.88	16.26	19.71	
Newsprint					
Mill investments		11,470	17,955	25,800	32,410
Offsite investments		1,175	1,475	1,940	2,310
Gross annual earnings		2,331	5,047	7,763	10,479
Venture profit per year		227	1,552	2,672	3,972
Venture profit in per cent of to total investment		1.80	7.99	9.63	11.44

Appendix IX-C

FOREIGN EXCHANGE EARNINGS

		Sales value FOB. dollars/ tons a	Foreign exchange in prod. cost dollars/ton f	Foreign exchange part of investment 1,000 dollars	Capital recovery charge on foreign exchange 1,000 dollars	Foreign exchange earnings dollars per year (first 10 years)	Foreign exchange recovery time years
Unbleached pulp							
Mill size;	50 tons/day	121.90	9.21	5,833	869	1,103	5.29
	100 " "	"	8.89	8,188	1,220	2,735	2.99
	200 " "	"	8.44	11,136	1,660	6,283	1.77
	300 " "	"	8.13	15,308	2.281	9,664	1.58
Bleached pulp							
Mill size;	50 tons/day	151.30	10.23	7,396	1,022	1,446	5.11
	100 " "	"	9.83	10,122	1,509	3,443	2.94
	200 " "	"	9.33	13.845	2,063	7,875	1.76
	300 " "	"	9.02	18.641	2,778	12,161	1.53
Unbleached papers							
Mill size;	50 tons/day	185.30	17.99	9,036	1,347	1,581	5.72
	100 " "	"	17.29	12,805	1,908	3,972	3.22
Bleached papers							
Mill size;	50 tons/day	253.90	22.68	10,694	1,594	2,453	4.36
	100 " "	"	21.87	15,075	2,247	5,874	2.57
Newsprint							
Mill size;	100 tons/day	137.28	11.58	9,569	1,440	2,960	3.23
	200 " "	"	10.89	15,291	2,279	6,569	2.33
	300 " "	"	10.62	22,258	3,137	9,982	2.23
	400 " "	"	10.58	28,094	4,187	13,551	2.07

Note: Foreign exchange earnings are;
in the first 10 years: $(a - f) \cdot 350\ x$ = capital recovery charge on foreign exchange.
after 10 years: $(a - f) \cdot 350\ x$.
Where x is the mill capacity.

Appendix IX-D

REPAYMENT PERIODS FOR FOREIGN EXCHANGE INVESTMENT

	Production capacity tons/day	Foreign exchange investment I_f (1,000 dollars)	Gross annual profit P_G (1,000 dollars)	Venture profit P_V (1,000 dollars)	Depreciation D (1,000 dollars per year)	Repayment period: By gross profit after taxation N_G (year)	Repayment period: By venture profits N_V (year)
Unbleached papers	50	5,833	1,003	-272	1,194	7.79	
	100	8,188	2,282	391	1,625	4.68	
	200	11,136	4,841	1,969	2,209	2.95	7.83
	300	15,308	7,400	3,336	3,024	2.65	5.94
Bleached pulp	50	7,396	1,287	-309	1,491	7.72	
	100	10,122	2,887	562	1,982	4.58	
	200	13,845	6,088	2,543	2,708	2.92	7.43
	300	18,641	9.289	4,336	3,635	2.57	5.48
Unbleached papers	50	9,036	1,614	-297	1,771	7.55	
	100	12,805	3,619	699	2,495	4.61	
	200	20,343	7,629	2,689	3,943	3.44	10.04
	300	27,881	11,639	4,680	5,391	3.90	8.42
Bleached papers	50	10,694	2,477	114	2,100	5.70	
	100	15,075	5,422	1,781	2,935	3.59	14.69
	200	23,837	11,313	5,116	4,605	2.70	6.06
	300	32,599	17,204	8,450	6,275	2.42	4.82
Newsprint	100	9,569	2,331	227	1,846	5.42	
	200	15,291	5,047	1,551	2,848	3.95	20.20
	300	22,258	7,763	2,672	4,072	3.74	14.27
	400	28,094	10,479	3,972	5,101	3.49	10.84

Appendix IX-E

AMORTIZATION

According to the regulations laid down by the Superintendencia de Compañías de Seguro, Sociedades Anónimas y Bolsas de Comercio, the minimum percentages of amortization referred to initial values and costs are as follows:

Machinery and installations	5 per cent annually
Furniture and utensils, draught animals	10 per cent annually
Automobiles, trucks and vehicles	25 per cent during the first year 15 per cent during the second year 10 per cent annually thereafter
Organization expenditure, tools, materials	20 per cent annually
Patents, concessions	Payment by annual instalments so that they will be fully paid for on expiration
Buildings and constructions, mining property, railways, underground pipes, telegraph and telephone networks, boats, rolling stock, etc.	No minimum is set for these and other accounts

Moreover, the Office of Internal Revenue, by virtue of paragraph f) of Article 17 of the Income Tax Law accepts "a reasonable amortization to compensate for depletion, wear or destruction of the goods used in the business or enterprise, including a prudent allowance for those which have become obsolute. The Office of Internal Revenue will determine the amount of the deductions which can prudently be made "*considering replacement costs.*"

Appendix IX-F

TAXES [1]

1) *Turnover.* A tax of 6 per cent is levied on the value of sales, to be paid for by the purchaser, but is not applicable to exports.

2) *Income tax - third category.* This tax applicable to industrial and business concerns amounts to 17.25 per cent on liquid profits. In addition, it is necessary to pay a 5 per cent tax (Law 7,600) for the construction of workers' houses (Corporación de la Vivienda). If the business has disbursed money for this purpose, the 5 per cent is deductible from such expenditure and is not payable.

3) *There is no tax on excess profits.*

1/ Source: Dirección General de Impuestos Internos.

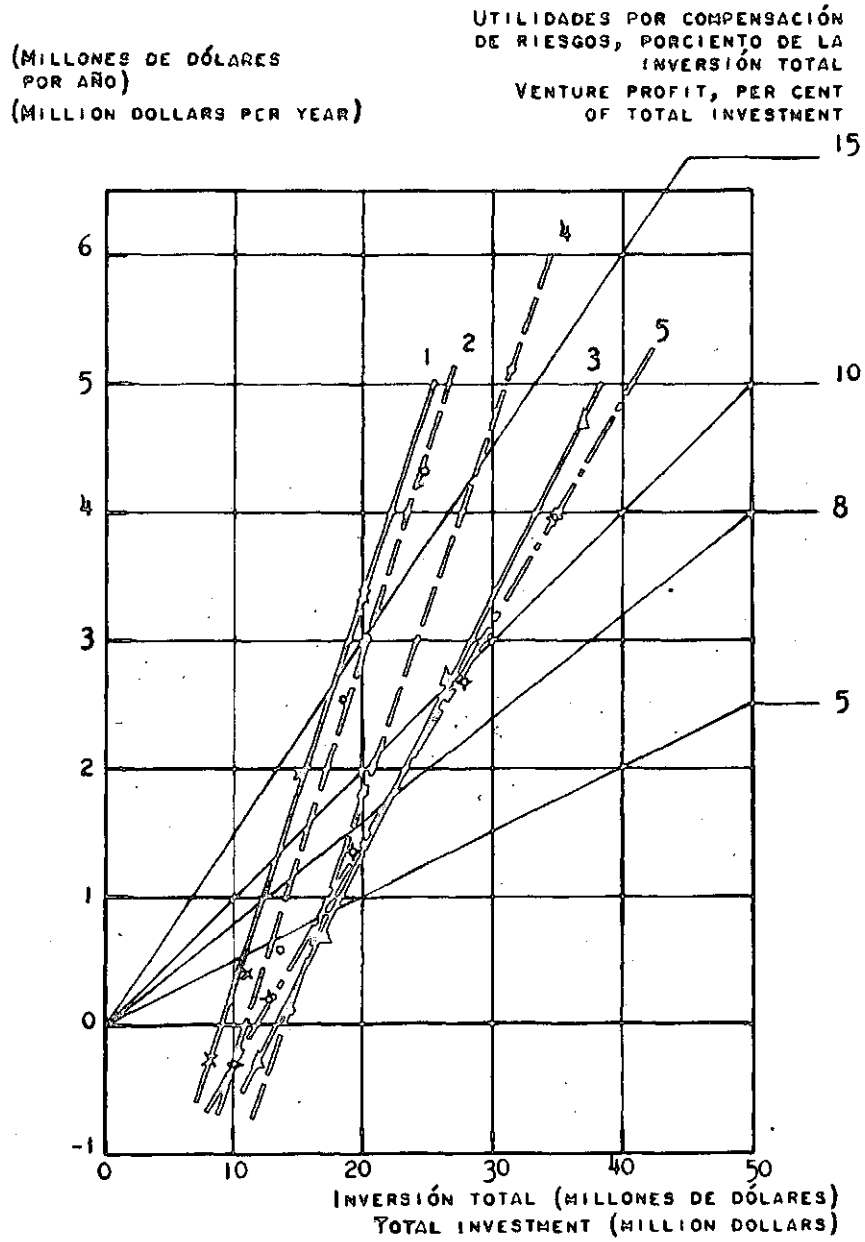
FIGURA IX - 1
FIGURE IX - 1

UTILIDADES POR COMPENSACION DE RIESGOS
EN OPERACIONES INDUSTRIALES, DESPUES DE IMPUESTOS

EN FUNCIÓN DE LA INVERSIÓN

VENTURE PROFIT AFTER TAXATION IN INDUSTRIAL OPERATIONS

FUNCTION OF INVESTMENT



1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

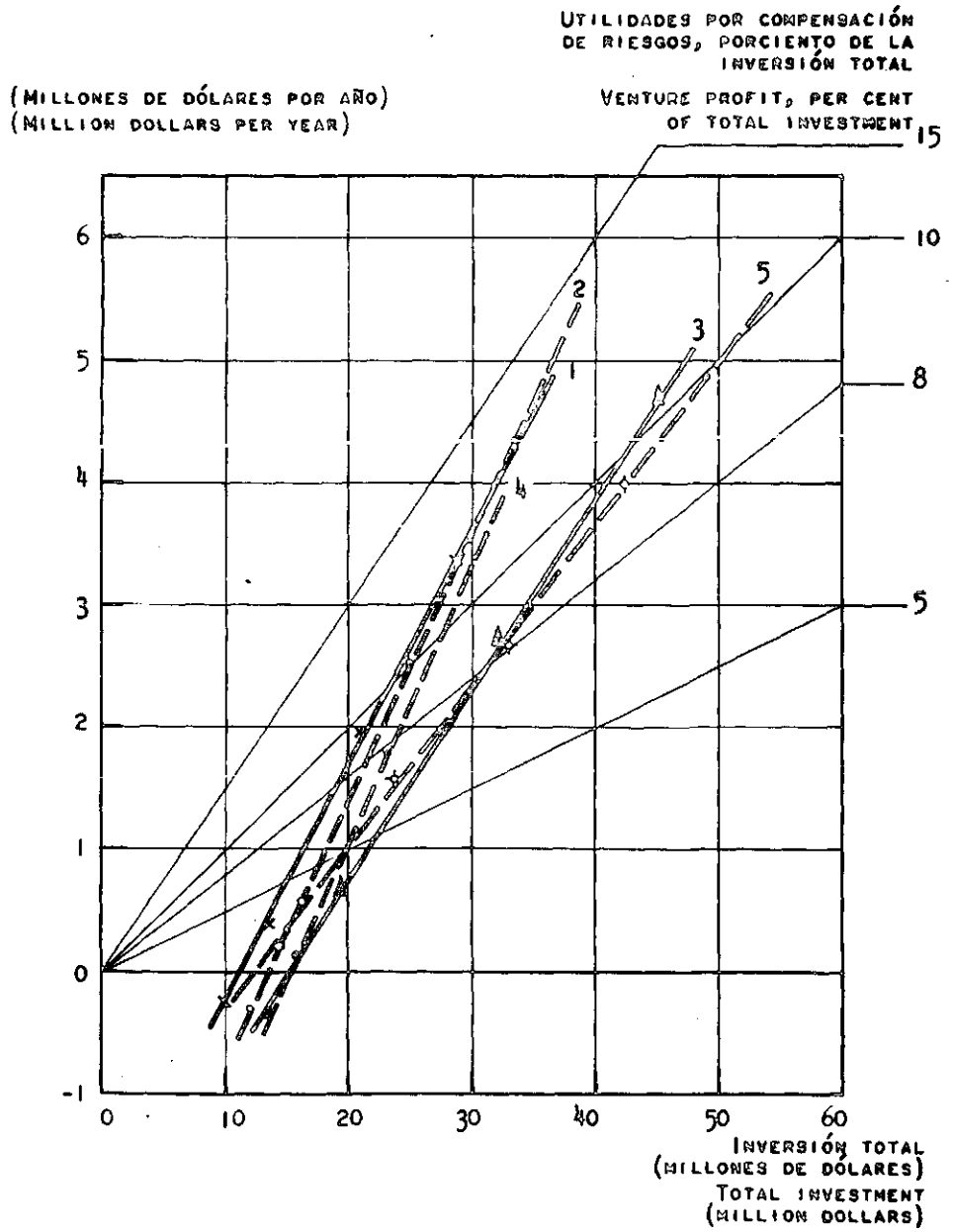
FIGURA IX - 11
FIGURE IX - 11

UTILIDADES POR COMPENSACION DE RIESGOS EN EXPLOTACIONES INDUSTRIALES Y FORESTALES COMBINADAS, DESPUES DE IMPUESTOS

EN FUNCIÓN DE LA INVERSIÓN

VENTURE PROFIT AFTER TAXATION IN COMBINED INDUSTRIAL AND FOREST OPERATIONS

FUNCTION OF INVESTMENT



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2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

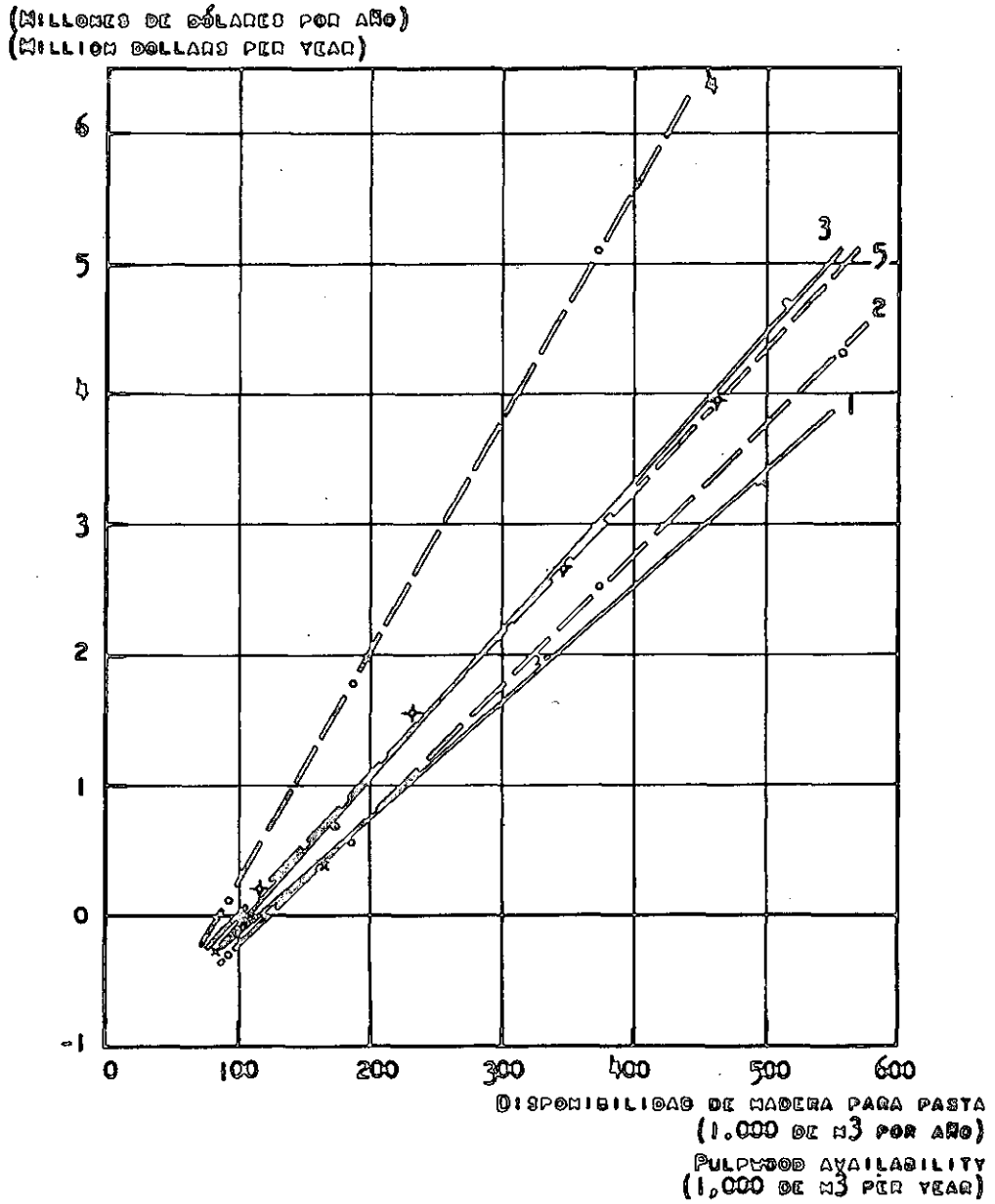
FIGURA IX - III
FIGURE IX - III

UTILIDADES POR COMPENSACION DE RIESGOS, DESPUES DE IMPUESTOS

EN FUNCIÓN DEL ABASTECIMIENTO DE MADERA

VENTURE PROFIT AFTER TAXATION

FUNCTION OF WOOD SUPPLY



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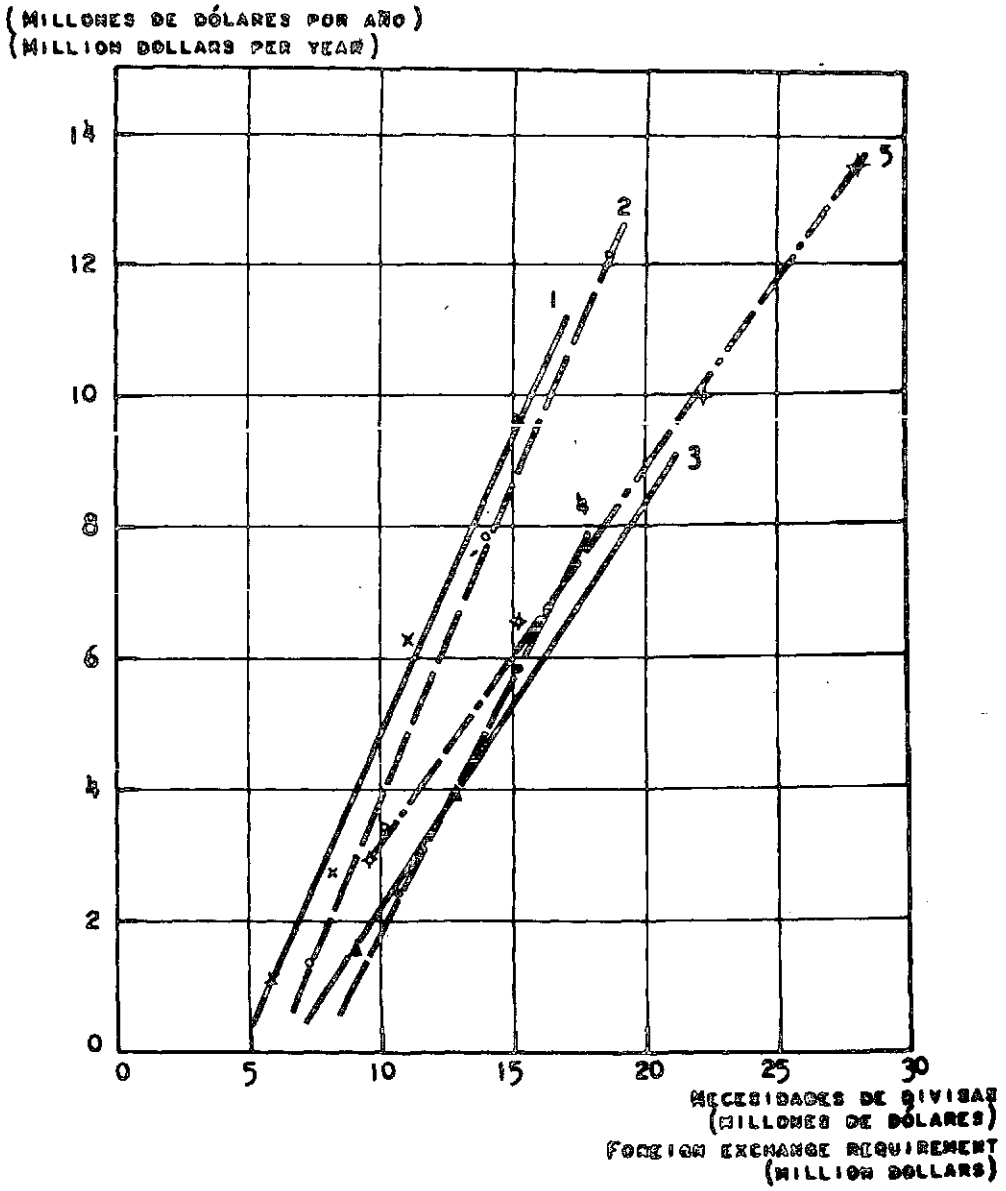
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

FIGURA IX - IV
FIGURE IX - IV

GANANCIAS EN DIVISAS
EN FUNCIÓN DE LAS NECESIDADES DE DIVISAS

FOREIGN EXCHANGE EARNINGS
FUNCTION OF FOREING EXCHANGE REQUIREMENTS



1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

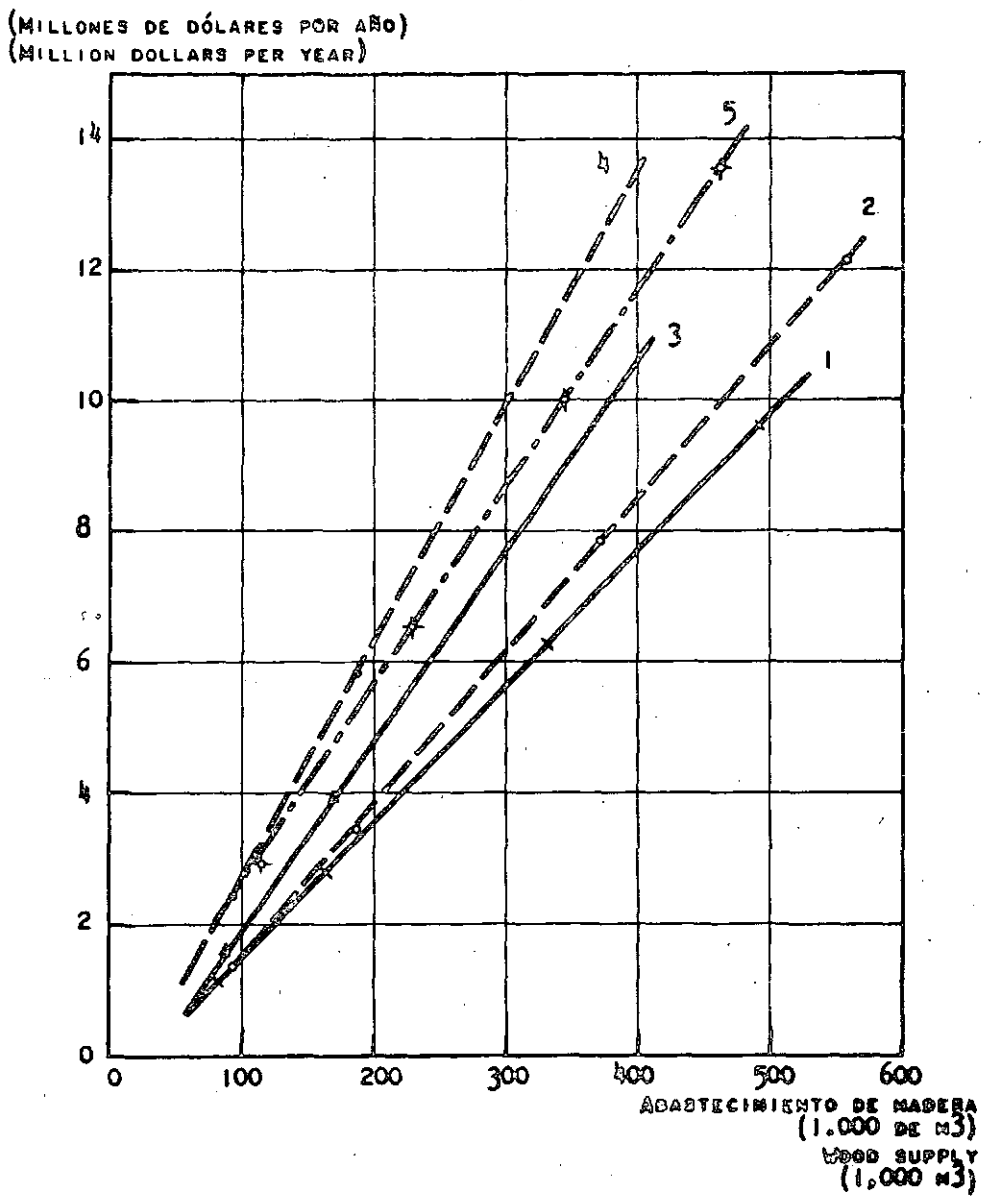
FIGURA IX - V
FIGURE IX - V

GANANCIAS EN DIVISAS

EN FUNCIÓN DEL ABASTECIMIENTO DE MADERA

FOREIGN EXCHANGE EARNINGS

FUNCTION OF WOOD SUPPLY



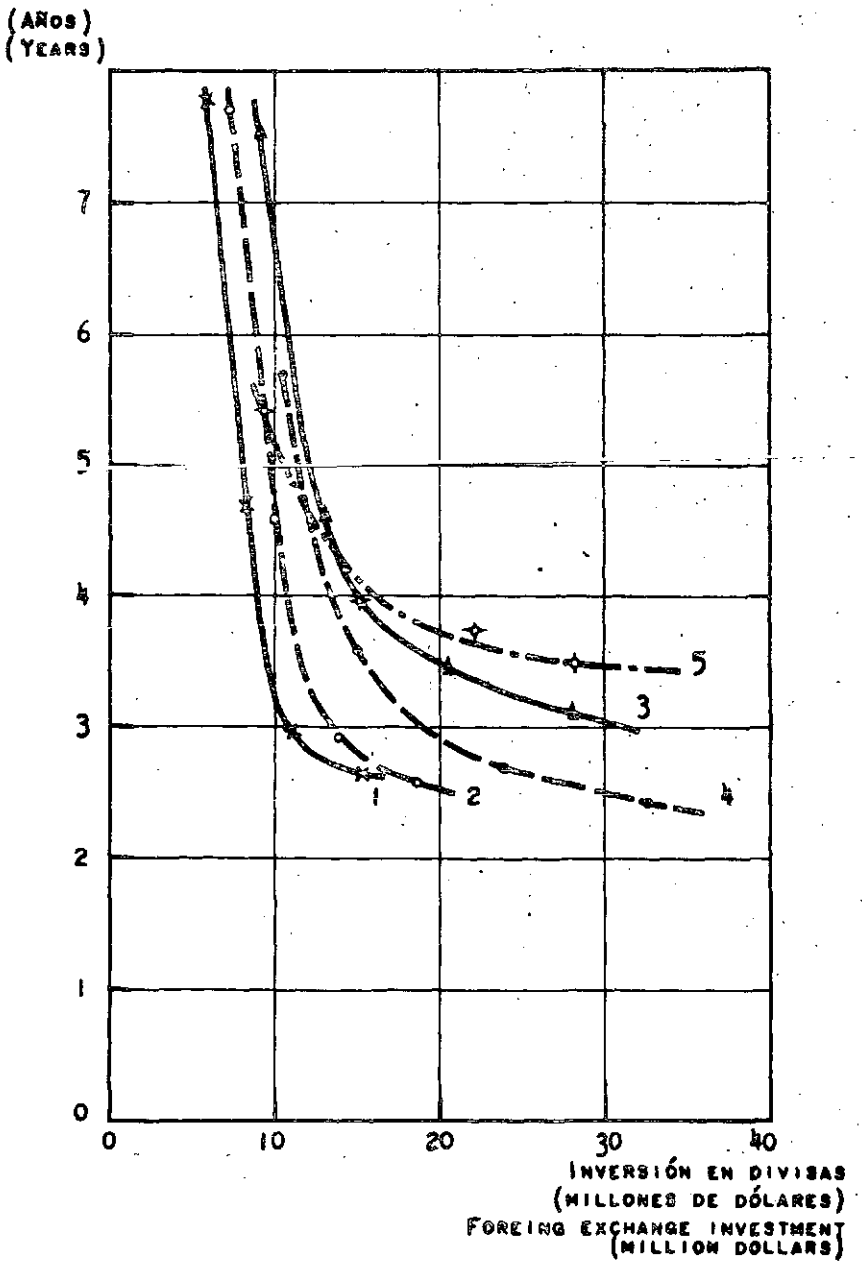
1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

FIGURA IX - VI
FIGURE IX - VI

PERIODOS DE RETORNO DE LA INVERSION EN DIVISAS
POR UTILIDADES BRUTAS ANUALES

REPAYMENT PERIODS FOR FOREING EXCHANGE INVESTMENT
BY GROSS ANNUAL PROFITS



1. PASTA SIN BLANQUEAR
2. PASTA BLANQUEADA
3. PAPELES SIN BLANQUEAR
4. PAPELES BLANCOS
5. PAPEL DE DIARIO

1. UNBLEACHED PULP
2. BLEACHED PULP
3. UNBLEACHED PAPERS
4. BLEACHED PAPERS
5. NEWSPRINT

ANNEX X

PRICES IN JUNE 1957 RELATED TO A SPECIFIC PROJECT [1]

1. *Cost of wood and other raw materials.*

Pulpwood. The present cost of this material, delivered at the mill site, has been estimated as follows:

	Ch.$ 1,000 [2]
Stumpage	
Felling and cutting	420
Logging and woodland roads	540
Miscellaneous	140
Social insurance, other insurances, etc.	270
Main roads	330
Transport, average, railway and lorry combined	2,000
Total cost, per solid cubic metre, at mill	*Ch.$ 4,700*

Availability and cost of other raw materials

The following list shows that most raw materials required for the production of pulp and paper are available in Chile from domestic sources. The prices indicated refer to the present costs at practically any of the possible mill sites within about 100 kilometres of the port of Talcahuano.

(1) - LIME Domestic supply, from the same source that now supplies the Huachipato Steel Mill, near Concepción. This material is shipped from Quarello Island to San Vicente Bay in the vicinity of Concepción and the price is about Ch.$10,000 per ton at possible plant sites.

(2) - SODIUM SILICATES Can now be obtained domestically, 40 Bé., at about Ch.$62,000 per ton, delivered in Santiago. Freight to possible plant sites is estimated now at Ch.$8,500 per ton.

(3) - RICE OR CORN STARCH From domestic sources, now being delivered at Llay-Llay at a price ranging from Ch.$190,000 to Ch.$210,000 per ton. Ch.$8,600 per ton should be added for delivery to plant site.

(4) - DEXTRIN From domestic sources delivered at Llay-Llay at about Ch.$230,000 per ton. Freight charges to plant site would amount to Ch.$8,600 per ton.

(5) - GUM ROSIN Domestic production is very limited, from a small plant near Concepción. This material must normally be imported. It can be brought in from Portugal at about US$300 per ton, CIF Talcahuano, M or N grades. If imported from the United States (I or better grades) it could be delivered CIF Talcahuano at US$230 per ton. These prices are increased by about 50% due to customs duties and tax. Freight to possible plant sites would amount to about Ch.$1,350 per ton.

(6) - SALTCAKE Within about two years the nitrate industry in Chile will be able to deliver this raw material with a purity of about 97%, containing approximately 1.2% sodium chloride, 0,6% sodium nitrate, 0.4% magnesium sulphate and 0.008% iron. The price is now estimated at US$ 20 per ton Chilean port and about Ch$10,000 per ton should be added for freight to Talcahuano and inland freight to the plant site.

At the present time this product with a purity of about 90% or less is also available from domestic sources.

(7) - SODIUM CARBONATE The nitrate industry in Chile has considered producing this material, but it must now be imported at the price of US$ 75 per ton, CIF Chilean port, containing 97% carbonate. Clearing through customs would raise this price by about 60%. There would

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1/ *The information in this annex about various prices as of June 1957 has been submitted by the Celulosas Chile S.A. to which enterprise the Advisory Group wishes to express its sincere thanks both for the permission to publish the data as also for the many fruitful and interesting discussions about various industrial problems which have taken place with the officials of this company*

2/ *All these values should be converted into U.S. dollars at the rate of Ch$650 to the dollar, in order to have as true a picture as possible of those costs in United States currency at this time.*

be an inland freight charge to plant site of about Ch$1,350 per ton.

(8) - FORMALDEHYDE Domestic industry produces only a smallquantity of wood alcohol of poor quality a by-product of wood distillation. Therefore this product must be imported at an estimated cost of US$ 43 per ton, CIF Talcahuano, and about 10% should be added to this price for customs duties, plus about Ch$1,330 per ton for inland freight.

(9) - ALUMINUM SULPHATE This product can be obtained domestically at about Ch$68,000 per ton, delivered in Santiago, containing approximately 15.5% AL203 and 0.2% to 0.3% iron.

There is also a less pure substance, used for treating water, delivered at Santiago at about Ch$ 85,000 per ton.

For either product, the freight charges between Santiago and possible plant sites would amount to Ch$8,000 per ton.

(10) - SULPHUR There are several domestic producers in the northern zone of the country, who can deliver at the present time at the price of Ch$ 50,700 per ton, CIF Talcahuano. The material is refined, in lumps, containing approximately 99.5% sulphur and 0.5% ashes. Inland freight to the plant site would amount to about Ch$1,350 per ton.

(11) - CASEIN Domestic production is small and the material is imported from Argentina at a cost estimated at US$350 per ton, FOB, point of origin, but additional charges, including freight, customs duties etc., bring the price in Chile up to Ch$680,000 per ton at Chilean ports. Inland freight would amount to about Ch.$1,350 per ton.

(12) SODIUM CHLORIDE For chlorine and caustic soda, is in abundant supply, containing 98.98% sodium chloride, 0.19% sodium sulphate, 0.54% calcium sulphate, no nitrates or nitrites, potassium, magnesium or lithium salts, to be delivered in bulk, with an average size of 3/8", which is commonly accepted for electrolysis. The price is about US$6 per metric ton FOB port of origin. Freight from this port to Talcahuano is estimated at about US$7 per ton and for shipments of about 1,500 tons per ship it might amount to only US$6. Inland freight to plant site would be about Ch$1,350 per ton.

(13) - TITANIUM DIOXIDE This product must be imported at prices prevalent for delivery in United States ports. The freight from United States ports to Talcahuano, for the product in sacks, amounts to US$50 per metric ton. To this CIF Chilean port cost about 35% must be added for customs duties and tax, plus about Ch$1,350 per ton for inland freight.

(14) - CHINA CLAY Of domestic origin, in lumps. It is estimated that during the October/April season the price will amount to Ch$32,000 per ton, FOB railway truck at Santiago station. Railway freight charges to plant site are estimated at Ch$8,000 per ton.

This China clay contains only traces of iron and approximately 25% alumina, and 70% silica. There are other products with a slightly higher content of alumina and a lower proportion of silica; the material is 80-84% white.

(15) - TALC Prices of this material are quite similar to those of China clay, for delivery at Licantén station, from domestic sources and with freight charges to the plant site amounting to about Ch$8,000 per ton. The material is 65% white.

(16) - SODIUM SULPHIDE Produced domestically, obtainable in Santiago at about Ch$140,000 per ton, containing approximately 58% sulphide. The freight charges from Santiago to the plant site amount to Ch$8,000 per ton.

(17) - SODIUM PEROXIDE This material is not being produced in Chile now, but there is domestically produced hydrogen peroxide of 100 oxygen volume. Perborates are now produced in Chile and it is therefore possible to produce sodium peroxide, in which event and given sizeable consumption, the price could be adjusted to the value of this material in the international market, plus 40%, corresponding to the customs duties and tax now levied on the imported product.

2. Building materials and fuel costs

(a) Building materials

Building costs can be estimated on the following bases: from Ch$35,000 to Ch$55,000 per square metre; Ch$13,000 per cubic metre of foundations; and Ch$30,000 per cubic metre of reinforced concrete. The following are some of the costs of individual building materials.

Cement Normal domestic production is about 750,000 tons, but 900,000 tons can be produced. Delivered at Concepción at approximately Ch$26,000 per ton.

Steel rods for reinforcing concrete Available from national steel mill, near the probable construction zone at Ch$125,000 per ton.

Roofing Cement-asbestos domestically produced, delivered at Talcahuano port at approximately Ch$1,100 per square metre. Galvanized steel (corrugated) from domestic sources can be delivered at Talcahuano for about Ch$1,100 per square metre.

Steel piping Made in Santiago up to 4" and in the Concepción area in larger diameters, to meet specifications. Black pipe in diameters used inside the buildings, costs approximately Ch$200 per kilogramme delivered at Santiago, with a freight aggregate of about Ch$9 per kilogramme for delivery to the Concepcion area. The price for pipe over 4", manufactured within the zone, is about Ch$170.00 per kilogramme.

Copper piping Manufactured in Chile at a price somewhat higher than steel piping and in diameters up to 5". Proportionally this pipe is less expensive than imported pipe.

Cement tubing For pressures up to 20 atmospheres, with cast-iron couplings, is produced in Chile and delivered at Santiago at prices ranging from Ch$700 per metre for the 2" diameter size to Ch$2,500 for the 6" diameter size. The freight aggregate to the Concepción areas amounts to approximately Ch$9 per kilogramme.

Concrete tubing (not reinforced) This tubing for sewer systems is also produced in the country in sufficient quantities and delivered in the Concepción area at prices ranging from Ch$250 per metre for the 3" diameter size to Ch$3,500 for the 32" diameter size.

Bricks Delivered in Concepción at prices from Ch$14 to Ch$18 each, depending on quality. Also in the same area, refractory bricks can be obtained for about Ch$32 each.

Nails Produced in the Concepción area, in ample supply, for the price of about Ch$200 per kilogramme.

Black wire Also available within the area at an approximate price of Ch$200 per kilogramme.

Sand Obtainable within the zone of probable construction, at about Ch$650 per cubic metre.

Crushed-stone Delivered in the Concepción area at about Ch$3,000 per cubic metre.

Lumber In ample supply in the Concepción area, at about Ch$40 per board foot, for structural purposes, and about Ch$26 per board foot for concrete moulds and similar purposes.

Conductors and electric wires Manufactured in Santiago, both in standard types and to meet a number of specifications. For a project like this, the prices would, on the average, be only slightly higher than those of the imported products, if freight and import charges are included in the latter case.

(b) Fuels

Wood Obtained from thinnings and the clearing of forests. Could be supplied in sizes averaging 2" x 2" x 1" approximately, dry, with a calorific value of 3,200,000 calories per kilogramme; 60% yield, with 25% moisture, and 0.5% ash. The price at the mill can be estimated at Ch.$1,300.

Coal-breeze (culm) As the probable site of the mill will be within the major coal-producing region of Chile, there is an abundant supply of this by-product in sizes ranging from 1/8" to 1/2" or larger. An average analysis shows: fixed carbon, 43%; volatile matter, 34.5%; ash, 19.5%; and moisture, 3%; calorific power, 6,315,000 calories per kilogramme, sulphur content, 1.4%. The price estimated for the Concepcion area, aboard railway truck, is Ch$9,500 per metric ton.

Coal Screened material, not much smaller than 1", at the minimum, with the following analysis: fixed carbon, 47.4%; volatile material, 40.2% ash, 8.8%; moisture, 2.6%. Calorific power, 7.076%, with 0.9% sulphur. The estimated price, aboard railway truck, in the Concepción area is approximately Ch.$12,350 per ton.

Fuel Oil N° 5 Delivered at Concepción can be estimated around Ch$39,000 per ton, with a calorific value of 10.5 to 10 million calories. A sizeable amount of the supply is imported, but efforts are being made to make the country self-sufficient in this fuel.

3. *Salaries and wages*

This classification includes of course employees and manual workers.

(a) Labour

This group is subdivided into agricultural labour and construction and industrial labour. Minimum agricultural wages vary depending on the section of the country, but in the areas around Concepción they

can be estimated to average Ch$300 per day. It must be pointed out that, in Chile agricultural labourers frequently work more than eight hours a day which may offset deficiencies in performance or yield. At any rate, it is preferable not to give hourly rates because of the peculiar features of this type of work. It is important to mention that the workmen used for logging around Concepción are paid Ch$530 per day as a result of circumstances influencing wages in this highly industrialized area. Further inland, forest workers receive wages somewhere between the minimum agricultural pay (Ch$300 per day) mentioned above and the higher figure paid in the Concepción are (Ch$530 per day).

Minimum industrial building wages amount to Ch$500 per day for eight hours of actual work throughout the country. Actually, in the Concepción area a manual worker earns approximately Ch$650 per eight-hour day; semi-skilled workers, such as masons, earn approximately Ch$850 per eight-hour day, while skilled workmen (concrete steel reinforcing erectors, plumbers, electricians, etc.) are paid from Ch$1,000 to Ch$1,200 per day.

There are several features concerning this subject that must be borne in mind so far as the cost of labour to the company is concerned. For instance, *16.66% must be added to all agricultural or industrial wages* due to what is called in Chile the *"semana corrida"*; in other words workmen who attend six days a week are entitled to payment for the seventh day as a bonus for their attendance. Furthermore, social legislation and other related legal provisions increase the cost of labour to the company by 35%, this percentage being applied after the addition of the previously mentioned 16.66%. The net result, on the average, is that to all labour wages paid an approximate total of 58% must be added (this percentage includes accident insurance, which is not compulsory) in order to evaluate the total real cost to the company.

Summarizing, the cost to the company, based on above daily rates, would be as follows (all figures in Chilean currency):

Agricultural workers (forest):

Daily: (530 + 16.6%) 1.35 = 834

Non-skilled construction workers

Hourly: [(650 + 16.6%) 1.35] : 8 = 128

Semi- skilled construction workers

Hourly: [(850 + 16.6%) 1.35] : 8 = 167

Skilled construction workers

Hourly: [(1,100 + 16.6%) 1.35] : 8 = 217

For industrial operators an additional 10% must be added to the above figures

(b) Salaried Personnel:

Unskilled office help is hired in the Concepcion area for salaries fluctuating from Ch$26,000 to Ch$38,000 per month. The average figure paid in an office is calculated to amount to about Ch$45,000 per month.

Foremen in charge of construction workers are also paid, on the average, Ch$45,000 per month, but the supervisor of a construction job of average importance receives about Ch$90,000 per month.

To continue with the higher-ranking employees, it may be mentioned that an accountant receives between Ch$110,000 and Ch$125,000 per month; a shift foreman, or supervisor, receives about Ch$90,000 per month; the average engineer is paid about Ch$200,000 per month, and a chief engineer or head of production between Ch$260,000 and Ch$350,000 per month.

Legal provisions of various sorts, including legal bonuses, increase the cost to the company by 65%, in addition to the above figures paid directly to individuals.

It is a common practice in Chile that administrative personnel, in positions higher than those mentioned above, earn both a salary and a participation percentage, calculated on the basis of output or

profits. Naturally the legal provisions apply only to their respective salaries and therefore the percentage increase in cost to the company for this personnel is proportionally reduced from 65% to 30-60%.

At the present moment, a rate of exchange of $650 per dollar may be applied to convert the salaries and wages given herein to their dollar equivalents.

It may be assumed that any further depreciation of the national currency will not appreciably upset, for a reasonable period of time, the calculations that are based on dollars. In other words the corresponding amounts of wages and salaries in Chilean currency may increase as people press to maintain the size of their income in proportion to a given rate of inflation, but inasmuch as, for all practical purposes, the dollar is stable, the dollar equivalents quoted should not normally undergo any sizeable increase and there would normally be only a slight rise to allow for a gradual improvement in the standard of living.

For all these reasons, it is felt that these estimates of wages and salaries will provide a reasonably accurate guide, notwithstanding further depreciation of the Chilean currency or similar unforeseen developments.