A REGIONAL DEVELOPMENT PROGRAMME OF FORESTRY AND WOOD INDUSTRY IN THE STATE OF MARANHAO, BRAZIL

OVERSEAS TECHNICAL COOPERATION AGENCY

JAPAN

PREFACE

The Overseas Technical Cooperation Agency (OTCA) has the great pleasure of presenting the Report on "A Regional Development Program of Forestry and Wood Industry in the State of Maranhao, Brazil" prepared by Messrs. T. Uemura, H. Nakamura, and K. Ohta, who were dispatched to Brazil by OTCA upon instruction from the Government of Japan for a preliminary survey on the above-mentioned project in response to the request of the Government of Brazil.

We are sure, their survey in Brazil from March to May in 1967, was quite successful in collecting data from various sources with the great help of the Government of Brazil and having useful discussions with the SUDENE and other relevant organizations in Brazil.

After their return home, we are very happy to inform you, they endevoured to devote themselves to preparing the report after their careful studies about the data collected and informations given in Brazil.

Finally, on behalf of OTCA, I do wish to take this opportunity to express my sincere gratitude for the generous cooperation and assistance to extended to the experts by the Government of Brazil.

February 1970

Keiichi Tatsuke
Director-General
Overseas Technical Cooperation Agency
Tokyo, Japan

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Chapter I. Introduction

1. Start of Survey

Brazil covers a vast area of land, which contains a large areas of developing region. In general a cultured living standard has made great progress in the south, with concentration of population and development of many sectors of industry. On the other hand in the north, economic development has been delayed. It was to promote development in the region that the Amazon development agency (SUDAN) was established in the north and another development agency (SUDENE) in the north-eastern region of the country. The area of land under the direct administration of SUDENE covers 9,674 square kilometers in the north-eastern region. In this region along the east coast there is a belt of dependable rainfall that is supporting development. In the interior of the region is a dry area with a desert, and in the western part is an extensive area of tropical rain forests in the Amazon river basin which is connected with the direct control region of SUDAN. In 1958 when the north-eastern region of the country was hit by a serious drought, many inhabitants there died or were dispersed as refugees. Since then, SUDENE has established many settlements in forest regions in the state of Maranhao in which SUDENE has been making effort to urge farmers to settle down and raise several kinds of farm products, chiefly rice. In the region shifting cultivation has been made, forests being burnt up and reduced to ashes.

As SUDENE was anxious to make efficient use of the forest resources, a survey team was dispatched from Japan in November 1965 to investigate the possibility of industrial utilization of the resources by the pulp and paper industry, the result of which having been published from the Overseas Technical Cooperation Agency in a report titled "Report on the Survey for the Development Plan of the Forest Resources in Brazil" (hereafter the report will be abbreviated as "Ohmi report", taking the name of the chief of the team, Mr. Taro Ohmi). Given in the report is the conclusion reached by the team, namely, that industrial utilization of the forest resources in the state of Maranhao would be possible, indicating estimation of it on the basis of prerequisties.

Later, the authorities of SUDENE requested the Japanese Government to dispatch an advisory group of spcialists to investigate the actual conditions of the region along the lines of the report and to confirm the details of possibility to carry out the project, also to obtain the professional advice on it. A group with the following three officials was sent to the country in March, 1967 to undertake technical cooperation.

Takeshi UEMURA, Chief of the Wood Technology Division Government Forest Experiment Station Ministry of Agriculture and Forestry (in charge of industrial utilization of wood, Chief of the group)

Eiseki NAKAMURA,	Head of the Logging Section Division of Forest Mechanization Government Forest Experiment Station Ministry of Agriculture and Forestry (in charge of management of the logging industry)
Kentaro OHTA,	Principal Economist Division of Forest Management Government Forest Experiment Station Ministry of Agriculture and Forestry (in charge of economy)

The three members carried out investigation, details of which are enumerated in the following sections. After having had over-all discussions with officials concerned of the state, and having tendered final advice on the direction of development, we returned home.

In this way our duties were discharged. However, our stay there being not long, and the data we were able to collect somewhat limited, we were unable to draw up a definite project program to develop the forest resources and integrate a wood industry in the state of Maranhao until sometimes after we returned to Japan. For instance, we could not obtain an ample number of samples of wood from the Maranhao forests due to the rainy season, and when some of them were obtained, we did not have any equipment to examine them. It was after we returned home that we were able to gather enough samples

for our investigation, a greater part of which were sent to us from the officials concerned at our request.

In compliance with the earnest attitude and expectations of SUDENE, we worked out projects of development of the state of Maranhao after having examined the data and materials we obtained. This report is an extension of the Ohmi report, may of the assumptions of which we could clarify in this report. If both reports were looked over and the recommendation therein adopted, the appropriate and suitable direction of development of the state will take concrete shape.

We shall be much happy if this report proves to be of some use to the administration of SUDENE in the state of Maranhao, and contribute to the development of the states of Brazil.

Remarks:

Commodity price in this report was the one prevailing during march to may 1967, and exchange rate concerned is as follows:

1 curuzeiro (Novo) = 133 yen = 0.37 U.S.$. Curuzeiro Novo (Cr$ or CrN$) is a currency in Brazil after the devaluation, which is equivalent to 1,000 Curuzeiro before it.

2. Outline of Investigation

On march 14, 1967 our survey started, and it was carried out for two months chiefly in the state of Maranhao and other regions of this country according to the necessity of it,

in order to clarify the following items:

Status quo of the wood industry in Brazil

Conventional utilization of wood by tree species

Commercial tree species and its quality in the state

Possibility of the wood industry and its possible location

Circulation of wood and wood based materials

Location of the wood industry in the state

Survey of the mills concerned in the state

Growing stock of available timber resources in the state

Development of forests in the state

Survey of forest operations in Brazil

Methods of survey of forest resources and its results

Outline of development project of the region under the direct administration

Techniques of road construction

Survey of settlements

Possibility of economic development of the timber resources

Relationships between regional development and forestry with related industries

Commercial basis of the wood industry

During the period we conducted the above-mentioned survey and debated the problems with officials in charge of it completely, the log of which is set forth in the following Table, and the course of our survey illustrated in the following Figure.

For the most part of out investigation we stayed in Sao

Luis and carried out survey in the most efficient way, with the cooperation of many people, particularly with the goodwill and support of the authorities of SUDENE-GIPM, by which we believe we were able to realize our purpose. On the basis of this investigation this report is field.

3. Fundamental Policy

It is SUDENE that has a subordinate group, abbreviated as GIPM, to develop the state of Maranhao. GIPM is an organization which controls areas under the direct administration of SUDENE with an aim to carry out settlement projects in a most positive way.

During our investigation it was the divergent perspectives between the headquarters of SUDENE and GIPM that came into question in our approach to formulate the basic policy. The former was chiefly interested in the establishment of pulp plants and other phases of the wood industry with which they aimed to carry out economic development in the region, while the latter in the efficient utilization of stumpages that would be cleared away by burning for deforestation, in the processes of which farmers would obtain employment and would be able to derive some amount of income. These two approaches lacked apparent common features, which made the problem complicated.

First of all, the following three essential conditions have to be fulfilled to set up wood processing mills of which a pulp plant is the center:

(a) Satisfactory conditions as to location must be secuable,

(b) Continuous supply of wood with stable quality must be possible at low price,

(c) Sufficient demand for the products or at least development of a new market must be realizable.

As to the first condition, the Ohmi report has proposed to establish a wood industry in Pindare-Mirim, but our careful findings reveal that to our regret Pindare-Mirim would not be the most suitable site as the center of the industry from the social and economic viewpoints, because it is nothing but a small town with inadequate potentiality of industrial power in addition to its poor cultural level, although it is situated along the Pindare river and accessible to Route 22. It is considerably difficult to anticipate development of the north-eastern region only by a large-scale installation of a pulp plant. If self-sufficiency of paper were the goal of their policy, Recife would more likely be the right place, this city being the cultural center of the region. As far as development of the state of Maranhao is concerned, Sao Luis, capital of the state, is much better. At any rate, balanced growth of various sectors of industry would be advisable.

In regard to the second condition, it will be better to select a center of development in some other region where better forest conditions have been maintained and exploitable overcutting has not been started, if supply of industrial wood is imperative. It should not be overlooked that both first and

second conditions would not contribute much to the efficient utilization of timber from cleared lands in settlements nor to the increase of employment among the farmers. Concerning the third condition, it is necessary to consider export of pulp, wood and wood products, excluding furniture, to other regions or foreign countries because of the poor demand for them in the region. However, the export of forest products would not form a direct connection between settlements and integration of the wood industry.

On the other hand, it would be indispensable to supply continuously a large quantity of wood with a stable quality to a group of mills once a large scale of wood industry were established. For this purpose well-formed logging plans and efficient organization of the logging industry would be essential, bearing in mind that a small amount of logs produced in cleared lands by farmers there will not be able to meet the demand. In other words, a short-term supply of farmers' manpower in the logging operation, for instance, during their slack season, would not be able to furnish enough logs to the mills, and in this way a constant supply of labor throughout the year would become urgent. It is not under such circumstances of the integration of wood industry that the problems of efficient utilization of timber and farmers' manpower would have to be worked out. On the other hand, development of a small-scale wood industry and a small new market for wood consistent with the industry would be what they need to make the best use of timber in the settlements and give them employment.

The headquarters of SUDENE asked us to carry out this project in cooperation with GIPM. We started to work at the office of GIPM in Sao Luis, which became our base. Now we were in a position to draw up a development project for the state of Maranhao, which did not cover the whole area of the northeastern region. In reality the people are rather poor in the state which has much possiblity of development, unlike the desert in the east, and development of the state would contribute much to the progress of the whole area of the northeastern region. However, development of the state of Maranhao will not be realized only by emigrants to the inaccessible areas of it who will engage in logging to clear land for agriculture, but by industrial development. Therefore, it is desirable to start development of industry in Sao Luis which is the largest city in the state with only one but high level of industrial potentiality. This will be the first step to the development of the state of Maranhao.

Luckily enough, a development project has been in progress in the old city of Sao Luis by constructing an industrial center in an adjoining area instead of destroying the old streets of it. An office in charge of developing the state of Maranhao is abbreviated as SUDEMA. Improvement of Itaqui port is a good example of this project. It was due to the progress of the project that the establishment of a wood industry with a pulp plant as the center of it was drawn up as a plan.

In this case logs can be transported to the port at low cost, making use of roads, rivers and sea from the forests in

the interior of the state of Maranhao via Pindare-Mirim. It is needless to say that construction and maintenance of roads is essential to secure the supply of a large quantity of wood, thereby increasing the efficiency. Construction of a wood transport-ship is also desirable for the purpose as logs can also be transported from Belem and other primary points.

On the other hand, it is desirable to establish at first a sawmill of medium scale, a flooring mill, and a furniture factory in Pindare-Mirim, aiming to make posible the efficient utilization of wood from cleared lands and to increase employment of farmers in the area. Furthermore, Pindare-Mirim would become an advanced base to develop the state by industrialization, gaining experience of operation of the wood industry. In this way this project can kill two birds with one stone.

At present stumpages in the reclaimed land are burnt up. However, gradual improvement of this wasteful way of clearing should be made by starting selection of commercial tree species from the woods which can be transported to the mills in Pindare-Mirim for processing, instead of a drastic measure to utilize completely all the wood to be cleared from the beginning.

A similar moderate project is also desirable in establishing the wood industry in Pindare-Mirim. Enlargement of the business should be carried out step by step, after confirming fully the possibility of success at the next stage. Only through this basic process will Pindare-mirim be able to supply wood to Sao Luis and others.

In parallel with the establishment of the mills, organization of the logging industry must be dealt with, starting on a small scale as already suggested. For progress in this, roads will play a decisive role in transportation of wood and wood products. In fact it is apparant that roads connecting the forests in the interior of the state of Maranhao with Sao Luis will determine the success of development of the state. Particularly, a waterway in the Pindare river as well as Route 21 and 22 have to be maintained in good condition in all seasons. As to this, in this report some valuable suggestions are made. Transportation systems in this region are of vital importance, since they will be the main arteries in the regional development that ties Sao Luis with the interior.

The former forest lands which were cleared for cultivation annually might be in danger of running to desert under the weather and soil conditions of the state of Maranhao, and excessive rotation of crops without appropriate fertilizers will eventually reduce fertility of the land. Therefore, the best way to prevent this catastrophe would be to apply crop rotation side by side with aforestation. It is also suggested in the report that following the harvesting of commercial trees which will be the raw materials for the wood industry, burning of the forests should be done to make the land rich, which will return to the former forest lands after having been cultivated certain periods.

Finally, it can be concluded that the time might come when mere management of forest resources along Route 22

would not result in sufficient utilization of the forest resources in the state of Maranhao. On this assumption a remark is added to the report recommending establishment of a base to develop the forest resources along the Gurupi river be considered as the second step to the over-all utilization of the entire forest resources in the state.

4. Acknowledgements

All our work for the project has been supported by a large number of people. First of all we express our sincere thanks and appreciation to the officials of the administration concerned of the Brazil Government. Particularly, we appreciate tremendously the help of SUDENE. Above all, we would like to give warm thanks to the young officials of GIPM who not only traveled with us and helped us in every investigation, but also deliberated and entered into discussion with us so earnestly that we were much impressed with their enthusiasm. In addition to the Government officials we enjoyed the close support of many people, public and private, in Brazil.

We feel indebted to the officials of the Japanese Embassy and Consulate-general in Brazil for their helpful advice and assistance. Our investigation could not have progressed so smoothly as it did without them. Thanks are also due to the Japanese residents who supported us sincerely as well as to the members of JAMIC who taught us a lot of valuable things stemming from their comprehensive experience in Brazil.

It is needless to say that the good results we were able

to obtain in this investigation owe much to the support of many people, and we shall long remember their friendship extended to us. In particular we were deeply impressed with earnest activities of young people we came in contact with during our stay in the country, and we cannot but pray for a rosy future of this country of Brazil with abundant resources and huge potentiality of development.

Space limits do not permit us to enumerate the names of all the people to whom we owe much, but we are greatly indebted to them.

It was only the results of an experiment on cooking of pulp that the Ohmi team made from samples of wood they obtained in the Amazon basin during their short visit to the country. However, we were able to bring home a large number of samples of tree species we directly encountered in settlements, of the quality of which we carried out experiments to clarify possible uses of the woods. Here we express our appreciation of the cooperation of members of the Wood Technology Division of the Government Forest Experiment Station, and tender our thanks to the research staff of the Research Institute of the Jujo Pulp Company for their experiments of five-stage mixtures and cooking of pulp by the kraft method.

Log of the Survey

TUE	March 14	Arrival in Rio de Janeiro
WED	15	Visit to the Rio Office of ISHIBRAS Co. and Mitsui Bussan Co. for making a market research
THU	16	Call at the Jardin Botanico and inspect the tree species there. Visit to the Japanese Embassy, Foreign Ministry, and the SUDENE branch office for making survey arrangements (leave Rio de Janeiro and arrive in Sao Paulo)
FRI	17	Call at the Sao Paulo Institute de Pesquisas Technologicas and make study of tropical wood
SAT	18	Survey of wood utilization and price structure at the Maeda Furniture Workshop and the Enussani Sawmill
SUN	19	Survey of the economic conditions in north Brazil; maker research at the Chamber of Commerce and Industry
MON	20	(Leave Sao Paulo and arrive in Recife) Visit to the Japanese Consulate General
TUE	21	Hearing of the situation in north Brazil at the Consulate General. Visit to the SUDENE and arrange for the survey schedule

WED	March	22	Hearing of the situation at SUDENE and the GIPM. Study of the wood of north Brazil at the ITEPE
THU		23	Adjusting the data. Arrangements at Consulate General (leave Recife and arrive in Sao Luis)
FRI		24	Arrangements for the survey
SAT		25	Hearing of the situation of settlement at the office of the Japanese Medical Survey Team
SUN		26	Survey of the general conditions in Sao Luis
MON		27	Discussion at the SUDENE and the GIPM to determine the survey schedule
TUE		28	Visit to the SUDEMA
WED		29	Survey of the concrete telephone pole factory, machine repair shop, and the furniture factory supported by the Government and the Maior Sawmill
THU		30	Arrangements for the survey schedule in the interior, and on-the-spot inspection of construction work of new port at Itaqui. Also survey of water supply capacity and filtration plant at Batatan
FRI		31	Arrangements for the aerial survey schedule. Call on the State Governor and the Director of the Industrial Center

SAT	April	1	(leave Sao Luis and arrive at Alto Turi) Aerial survey of the forests in the Alto Turi area; hearing of the situation in the area
SUN		2	Survey of the forests in the Alto Turi area
MON		3	(leave Alto Turi and arrive at Zedoca) Zedoca party makes aerial survey of the settlement; hearing of the situation at the Agricultural Experiment Site. Bacabal party leaves Zedoca and arrive at Bacabal. Call at the Bacabal County Office; Inspection of the industry, visit to the Statistics Office to collect data
TUE		4	Zedoca party leaves Zedoca and arrives at Cocalinho, inspect the saw-mill directly managed by the SUDENE; arrange for the collection of the test pieces. Leave Cocalinho and arrive at Zedoca. Bacabal party surveys the saw-mill and market of wood and paper
WED		5	Zedoca party surveys the movement of population and weather pattern. Bacabal party leaves Bacabal and arrives Pindare-Mirim. Call at the Contry Office there; collect data at the Statistics Office
THU		6	Zedoca party leaves Zedoca and arrives at Pindare-Mirim. Call at the County Office;

			survey general conditions, port, saw-mills of box wood, wood market, wood utilization and wood price. Visit to the Agricultural Experiment Station
FRI	April	7	Survey of the furniture workshop directly managed by the SUDENE. (leave Pindare-Mirim and arrive in Sao Luis)
SAT		8	Adjustment of the data
SUN		9	Survey of the Japanese settlement in the suburbs of Sao Luis, Survey of the situation of building construction work in Sao Luis (leave Sao Luis and arrive in Belem)
MON		10	Hearing of the situation at the General Consulate; wood market at the branch office of Mitsui Bussan Co., and settlement in the Sao Paulo branch office of the Japan Emigration Service (JAMIC)
TUE		11	Survey of Belem port, wood from Amazon at Museu Goeldi, soil and land fertility at the North Brazil Agricultural Experiment Station. On-the-spot inspection of the construction work of the Japanese-Brazilian match workshop
WED		12	One party surveys the settlements, progress of forest development and wood sup-

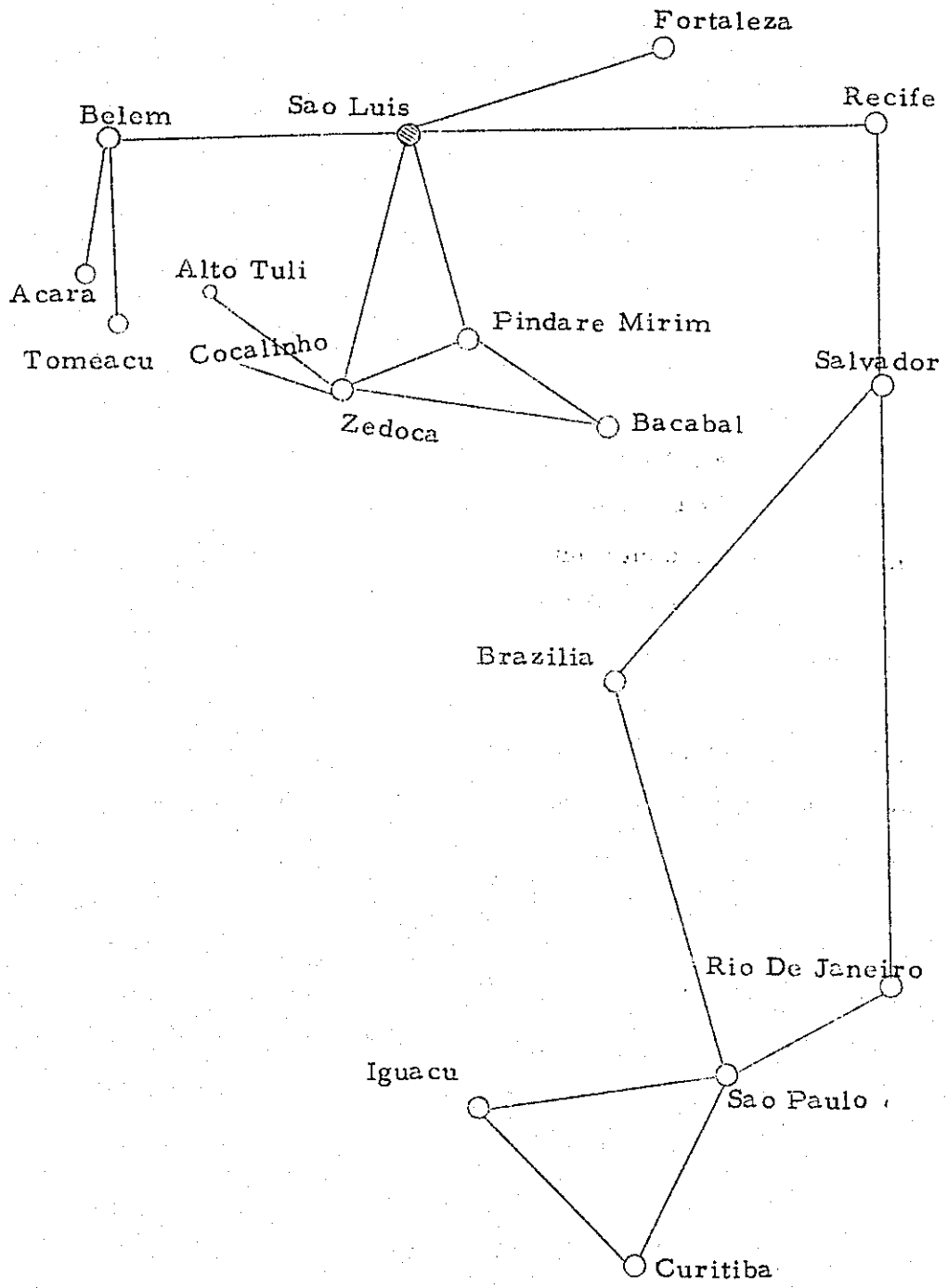
			ply at Tomeacu under JAMIC The other party calls at the SUDAM. Inspect development administration; survey of the wood market at the Belem branch office of Mitsui Bussan Co.
THU	April	13	One party leaves Tomeacu after surveying the settlement and arrives in Belem to survey the wood furniture market at the Yamada Furniture Workshop and several furniture stores. The other party at Belem calls at the Statistics Office of the state of Para to collect data
FRI		14	Survey of the pulp and paper manufacture at the Pulp-plant FACEPA
SAT		15	Inspection of the settlement to develop forests at Acara; survey of the ecology and market of the agricultural and forestry products from the area
SUN		16	(leave Belem and arrive in Sao Luis) Aerial Survey of the forests and the development
MON		17	Rearrangement of the survey schedule. Adjustment of the data
TUE		18	Adjustment of the survey instruments, materials and the data

WED	April	19	Zedoca party (leave Sao Luis and arrive at Zedoca), resurveys the forests and make experimental logging Sao Luis party collects materials and computs the data
THU		20	Classification and study of the test pieces sent from Zedoca. One party leaves Sao Luis and arrives at Fortaleza to visit the Dean of the Ceara University School of Economics. Survey of the development conditions of the state. Call at the Fortaleza branch office of the SUDENE and Northeastern Brazil Development Bank
FRI		21	Study of the wood and survey of the wood market. Zedoca party leaves Zedoca and arrives in Sao Luis. Fortaleza party surveys the conditions of the urban area and the port.
SAT		22	Survey of the furniture stores. Adjustment of the data. Fortaleza party surveys the wood market. Leaves Fortaleza and arrives in Sao Luis.
SUN		23	Discussion on the collected data to decide a developing plan.
MON		24	Visit to the Director of the Industrial Center. Discussion on the data of the industry

			of the state of Maranhao; guidance in the manipulation of the instruments; preparation for the discussion to be held on April 25
TUE	April	25	Discussion with the officials of the GIPM to evaluate the conclusion. The SUDENE to determine the test pieces to be sent to Japan
WED		26	Adjustment of the data
THU		27	(leave Sao Luis and arrive in Recife) Visit to the Consulate General. Interim report on the outline of the survey. Arrangement of the survey schedule
FRI		28	Call at the Nippon Reizo Co, and the Training Center of Fiber Industry; hearing of the situation. Arrangement at the SUDENE
SAT		29	Arrangement for the survey
SUN		30	(leave Recife and arrive in Salvador) Call at JAMIC; hearing of the forestry and the wood market in the state of Bahia
MON	May	1	(leave Salvador and arrive in Brazilia) Inspection of the city and market
TUE		2	Hearing of the situation in Brasilia at the Japanese Embassy (leave Brazilia and arrive in Sao Paulo)
WED		3	Interim report on the outline of survey; arrangement for the survey at the Consulate General; hearing of the situation at the settlements.

			Discussion of plywood production with the director of the plywood plant
THU	May	4	Hearing of the situation of the settlements in the south at the branch office of JAMIC and arrangement of the survey
FRI		5	Hearing of the situation at the ASPLAN. Inspection of the American Saw-mill; market research at the Madeirex Lumber Wholesaler; survey of the wood price and quality
SAT		6	Discussion with the heads of the Japanese North Brazil Development Conference
SUN		7	(leave Sao Paulo and arrive at Iguacu) Survey of the forest conditions; hearing of the silvicultural conditions at the Iguacu branch office of JAMIC
MON		8	Survey of the logging industry and the second growth, and transportation of logs by the Parana river (leave Iguacu and arrive at Curitiba)
TUE		9	Survey of the southern forests and the wood market at the Parana forestry college; survey of the yield rate, efficiency, price and quality of the plywood plant at the Madeiras Compensado and Codega Survey of the mechanized logging industry at Catapila de Curitiba

WED	May	10	Hearing of the situation from Dr. Lucas A. Tortorelli, F.A.O. Hearing of the timber utilization and situation in the south and north from the professor of the field at Curitiba Forestry College. Call at the CODEPA and collect data; survey of the largescale tree planting program of the state of Para Hearing of the situation in southern Brazil at the Industrial Union of the state of Para (leave Curitiba and arrive in Sao Paulo)
THU		11	(leave Sao Paulo and arrive in Rio de Janeiro) Interim report on the outline of the survey at the Japanese Embassy
FRI		12	Adjustment of the data and the arrangements for the survey
SAT		13	Ditto
SUN		14	Departure from Rio de Janeiro


Fortaleza
Belem
Sao Luis
Recife
Acara
Alto Tuli
Pindare Mirim
Tomeacu
Cocalinho
Salvador
Zedoca
Bacabal
Brazilia
Rio De Janeiro
Iguacu
Sao Paulo
Curitiba

Chapter II Development Project of Wood Industry

As was stated in the previous chapter, development of forest resources in the state of Maranhao will not always be advatageous, compared with that of other states. In the state of Maranhao, which is not blessed with other natural resources and to which the importation of the primary products economically from the other states is not so convenient, industrial development in and around Sao Luis will be essential in order to make possible and advance a higher economic structure there. The forests are very important resources in the state that can contribute much to reach the goal.

At present techniques of logging as well as transportation have not been developed, and surveys of the forest resources in the state have not been sufficient. Therefore, it will be too early now to combine development of the forest resources directly with that of industrial city in Sao Luis at the present stage of a mere planning. For this purpose, a number of prerequisites must be established. The problem in this case is in the processes of taking in hand the prerequisites one after another to develop the wood industry step by step within the constraints of possibility. If the above-mentioned direction were looked for, what project would be right? We would like to study the matter in the following sections.

1. Timber Resources in the Area under the Direct Control of SUDENE

A greater part of the forests in the state of Maranhao

except for the babacu forests and swamps near Sao Luis in the north are classified in the Amazon tropical rain forests and are rich in tree species. Therefore, almost all of them are broad-leaved forests. In average there are more than two hundred tree species in one hectare of it. Forest resources under direct control of SUDENE are located in the same region, but surveys of it have been imcomplete and with poor data. Definitely, aerial photographs and analysis of it are necessary to throw light upon these vast forest resources, but such data have not been available. We tried to determine the timber resources under SUDENE and the possibility of their utilization on the basis of our observation and survey with information of forest survey by GIPM.

According to the surveys carried out by Dr. Hildebrand with GIPM by setting up a belt of sample plots around Zedoca, usable volume of stumpages with DBH over 25 cm. excluding crown ranges from 127 cubic meters per hectare to 343 cubic meters per hectare. In average 220 - 330 cubic meters. Kind of tree species are many and comprise common and majestic ones, but their distributions are not averaged. Tree species from eight sample plots are shown in Table 1, in which volume and number of each tree species per hectare are also set forth. From this Table volume of the cut by species will be estimated.

Actually, we broght home samples of various tree species obtainable through GIPM from logging in the state to clarify their scientific names of the species and the possiblility of their being commercially valuable. It is these characteristics

that determine the extent of uses of the tree species in the wood industry, and in consequence the future of the development project of the wood industry under consideration, the results of which are shown in Table 2. As can be seen, there are many tree species not available for sawntimber or plywood.

It is well-known that saw logs and logs for plywood are more valuable than pulpwood, so that right tree species should be allocated for the desired use. Those tree species suitable for pulpwood are classified in Appendix after experiments were made. Some tree species in the Table are difficult to cook and the yield rate is not good. However, they can be utilized if an appropriate means of cooking were chosen. Considering all these characteristics in relation to market conditions in Brazil, the uses of each tree species are shown in Table 2. Such tree species without any remark in the colume of uses are considered to be usable for pulpwood and wood for hardboard. Total volume of each tree species by uses are illustrated in Figure 1. The constitution of them is a little worse than of those to be produced from the Amazon basin. Incidentally, our observation and experiments revealed that their quality is not so good as that obtainable from Amazon. However, they can be considered sufficiently suitable as raw materials for the wood industry. As already mentioned, growing stock of the forests in this region are not excellent among those under direct administration, as seen from the sky, but can be classified between A class and B class shown in Fig. III-1. It is considered that the greater part of the forest resources under the direct adminis-

tration are more or less similar to this class.

It was during the rainy season that we came to the state, so that we could not carry out a large scale of experiments on logging. Nevertheless, it will be safe to estimate that the average of the growing stock per hectare by suitability classification of uses would be those as shown in Table 1, although some modification might be necessary as to the species and growing stock ratio which will be utilized in the progress of development. However, on the classification of uses in Figure 1 we have laid our plans for the development.

In reality, growing stock per hectare in the deep forests of Pindare area seems larger than that in Figure, and that along the Rio Gurupi valley. Better quality for lumber and plywood seems to be also larger than that in the Figure. However, we can say that there is no reliable data at all at present that can evaluate our figures and tables, which were made to the best of our ability and were the base of our development project.

2. Stages of the Development Project

If the conditions of the forest resources and utilization of the forest products were approximately those set forth in the previous section, there could be several plans of industrial development, because there are vast forest in the state upon which any plan can depend, even consuming excessive volume of timber. The resources would not be exhaustible in the near future. Even allowing that, we should not forget that once mills started operation, continuous supply of wood will be essential daily to turn out a certain amount of products from them. It

is under these circumstances that a concrete shape of logging project has to be taken, for the purpose of which manpower, equipment and transportation facilities have to be secured.

On the other hand, a seed of modern wood industry has to be sawn and raised to attain more sound industrial growth.

The wood industry at present in the state of Maranhao still appears to be primitive, and it is rather dubious that even people engaging in the production of lumber and furniture have kept up with the progress of modern wood industry. Therefore, while the sudden establishment of a group of large mill complex could be undertaken, full and efficient operation of them would be extremely difficult. This being so, it is proposed to divide the whole processes of development into three stages with an aim to achieve a gradual but systematic growth of it. At each stage preparation for the next stage of development would have to be made, working out every problem of prerequisites for it to the extent that construction of the next stage would become resonable.

The first project demands establishment of a saw-mill, a flooring mill and a furniture factory near Pindare-Mirim, location of which should be the closest to the area under the direct administration. Pindare-Mirim is now a target of development to be undertaken by SUDENE. This city, having a population of 8,000, can be reached not only by road but also by a waterway. It will be an important transit base for the transportation of logs when the integration of wood industry is accomplished in Sao Luis in future. At present agriculture is

the center of industry of the city, and the level of its techniques is, frankly speaking, not high, with two saw-mills equipped with circular saws to saw hewn square and lumber. The volume of logs passing this point or consumed in this neighbourhood has reached 25,000 cubic meters per year only through irregular and primitive business transactions. In addition to the industrial techniques, the level of culture also has not made good progress.

The amount of water available from the Pindare river has been ample and industry of any kind can be fully supplied with water. When a power-generating station which is now under construction at Boa Espelansa is completed, the city will be able to purchase electric power advantageously because of its short distance from the station. However, other points that were not enumerated here indicate disadvantageous terms of industrial location of the city. In other words, if a large-scale mill or a group of mills were established here, they would have to import many skilled manpower from other regions. If employees of the mills wished to enjoy standard of cultured life, they will not be able to settle down in this place. Especially, it will be extremely difficult to employ skilled engineers. Moreover, waste materials outflow from the uncomplete pulp plant may prevent fishing down stream of the Pindare river, and long and poor transportation facilities caused by poor demand in the area may adversely affect the quality of the products. From the foregoing it will be seen that there are many problems in establishing the wood industry here, considering

all these circumstances together.

On the other hand, this city is vitally important as a transit base from the standpoint of connecting Sao Luis industrial project with development of the forest resources in the area. It will be indispensable for the growth of the city to train the personnel to acquire experience in wood processing and marketing, and to form the way of thinking among the inhabitants so that they pay much attention to the industrial utilization of wood.

As a preliminary step it is suggested first of all to construct a saw-mill that can be operated with low level of techniques, and a flooring-block mill in relation to it, both of which turn out primary good saleable in other areas. In addition to it, a furniture factory should be established to meet local demand for the products.

As to supply of logs, only valuable tree species as sawntimber should be cut, and the rest burnt up. Thus, the way of harvesting is to start from the conventional stage of procedures and go up to the latest and advanced way of development, this being the most feasible process to follow.

When this project is successfully accomplished, another set of similar mills should be established to attain a position of the base of lumber at Pindare-Mirim. A series of activities up to this stage is considered to constitute the first project, which will help economic improvement of Pindare as the center of regional agriculture.

It is after the stage of the first project that wood

industry would be established in Sao Luis, which is the capital of the state of Maranhao with a population of 350,000, enjoying a living and clutural standard far superior to that of Pindare. Concerning industrial techniques, it is only a technical school that has been established in the city as an educational institute for the manufacturing industry. However, an auto-repair shop under the management of SUDENE, palm oil factory, coca-cola factory, and so on are under operation. It should be noted that it would be possible to employ some of the citizen in the new industry.

As already mentioned, industrialization of Sao Luis is greatly important to develop the state of Maranhao. It is due to the growth of the sugar industry that Recife has grown from a small city like Sao Luis to be the fourth largest city in Brazil with a population of one million. There is some possibility of achieving similar progress in the development of Sao Luis by utilizing primary goods from the forest resources in the state to work up a wood industry. This could be a short-cut to success. We will take this as a start of the second project, and will describe it further now.

Our first and basic aim is to utilize logs. This leads to the integration of sawmill, flooring mill and furniture factory as the initial and essential plan. In parallel with them, it is advisable to install a plywood plant to export the products to the United States of America. In addition to them, a pulp plant which utilizes wastes from the sawmill and such tree sepcies not available for lumber and plywood, and a particle-board

plant which makes use of wastes from the plywood plant with comparatively homogeneous quality should be set up. Saw-dust should be dumped. In future it may be made use of to turn out compressed fuel or briquettes which will be in demand as low priced fuel. This mill being close to the city, the cost of the fuel will be eased considerably.

Along with them it will be of utmost importance to ensure an adequate supply of water to the industry. The capacity of water supply in Sao Luis is now 25,000 cubic meters per day and will be increased to 56,000 cubic meters per day when a reservoir at Batatan starts to function. Deducting essential water for daily life which is estimated to reach 35,000 cubic meters, 21,000 cubic meters of water would be available for other use per day. However, 50,000 tons of water is necessary for turning out 100 tons of pulp, hence a shortage of water problem will have to be solved.

Obviously, it is essential to supply enough water for any industry in industrial city planning. Our investigation could not reveal that a water supply program has been contemplated in the case of industrial city planning next to the Itaqui port. If a complete water supply program has not been given consideration, it is hoped that one independently from our project will be worked out.

This island being rolling, not to speak of an example of reservoir at Batatan, it is presumably possible to construct a reservoir and a waterway from rivers close to it. Under these circumstances, water supply program and construction works

should be started as one of the prerequisites of pulp plant construction, concurrently wit the progress of the first project.

Next to be taken in hand is the construction of a port at Itaqui. It is a considerably long time since the construction work started. Upon completion of the work, machinery, construction materials and various kinds of raw-materials would be easy to import, resulting in saving much time for the construction of mills and smooth operation of wood processing.

According to the present project, ship berths with the capacity of 5,000 tons is under consideration, but construction of one with 20,000 tons capacity is desirable. When transportation net-works became sufficiently developed, it will be possible to make pulp chipes from surplus wood in the mills and export not only them but pulp or other products to foreign countries. Inversely, when pulpwood is in short, they will be able to import pulpwood or chips from other regions.

Secondly, it is desirable to construct an all-weather road or waterway between Pindare and Sao Luis. Present road can not be used during the rainy season and even during the dry season the road surface is not solid enough for a heavy truck. This road has to be improved as soon as possible.

It the case of a waterway through the Pindare river, transportation would be more convenient and cheaper. At present, transportation cost of commondities by land between Pindare and Sao Luis is three times as high as that by water. It a exclusive transport-ship were employed for wood, freight rate would be much lowered.

The Pindare river is high but there are shallow waters at several places on the way, and that would have to be remedied. If 500 cubic meters of wood had to be transported daily by water, special type of raft which will be described later would be worthy of consideration. The merits of water transportation of logs is that immersion in water prevents deterioration of the quality, but some measures for transporting a large amount of logs and that for sinkers would have to be worked out.

Some long time will elapse before the third project can be taken up, when, for instance, expansion of the wood industry in Sao Luis might be attained in the new situations in that time. In this report a blue print of a completely new city of wood industry is to be considered, construction of which depends upon the progress of development of the forest resources along the Gurupi valley and other forest resources, excluding those from which logs are transported through Pindare.

This city is to be built artficially as a center of wood industry on a scale much larger than that of Sao Luis. To such center a hard-board plant should be added. Assuming this kind of integration of wood industry can be achieved in Sao Luis, modification, when needed, will be easy. Candidly speaking, a log supply project is more important than a blue print of plant arrangement.

3. The First Project

In the first project the establishment of a sawmill with

a flooring mill and a furniture factory was proposed to lay the foundation of the development. The location of the integrated wood industry is on the westside of the intersection of both Route 22 and the Rio Pindare river which will be used for the transportation of logs to Sao Luis. Another way to establish it is in Pindare-Mirim, in the case of which a small landing place where loading and unloading will be feasible in all seasons will have to be constructed and a log pond next to the mills. It is desirable to keep in store logs for as much as three months' operation of the industry in the log pond. Estimating the capacity of storage of logs as 0.3 cubic meter per square meter, then the first stage will demand 18,000 square meters and the second stage 35,000 square meters of log pond, respectively, as will be explained later.

The scale of the sawmill is proposed to be medium in principle at first, because at this stage demand for lumber would not be enough, and forest workers will not have much experience of logging.

Growing stock of the forest under the direct administration in log volume is 220 cubic meters per hectare in average, among which that of sawn timber is approximately 90 cubic meters. At the initial stage of development it will be difficult to harvest and haul all of the sawn timber from the forests; about 20 per cent of them will be left in the woods with such tree species as are not suitable for lumber, both of which will be burnt up eventually. If one hectare of forest stand be cut per day, logs to be transported to a sawmill would be 70 cubic

meters per day. If yield rate of sawing were assumed 65 per cent, 45 cubic meters of lumber would be obtainable. Flow sheet of this case is illustrated in Figure 2.

Equipment, site, and allocation of manpower are set forth in Table 3. In this area the rainy season lasts about six months during which time timber production will be halved and even during dry season incomplete logging system would make necessary the storage of logs for three months, totalling 5,300 cubic meters. A log yard with this capacity will be needed. However, considering termite damage and decay, a log pond would be advisable.

Roughly 70 per cent of logs transported to sawmill would be suitable for furniture, so that a pretty large furniture factory can be operated. But distance from here to other states or Sao Luis is so long that merits of production cost would be offset by transportation cost. Consequently, furniture production will have to be restricted to meet local demand for it from Pindare-Mirim, other local communities, and people in settlements. Production of 4 furniture will be 1,200 a year, which will be sufficient for the demand. Equipment, site, and manpower for the factory is shown in Table 4. (This factory may produce more furniture or furniture parts for future.)

Tree species available for flooring in the state of Maranhao and under direct administration are Pau amalero, Sucupira, and Totajuba, the total volume of these trees being assumed to be only 6 cubic meters per hectare. Therefore, establishment of a flooring mill is omitted, and it is suggested that logs suitable for flooring would be ripped or cross-cut by

surplus capacity of the sawmill to meet the local demand for flooring. If production and export of parquet were pursued, a parquetmill can be built, making use of many kinds of tree species around it. But a dry kiln and such techniques higher than those of sawmill production would be needful in this case. It will be better for them to take it up at the second stage of the first project.

After the first stage has got a good start in the right direction, another complex of sawmill, flooring mill, and furniture factory, should be established at the same place. The flow sheet in this case is illustrated in Figure 2. The items of each mill could be similar to the former one and equipment, site, and allocation of manpower of flooring mill is shown in Table 5. (The plan of parquetmill is as shown Ohmi report)

4. The Second Project

With the integration of a wood industry attained in Sao Luis, and the first project under stable operation, the second project would start. At the same time, at the interesection of the Pindare river with Route 22, a log yard should be constructed with necessary and sufficient area together with loading facilities, which is operational throughout all seasons.
The log yard should be a log pond with capacity to handle sinkers as will be described elsewhere. The storage capacity of it is suggested to be 30,000 cubic meters, and an area of at least 100,000 square meters would be required. In addition to

it, another 10,000 square meters of site will be necessary to establish other facilities and a temporary log yard. It is needless to say that improvement of waterway of the Rio Pindare river and that of road surface of Route 22 as well as building of a bridge over the river are much needed.

The integration of wood industry at this area includes a sawmill, flooring mill, furniture factory, plywood plant, particle-board plant and a pulp plant.

The furniture factory aim is to meet demand in Sao Luis and its daily production is limited to 8 sets, the contents of which being not different from the previous stage. But another line of production will be added to it.

The flooring mill will produce parquet for export in addition to the main products for local demand, activities of which will remain unchanged as in the second stage of the first project.

The initial set of a sawmill, flooring mill, and a furniture factory will expand to two sets as shown in Table 3 and 4, and another set as shown in Table 5. Although they operate in the same building, each mill can be independent.

Growing stock of tree sepcies suitable for plywood production is show in Table, being about 30 cubic meters per hectare. Assuming harvest of 2.5 hectare of forest stand per day, volume of logs to be transported to the plant will be 75 cubic meters per day. Estimating the yield rate being around 50 per cent, about 38 cubic meters of the products will be manufactured each day. The rest of the logs would be transported

to the sawmills. Way of logging in this case being clear-cutting, 90 cubic meters per hectare of sawn logs will be hauled from stands. Deducting 30 cubic meters per hectare of logs for plywood, 150 cubic meters of saw logs will arrive at the sawmills daily by harvesting 2.5 hectares of forests.

A particle-board plant will make use of waste from the plywood plant to manufacture single-layer boards, to the surface of which a veneer will be applied by adhesive to make the products. This commondity has not been on sale in Brazil. One of high quality is needed for export, and steps will have to be taken to open a new market for it.

The capacity of the pulp-plant should be as large as the one described in the Ohmi report, manufacturing 100 tons of bleached pulp per day, 870 tons of printing paper per month, 420 tons of wrapping paper per month and 600 tons of kraft paper per month. The whole flow sheet is illustrated in Figure 3. All such logs suitable for plywood that were collected via Pindare-Mirim should be transported to the plywood plant in Sao Luis. It is needless to say that the pulpwood consumed in Sao Luis would come from Pindare at the same time. Transportation of logs between Pindare and Sao Luis will be made chiefly by water and supplemented by land.

Transportation by water will employ a special raft with tow boat as will be stated later, and particular attention should be paid to transport sinkers by the rafts.

The plans of pulp plant and plywood plant are as shown Ohmi report. Equipment and manpoer necessary for the particle-board plants are illustrated in Table 6.

In the integrated wood industry in Sao Luis a long pond should be constructed with the capacity to store as much as three months' consumption of logs by the industry. It should be designed to handle sinkers by making use of ebb and flow. As to a log yard a remark will be made elsawhere.

5. The Third Project

This project should be carried out when the integrated industry in Sao Luis is able to meet any demand for the products in and out of the country. If the products from the industry were in bigger domand than the capacity of production that was set in the previous project, logging should be achieved to utilize the forest resources in the state of Maranhao along and near the Gurupi valley to be well off in the region, but should strictly avoid transporting logs through Pindare-Mirim because of its high cost. In this state integration of wood industry should be attained at the intersection of Route 22 with the Gurupi river as will be mentioned later. A scale of the industry should be dtermined by the demand for the products. If the scale of it were assumed to be larger than that in Sao Luis, its flow sheet will be like that illustrated in Figure 4. Details of the project were omitted because the future will determine them. The over-all logging project covering three stages is shown in Table 7.

FIG II-1 VOLUME OF USEFUL WOOD FOR EACH USE
(per ha)

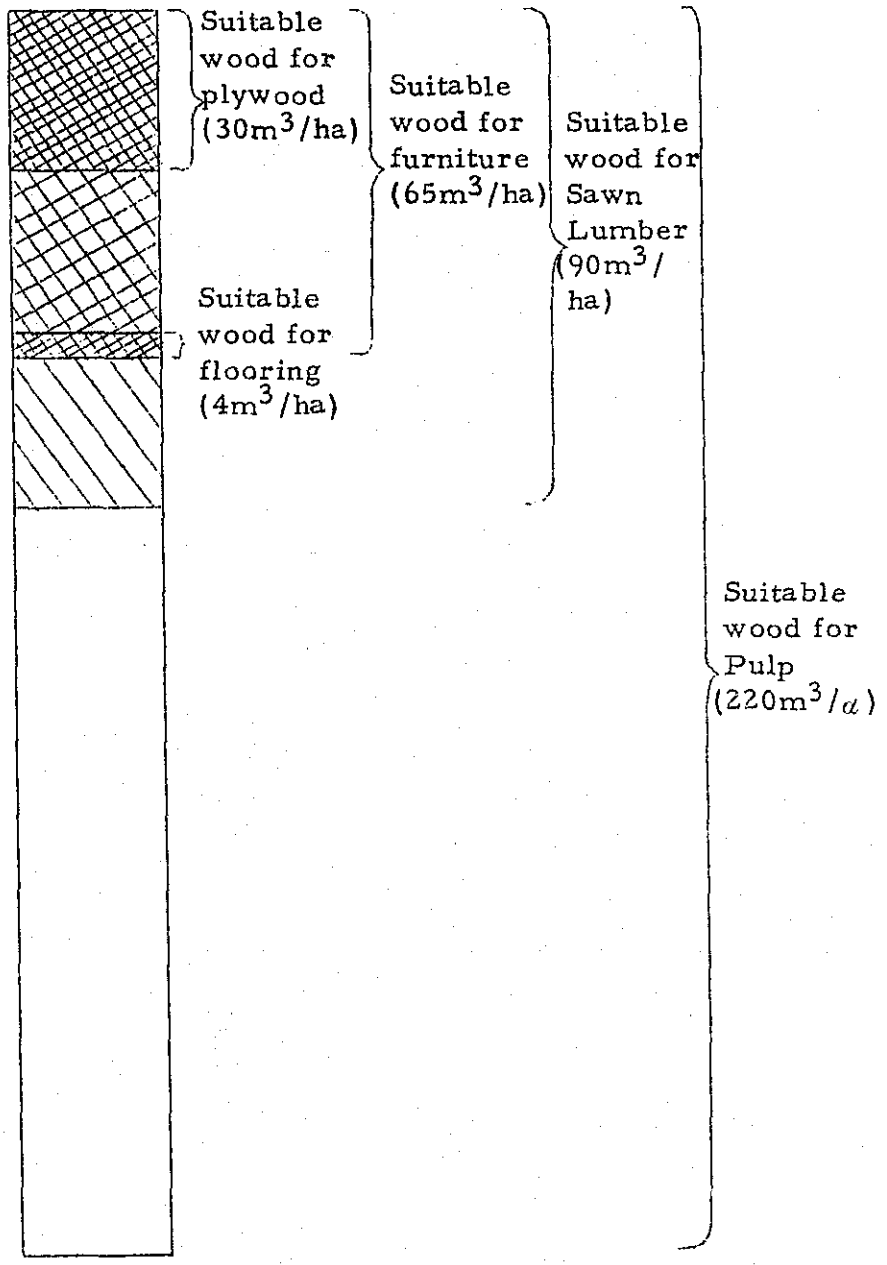


FIGURE II-2

FIG II-2 FIRST PLANNING (1ha/day cutting for each step)

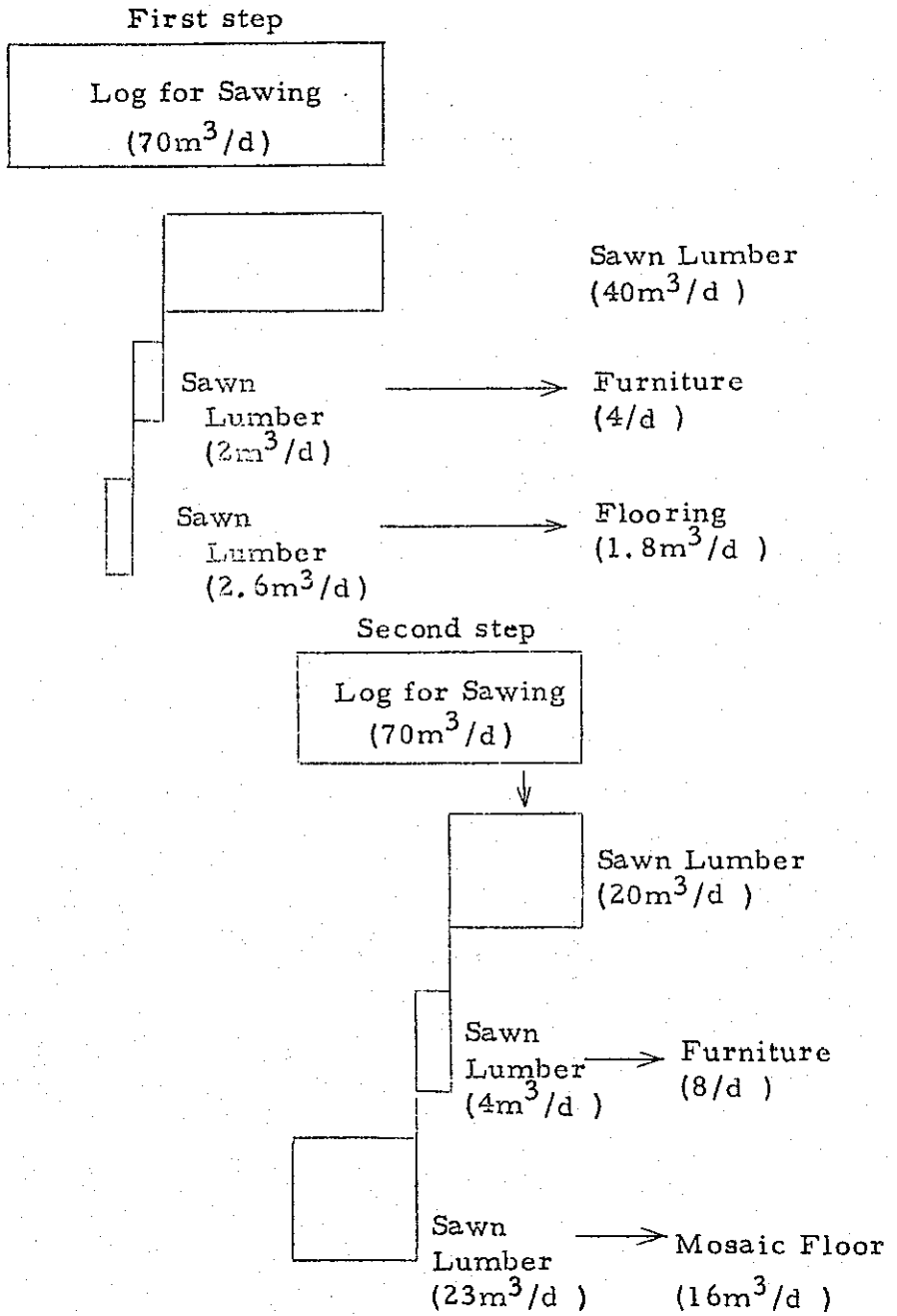


FIG. II-3 SECOND PLANNING (2.5ha/day cutting)

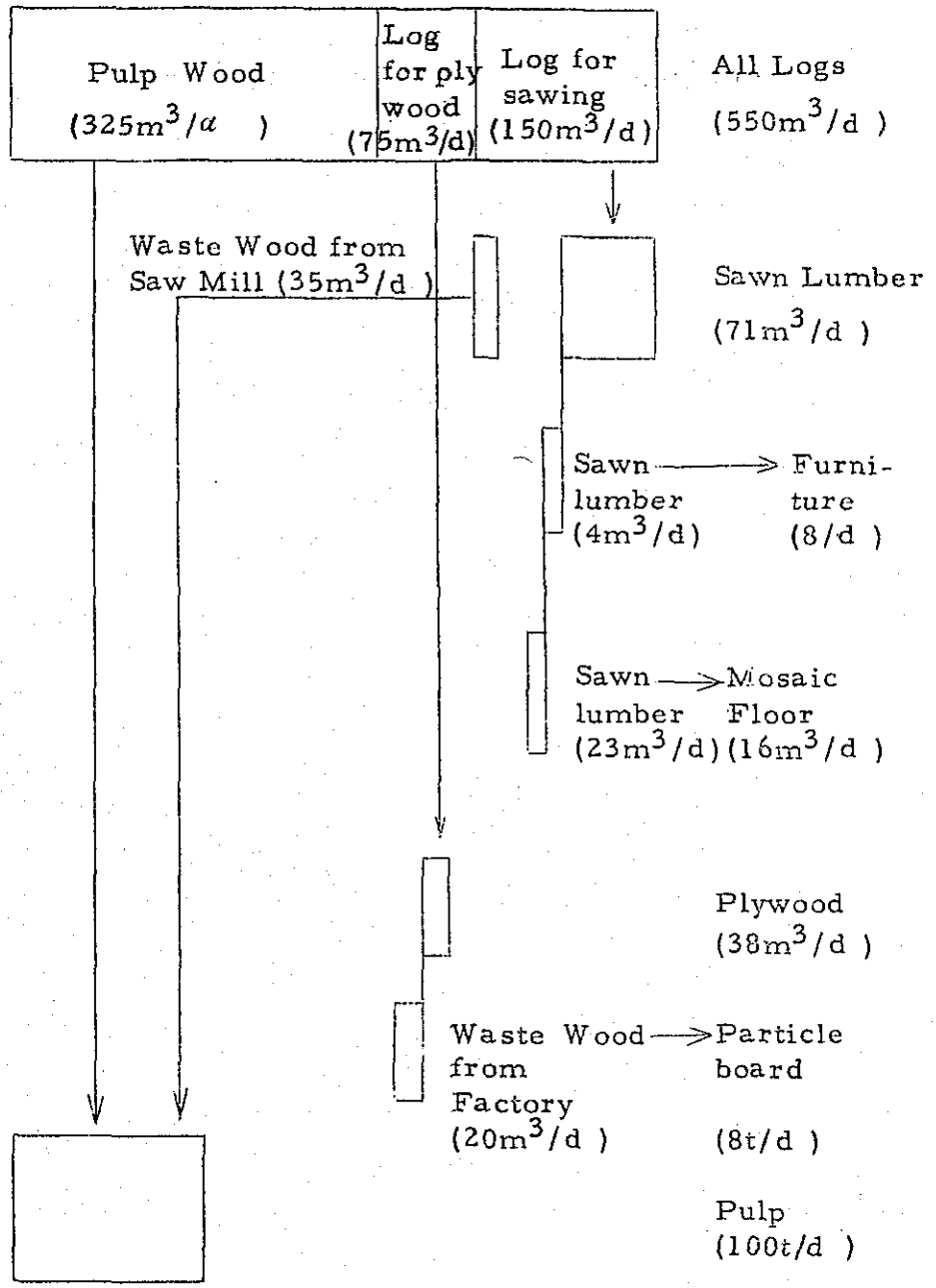


FIGURE II-4

FIG. II-4 THIRD PLANNING (19 há/day Cutting)

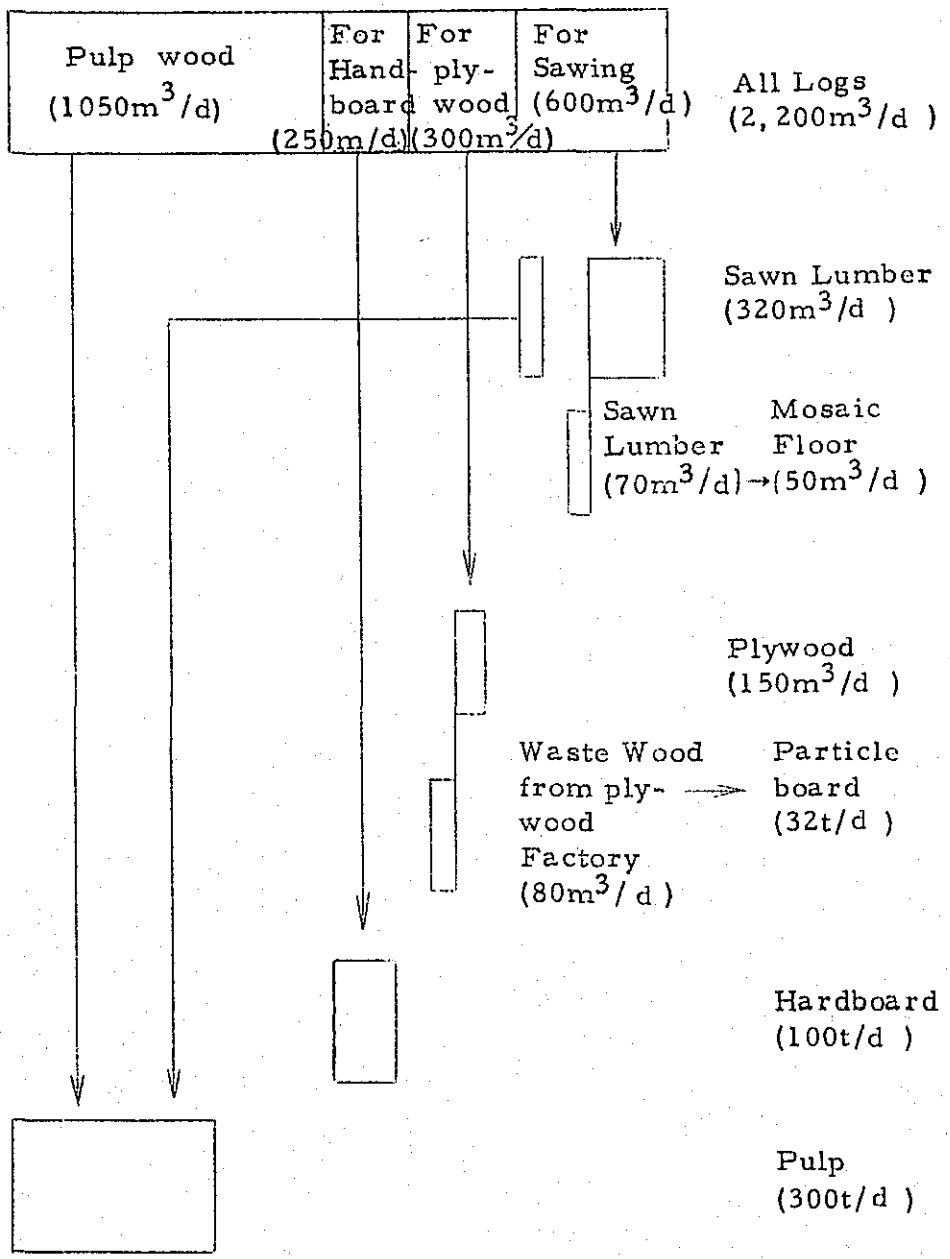


Table II-7 Cutting Plan

Step of Industrization		Cutting Area	Cutting Area (hd/α)	Total of Cutting Area (ha/α)	Cutting Volume (m^3/α)	Total of Cutting Volume (m^3/α)	Remarks
First Planning	First Step	Near the Zedoca	1	1	70	70	
	Second Step	Near Zedoca	1	2	70	140	
Second Planning		Inner Area of Pindare	2.5	4.5	550	690	
Third Planning		Along and near the Gurupi Valley	10	14.5	2200	2890	

Table II-1

Table II-1

Species	Volume m^3/ha	Number no/ha
Acoita cavalo	2.27	1.50
Algodão bravo	0.76	0.25
Almora	0.36	0.38
Ameiju	0.86	0.87
Amesela	1.06	1.25
Andiroba	6.17	4.37
Angelim	1.11	0.38
Angelim d'agua	1.10	0.13
Angelim de coco	1.06	0.25
Angelim brznco	0.18	0.13
Angico branco	0.32	0.13
Angico preto	0.55	0.13
Axixa	1.89	1.12
Bacuri	1.20	0.50
Bacuri pari	0.81	0.63
Barriguda	11.54	0.38
Barroze	9.40	8.61
Barrote vermelho	10.38	9.50
Birabu = envira vermelha	0.10	0.13
Breu preto	0.19	0.25
Broqueiro	0.73	1.12
Buraninha	0.07	0.13
Burangi	3.14	0.50
Burdao bravo	0.37	0.25

Table II-1

Species	Volume m^3/ha	Number no/ha
Cabelo de cutia	0.17	0.25
Cacauzinho	0.30	0.38
Cajueiro bravo	5.23	0.50
Cajuacu (cajui)	21.38	3.87
Capeeira vermelha	0.08	0.13
Catingueira	1.80	1.12
Catuaba branca	0.09	0,13
Cedro rosa	0.29	0.25
Cedro bravo	0.66	0.13
Conduru branco	0.11	0.13
Copaiba	1.38	0.13
Costela de anta	0.25	0.25
Cravo preto	0.05	0.13
Cupiuba	0.95	0.50
Cupuacu	0.97	0.87
Cutiuba	0.46	0.25
Embiriba	0.42	0.38
Embireira	0.55	0.50
Emburaninha	1.03	0.87
Estopeiro	8.09	1.00
Faia	3.35	2.50
Fava	0.05	0.13
Fava de anta	0.07	0.13
Favela	5.67	1.50
Faveira	1.37	0.50
Feijão bravo	0.06	0.13

Table II-1

Species	Volume m^3/ha	Number no/ha
Freijo	0.35	0.38
Gameteira	0.98	0.50
Genipapinho	0.65	1.12
Goiabi nka	0.25	0.25
Goncala alves	0.85	0.75
Imbauba	0.80	0.75
Inga (brenco)	0.06	0.13
Inga bravo	1.78	2.12
Inhare	0.74	0.50
Jaraguba	0.31	0.13
Jatobá	4.53	0.50
Jatoba mirim	6.22	0.87
Juruparana	0.27	0.75
Leiteira	0.76	0.38
Limáozinho	0.08	0.13
Louro	1.34	0.25
Mama caehorro	0.16	0.25
Mamui	0.76	0.38
Mangue branco	2.01	2.12
Mangue (vermelho)	1.74	2.12
Maria preta	0.57	0.63
Macaranduba (vermelha)	0.42	0.38
Macarandubinha	0.11	0.13
Mirindiba	0.37	0.50
Mutamba branca	0.16	0.25
Mutamba preta	0.51	0.87

Table II-1

Species	Volume m^3/ha	Number no/ha
Muriei bravo	0.20	0.25
Murure	0.91	0.87
Paruru	3.65	2.37
Paparauba amarela	5.18	2.25
Paparaúba branca	4.25	1.37
Pau amarelo	4.03	0.87
Pau d'arco (amarelo)	0.24	0.25
Pau d'arco sapucaia	0.50	0.38
Pau negro	0.16	0.13
Pau pombo	10.40	2.75
Pente de macaco	2.66	0.87
Piqui (á)	0.30	0.13
Piquirana	5.34	0.50
Pitomba de leite	1.02	0.63
Sacupembinha	0.73	0.38
Sapucaia	4.52	0.75
Sucupira (branca)	1.16	0.50
Sucupira preta	0.72	0.87
Tamarina brava	0.48	0.38
Tatajuba	0.31	0.13
Tauari branco	19.08	13.62
Tauari preto	26.51	10.37
Tuturuba	0.77	1.00
Total	220.84	106.70

Table II-2

Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Andiroba	Carapa guianensis Aubl. (Meliaceae)	0.53	Reddish brown	D	5 - 7	B	Plywood, sawed lumber, furniture, veneer
Andiroba	Carapa guianensis Aubl (Meliaceae)	0.57	Reddish brown	D	5 - 7	B	Plywood, sawed lumber, furniture, veneer
Amescla	Protium or Couepia sp. (Rosaceae)	0.80	Reddish brown	A	7 - 10	C	

Suitability for processing of Maranhao wood

Table II-2

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Angelim	Andira inermis (sw.) H. B. K. (Papilionaceae)	0.78	Reddish brown	E	30 - 40	D	Sawed lumber, Veneer
Barrote	?	0.87	Reddish brown	A	13 - 15	D	
Burangi	?	1.04	Reddish brown	A	30 - 40	E	Veneer
Casca fina	Aspidosperma sp. (Apocynaceae)	0.82	Light pinkesh	A	10 - 13	C	
Cedre (branca, rosa)	Cedrela sp. (Meliaceae)	0.44	Reddish brown	B	4 - 5	A	Sawed lumber, Furniture
Cedro bravo	Cedrela odorata vel aff. (Meiiaceae)	0.36	Light pinkesh	B	4 - 5	A	Plywood sawed lumber, furniture

Table II-2 Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Conduru	Apocynaceae (Aspido sperma ?)	0.96	Light brown	A	23 - 26	D	
Cravo (preto)	Lauraceae (Ocotea?)	0.91	Greenish brown	A	30 - 40	E	
Cravo amarelo	Ocotea sp. (Lauraceae)	0.64	Yellow	A	7 - 10	B	Plywood, sawed lumber, furniture
Cumaru	Coumarouna odorata Aubl. vel aff. (Papilionaceae)	1.03	Greenish brown	A	20 - 23	D	
Cupiuba	(Cutiuba ?)	0.47	Yellowish red	C	4 - 5	B	Plywood, sawed lumber, furniture
Cupuacu	Theobroma sp. (Sterculiaceae)	0.69	Yellowish white	A	5 - 7	C	

Suitability for processing of Maranhao wood

Table II-2

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Cutiuba	Qualea or Vochysia sp.. (Vochysiaceae)	0.48	Reddish brown	D	5 - 7	B	Plywood, sawed lumber, furniture
Envireira	?	0.74	Reddish brown	D	7 - 10	C	Sawed lumber, furniture
Fnbira	Ceiba sp. (Bombacaceae)	0.15	Grayish white	B	2 - 3	A	Sawed lumber
Embireira branca	Apeiba so, (Tiliaceae)	0.15	Grayish white	B	2 - 3	B	Float, core lumber, sawed lumber
Fstopeiro	Lecythidaceae sp.	0.64	Light pinkish	A	4 - 5	B	Sawed lumber, furniture
Faia (Louro faia ?)	Roupala sp. (Proteaceae)	0.54	Reddish brown	C	4 - 5	B	
Fava de paca	?	0.52	Light pinkish	D	5 - 7	B	Sawed lumber

Table II-2 Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Geniparana	Gustavia angustata (Lecythidaceae)	0.80	Light yellow	A	15 - 20	C	
Gonçalo alves	Astronium fraxinifolium Schott, (Anacardiaceae)	0.99	Redish	C	20 - 23	D	Sawed lumber, furniture, veneer
Guabiju	?	0.99	Reddish brown	A	26 - 30	D	
Guanandi	Lonchocarpus sp. (apilionaceae)	0.83	Yellow	C	23 - 26	D	Sawed lumber
Imbanba branca	Cecropia sp. (Moraceae)	0.16	Grayish white	B	2 - 3	A	
Imbavba preta	Cecropia sp. (Moraceae)	0.36	Grayish white	E	3 - 4	A	
Inga'	?	0.63	Grayish white	C	4 - 5	B	

Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Inharé	Brosimum paraense huber (Moraceae)	1.03	Redish	C	20 - 23	D	Sawed lumber, furniture, veneer
Jacaranda	Jacaranda copaia vel aff. (Bignoniaceae)	0.41	Grayish white	E	2 - 3	A	Sawed lumber
Jatobá	Hymenaea sp. (Caesalpiniaceae)	0.93	Reddish brown	C	26 - 30	D	Sawed lumber, furniture
Louro	Clarisia recemosa R. et P. (Moraceae)	0.75	Yellow	A	26 - 30	E	Sawed lumber, furniture
Louro	Lauraceae	0.76	Light yellow	A	15 - 20	E	

Table II-2

Table II-2 Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Mangue	Parinari or Licania sp. (Rosaceae)	0.84	Greenish brown	C	13 - 15	D	Sawed lumber
Massaran-dubinnha	?	1.19	Brown	C	30 - 40	E	
Massaran-duba vermelha	Manilkara bidentata vel aff. (Sapotaceae)	1.10	Reddish brown	A	13 - 15	D	Sawed lumber, furniture
Mutamba	Guazuma ulmifolia Lam. (Sterculiaceae)	0.36	Grayish white	E	3 - 4	B	
Orelha de macaco	Coumarouna odorata vel aff. (Papilionaceae)	0.94	Greenish brown	C	26 - 30	D	Sawed lumber, furniture

Table II-2

Common name	Scienfitic name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Pau d' arco (amarelo?)	Tabebuia serratifolia (vahl.) Nich vel aff. (Bignoniaceae)	0.95	Greenish brown	A	26 - 30	D	Sawed lumber, furniture
Paparauba	Simaruba amara Aubl. (Simarubaceae)	0.34	Whitish	E	2 - 3	A	
Paparauba branca	Simaruba amara vel aff. (Simarubaceae)	0.41	Whitish	E	3 - 4	B	Sawed lumber
Paparauba amarela	Simaruba amara vel aff. (Simarubaceae)	0.37	Whitish	E	2 - 3	A	Sawed lumber
Pau pombo	Anacardiaceae or Burseraceae	0.58	Light yellow	E	7 - 10	C	

Table II-2 Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Pau santo	Zollernia paraensis Huber (papilionaceae)	1.29	Dark gray	A	23 - 26	D	Sawed lumber
Pente de macaco	Apeiba sp. (Tiliaceae)	0.20	Grayish white	B	2 - 3	B	
Piqui (Piquia)	Caryocar villosum (Aubl.) Pers. (Caryocaraceae)	0.89	Greenish brown	A	23 - 26	D	Flooring, Sawed lumber
Piquirana	Caryocar glabrum vel aff. (Caryocaraceae)	0.80	Yellowish white	A	26 - 30	D	Sawed lumber
Quebra machado	Lecythis sp. (Lecythidaceae)	1.03	Brown	A	23 - 26	D	Sawed lumber

Table II-2

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	Kiln drying period (day)	Cracking	Use
Sacupenbinha	Diallum guianense (Aubl.) Sandw. (Caesalpiniaceae)	0.86	Brown	E	15 - 20	C	
Sapucaia	Lecythis sp (Lecythidaceae)	1.05	Reddish brown	A	23 - 26	D	Sawed lumber
Sucupira	Bowdichia sp (Papilionaceae)	0.89	Reddish brown	E	26 - 30	D	Sawed lumber, furniture, veneer
Tatajuba	Bagassa guianensis Aubl. (Moraceae)	0.98	Yellow	C	15 - 20	D	Flooring, Sawed lumber, furniture
Tauari branco	Eschweilera or Lecythis sp (Lecythidaaeae)	0.93	Greenish brown	C	15 - 20	D	Sawed lumber, furniture

Table II-2 Suitability for processing of Maranhao wood

Common name	Scientific name	Specific gravity (air dried)	Colour	Suitability for cutting	King drying period (day)	Cracking	Use
Urucurana	Guatteria sp. (Annonaceae)	0.51	Grayish white	E	3 - 4	D	Sawed lumber
Vaca amarela	Apocynaceae (Aspidosperma ?)	0.78	Yellow	A	10 - 13	C	Sawed lumber
Vermelinho	Eschweilera sp. (Lecythidaceae)	0.87	Light brown	A	23 - 26	D	
Visgueiro or Burra leiteira	Sapium sp. (Euphorbiaceae)	0.41	Grayish white	E	2 - 3	B	

Suitability for cutting

A	Very good
B	Good
C	Common
D	Bad
E	Very bad

Crocking

A	Very difficult to crack
B	Difficult to crack
C	Common
D	Easy to crack
E	Very easy to crack

Table II-3

Sawing factory

(a) Machinary

Item	Capacity	Number	Power	Price x 1,000 yen	Remarks
Band mill	1,500 m/m	1	75.00kw	2,500	
Auto Feed Carriage	1,200	1	30.00	5,000	
Frame Saw	400	1	75.00	4,000	
Auto Roller Band Resaw	1,100	1	23.50	1,500	
Auto Roller Band Resaw	1,100	1	22.50	1,150	
Ripper	350	1	11.25	900	
Chain Saw	2,000	1	7.50	300	
(Subtotal)			(244.75)	(15,350)	
Log Winch	12 ton	1	7.50	350	
Live Deck	6 m	1 set	4.50	700	
Log Loader	10 ton	1 set	11.25	750	
Chain Conveyer	6 m	1 set	3.75	500	
Chain Loader	3 ton	1	1.50	520	
Live Rolls	200 m/m	28	4.50	1,050	
Live Rolls	120 m/m	65	8.25	1,400	
Skids		9 set	6.75	1,350	
Conecting Roller		8 set		950	

Table II-3 Sawing factory

Item	Capacity	Number	Power	Price x 1,000 yen	Remarks
Belt Conveyer	18 m	2 set	9.75	1,400	
Chain Conveyer	3 m	1 set	1.50	400	
Dust Collector		1 set	22 50	1,500	
Fork Lift	3 ton	1		2,000	
Subtotal		5		150	
(Subtotal)			(81.75)	(13,020)	
Total			326.50	28,370	

(b) Labourers

Item	Number
Log Transporting	2
Band Milling	3
Frame Sawing	3
Resawing	3
Ripping	2
Classify etc.	4
Fork Lift	1
Odd Jobs	3
Total	21

(c) Building Area

Item	Area
Sawing	1,120 m^2
Classify	300
Office	80

Sawing factory Table II-3

Item	Area
Others	80
Total	1,580

Table II-4

Furniture Factory

(a) Machinary

Item	Number	Power	Price x 1,000 yen
Rip Saw	1	11.25 kw	1,000
Cross Cut Saw	2	2.25	300
Auto Ripper	1	1.50	500
Running Saw	1	11.25	300
Leveling planer	1	2.25	800
Hand planer	2	1.50	500
Single Surface Planer	1	2.25	400
Super Surfacer	1	2.25	600
Tilting Arbor Variety Saw	2	1.50	500
Glue Mixer	1	1.50	200
Glue Spleder	1	1.50	1,200
Cold Press	2	15.00	500
End tenoner	1	3.00	400
Hollow chisel Mortiser	1	1.50	300
Router	1	3.75	600
Milling Machine	1	2.25	600
Dovetail Jointer	1	2.25	300
Corner Locking Machine	1	2.25	600
Multi Spindle Drilling Machine	1		500
Double Saw	1	7.50	1,700

Furniture Factory — Table II-4

Item	Number	Power	Price x 1,000 yen
Belt Sander	1	1.50	300
Edge Bonding Machine	2		500
Belt Sander	1	1.50	300
Drawer Assembling Machine	1		800
Box Assembling Machine	1		1,000
Compressor	2	7.50	150
Edge Belt Sander	1	2.25	630
Spray Machine	1		150
Spray Booth	1		300
Belt Sander	2	1.50	300
Polisher	1	2.25	350
Dryer	1	3.00	500
Dust collector	1	10.00	2,000
Total		106.00	19,080

(b) Labourers

Item	Number
Log Selecting	2
Cross Cutting	
Lumber Cutting	4
Board Cutting	
Levelling	
Planer Cutting	7
Cross Cutting	

Table II-4 Furniture Factory

Item	Number
Bonding	
Pressing	4
End Tenoning	
Surface Processing	
Surface Processing	
Drawer Processing	
Drawer Processing	8
Dowelling	
Drilling	
Triming	
Sanding	
"	
Sanding	
"	
Assembling	12
"	
Drawer Assembling	
Spraying	4
Fitting	2
Packing	2
Total	45

Furniture Factory Table II-4

(c) Building Area

Item	Area
Wood Working	500 m^2
Assembly	330
Coating	50
Warehouse	520
Office	100
Total	1,500

Table II-5

Table II-5

Flooring Factory

(a) Machinary

Item	Number	Power	Price x 1,000 yen
Circular Saw	2	5.00 kw	200
Ripper	1	9.00	600
Levelling Planer	1	2.25	600
Single Surface Planer	1	10.00	1,200
Sizer	1	2.25	400
Super Surfacer	1	2.25	600
Three Side Planer & Moulder	1	15.00	2,000
End Matcher	1	7.50	1,200
Dust Collector	1	20.00	2,000
Fork Lift	1		2,000
Total		73.25	10,800

(b) Labourers

Item	Number
Wood working	10
Classify etc.	4
Fork Lift	1
Odd Jobs	1
Total	16

Flooring Factory Table II-5

(c) Building Area

Item	Area
Wood Working	600 m^2
Classify etc.	150
Warehouse	600
Others	200
Total	1,550

Table II-6

Table II-6

Particle Board Factory

(a) Machinary

Item	Capacity	Number	Power	Price x 1,000 yen	Remarks
Cylinder Chipper	1 t/hr	1	7.5kw	1,200	
Crusher	1 t/hr	1	22.5	1,800	
Screen		1	3.8	2,400	Vibration Type
Chip Dryer		1	11.3	10,000	
Silo	15 m^3	2		5,000	
Glue Mixer		2		500	
Glue Coating Machine	0.5 t/hr	1	22.5	3,500	
Chip Conveyer		1 set		5,000	
Forming Machine		1	7.5	8,000	
Hotpress	4 x 8' 1,000 t	1		24,000	Five Openings
Loader, Unloader		1		15,000	
Sander		1	13.5	7,000	10" x 2
Hotpress	4 x 8', 300 t	1		10,000	For Overlay Three Openings
Glue Spreader	5'	1		3,000	
Sizer		1		7,000	
Boiler	200 kg/hr	1 set		8,000	6 kg/cm^2

Particle Board Factory Table II-6

Item	Capacity	Number	Power	Price x 1,000 yen	Remarks
Machine					
Foundation				12,000	
Total				123,400	

(b) Labourers

Item	Technician	Operative (male)	Operative (Famale)	Total
Chief Technician	1			1
Precut		1	1	2
Crusher, Screen		1	1	2
Dryer		2		2
Glue Coating	1	2		3
Forming Pressing	1	2	2	5
Sanding		2		2
Surface Finishing		2	2	4
Sizing		1	1	2
Boiler		2		2
Odd Jobs			2	2
Total	3	15	9	27

(c) Building Area

Item	Area
Factory	700 m^2
Warehouse	700
Office	50
Total	1,450

Chapter III Forest Resources Development Project

1. The First Logging Plan

The aim of this plan is to harvest logs as by products of settlement by GIPM and to develop a small center of wood industry at New Pindare city.

Blue prints of arrangement of settlements and road systems are described as being of geometrical shape in the project of GIPM, but in reality there are swampy areas and creeks that will prevent the actual effective working of the arrangement. This being so, it will become necessary to modify them so as to be adaptive to the natural environments such as topography, and to improve the blue prints of arrangement, utilizing aerial photographs and field investigation for this purpose. Roads for agriculture and forestry being the most important as arteries of regional development, greater effort should be devoted to construct "all weather" roads in this region.

Maintenance of Route 22 being of course extremely important, its road surface should be dressed with the width of at least 4 or 6 meters so that trucks can move in all weathers. Moreover, construction of shoulders with the width of 2 meters on both sides of the road is desirable.

As a definite idea to improve the road system, the roads should be constructed at high lands regardless of its curves. In addition, adequate ditches and drainage should be

constructed in necessary places, and the road width should be given a camber so that better drainage may be maintained. Technical details such as these seem not to have been given sufficient consideration in laying out Route 22 and other roads, and as a result they cannot be used during the rainy season. Moreover, except for the roads running east and west, forests on the both sides of the roads should be cut for a width of 30 to 50 meters to let light and wind come in so that the roads may dry quickly after rainfall.

It is a fatal obstacle to the construction and maintenance of the roads here that gravel stones are hard to get. One way to overcome this is to make brickes as substitute for gravel or to dress the road surfaces with clay abundant in this region.

Bog iron ore (impure limonite) is found in many places which can be used as a substitute for gravel with good results. It is likely to be able to obtain a large amount of stones and rocks from Piracambu mountain chain, although prior investigation would be necessary. If such materials were obtainable in large quantities economically, about 100 kilometers of development road should be constructed from Zedoca to avoid swampy areas through A class and B class forests (illustrated in Figure III-1)along the Desordem hills with an aim to clear the land systematically and secure the supply of road gravel soon.

In this area the shortage of gravel is an impediment to road construction. For agriculture and forestry purpose a one-lane road 2.5 meter wide would be the limit that can be built. It is desirable to keep a wide shoulder, 2.5 to 3 meter

wide, on both sides of the road. When it is extremely difficult to obtain gravel, employment of the rutways method is advisable.

To do this, prepare a couple of gravel tracks on a road, to which the wheels of vehicles in use can keep. These tracks are made about 60 centimaters wide and 50 centimeters deep. Broken stones are filled into each trench and on the top of the larger sized broken stones, smaller sized broken stones can be spread and later rolled in. If water tends to lie between the broken stones, whether it may be gravel roads or rutways, the results are far from satisfactory. Better results can be obtained by spreading bundles of twigs here and there, and digging shallow trenches on the both sides of the road to encourage drainage of water in the tracks. For this road construction a tractor equipped with a back-hoe will do well.

It is considerably difficult to keep road in good condition if the gravel used is insufficient, and much time and effort would be taken for the maintenance of it. In the worst conditions such as a series of long or heavy rainfall, there would be no other way but to suspend traffic of vehicles to prevent possible damage. (See Figure III-2)

Zedoca and Cocalinho would be the basis of development but as the real basis available in future the northern side bank of the intersection of Route 22 with the Pindare river would be suitable. At present there is no bridge nor community in the place; however, it should be noted that a new market or manufacturing industry would develop when mechanization were

achieved to develop deep forests and export of agricultural and forestry products started. Let us call it for the time being "Pindare city of forest products".

This city will soon need a large area with cargo handling facilities. It is reported that the difference of water level between the rainy season and dry season is about 10 meters. Under these circumstances a quay will be needed consisting of 5 flights of steps with 2 meters of difference in height between the platforms (see Figure III-3) with which stable loading and unloading will be possible in any season.

With future progress in mind, it is advisable to design the quay big enough to berth a shallow steel transport-ship of 500 tons to handle agricultural and forestry products from the valley. Next to the quay a log pond should be constructed in which 5,000 cubic meters of logs can be stored in the dry season, and also a log yard with an area of 10,000 square meters in which logs to be transported to timber markets of the co-operatives or that in Sao Luis can be stored temporarily. The size of these suggested facilities seem too big but it is better to be on the big side, considering the development following this stage.

The present way of development should start at first from 20 nuclei, each of which consists of 50 families of farmers, totalling approximately 1,000 families in all. To each family 50 hectares of virgin forests is allocated, from which 50 cubic meters of sawn timber of various tree species may be obtainable. But at present all of them are burnt up.

Assuming each family will be able to harvest a hectare of forest every year, 50,000 cubic meters of saw logs can be produced a year by 1,000 families. However, it is beyond the capacity of these farmers to collect these valuable logs. If a cooperative were eatalished to harvest them with, to start with, 6 chain-saws, 3 skidding tractors, a D-8 bulldozer to haul heavy logs and for engineering works a truck-crane of 20 tons and 6 trailer trucks, and well trained crews, they can start their business by collecting logs. Beginning with a volume of 40 to 60 cubic meters per day, they will be able to increase the amount, with learning the processes, to 100 or 200 cubic meters a day in a year.

These crews of the mechanized logging operation will be supervisors or foremen at the second stage when full scale forestry activities could start at Caru forestry center located at an upper streams site along the Pindare river. It would be necessary for them to undergo heavy training under a good instructor from the beginning of the first stage.

Farmers, on the other hand, will be able to earn some amount of money, one curuzeiros (novo) per cubic meter or so, from stumpages which are to be burnt up in clearing their lands if the above-mentioned logging service does not materialize.

Estimating the cost of logging operation, approximately 3 curuzeiros per cubic meter in felling and bucking, 6 curuzeiros in skidding, and 8 curuzeiros in hauling will be incurred. The total production costs up to Pindare will be 18

curuzeiros and within 2,400 yen in Japanese money.

The average market price of sawlogs at Bacabal, a timber trade center in this region, being 30 curuzeiros per cubic meter, this logging operation can be profitable, so that operation of a saw-mill and allied wood working industries can stand on their own feet. With the possible increase of agricultural and these forestry products transactions, equipment and repair services will start as a related industry, thus promoting a rapid growth of Pindare city of forest products.

Concerning the demand for logs from a sawmill, flooring mill and a furniture factory that will be established according to the first wood industry project, ranging from 70 to 140 cubic meters per day, it is likely that log production from the nuclei mentioned above will be able to meet it.

Although this project aims at efficient utilization of logs obtainable from logging in the natural forests, an advanced project was elaborated in which forestry would play a role in support of farming, keeping reproduction of forest stands. Such a project is very important to prevent devastation of lands, while maintaining the fertility of farm lands.

This project attempts to keep the rotation in the following order: harvesting of natural forests --> agricultural cultivation (4 years) --> tree planting --> matured stands. In this project logging is under the management of cooperatives. To begin with, a pilot unit should be organized with a mechanized operation team as well as one or two nuclei for the experimental purpose to harvest 30 cubic meters of sawlogs daily.

If this experiment were successful, they could increase the number of units to meet growing demand. That is, from 20 nuclei comprizing 1,000 families, 10 teams could be organized with the capacity of harvesting 300 cubic meters of sawlogs per day. If saplings of a certain tree species could be harvested in 16 years, daily production of 1,700 cubic meters of sawlogs will be attained as will be mentioned later.

Note: See, Figure III-4.

2. The Second Logging Project

The project endeavors to supply continuously at low cost a large amount of logs to the integrated wood industry in Sao Luis covering a pulp plant with daily output of 100 tons, sawmill, flooring mill, plywood plant, furniture factory and particle-board plant, the total demand of which will eventually reach 500 cubic meters of logs per day.

Considering the traffic conditions in the state of Maranhao, it is advisable to construct these mills in a place as close as possible to the forest resources. Judging from this standpoint only, we believe Pindare-Mirim is more suited than Sao Luis. However, management of the industry with modern plant and equipment will demand a large number of skilled engineers. It is doubtful that they will settle down at Pindare-Mirim with the primitive circumstances prevailing there now. At any rate, it is desirable to make Sao Luis a driving force to develop the state of Maranhao. It was with this in mind that Sao Luis was chosen as the center of the wood industry in our development project as already mentioned.

Obviously, if development of the wood industry were achieved in Pindare-Mirim and modern surroundings were realized, a new group of the wood industry will naturally develop.

Whether a daily production of 500 cubic meters of logs from the nuclei which will be consumed by the wood industry in Sao Luis or Pindare-Mirim can be achieved or not is uncertain. Consequently, it will be necessary to organize at the upper reaches of the Pindare river a real and settled forestry center with the capacity of harvesting continuously a considerably large volume of logs that will be able to support the foregoing wood industry.

The site of the proposed forestry center is at the intersection of the Caru river with the Pindare river 80 kilometers up from Pindare-Mirim wood industry center, where the main stream enters A class excellent virgin forest region. As a transportation route connecting the forestry center with Pindare, a waterway is available. But efficiency of it being not good, it should be set aside as supplementary. It is advisable to construct a Pindare forest products road with a length of 50 kilometers which branches off from the turn 17 kilometers north on Route 22 from Pindare. On the way it will cross the small rivers, but it will not be difficult to build bridges over them.

In addition, it is suggested that a main forest road about 60 kilometers long extending east up to Piracumbu highlands be constructed. A series of these new roads will be of course arteries to develop and manage forest resources there. At the same time construction of the road over the highlands will pro-

duce a large supply of rocks, stones and gravel which are essential for the construction of other roads. Needless to say, it is advisable to start construction of the former at the earliest possible time.

A map in Figure III-1 describes a possible development of the forest resources in the entire state of Maranhao in which relative importance of the forest resources is indicated by alphabet; A class being the best, B class comparatively good, and D class those in a swampy area.

The growing stock of excellent virgin forests in A class is ranging from 200 to 300 cubic meters per hectare. If clear cutting were carried out for reforestation, usable volume of valuable tree species from the harvest would be at best 100 cubic meters, totalling common tree species such as Cedro, Andiroba, Barrote and Paparauba that area available for house building and wood working, precious wood, and pale softwood that is suitable for pulp production.

Under the second program it is necessary to supply daily 500 cubic meters of logs to the wood industry. Therefore, in consistent with this supply logging operation would necessitate at least 5 hectares of forests being felled every day, and 1,500 hectares in a year assuming 300 days of operation.

On the other hand timber production is of course to be started in Zedoca according to the first development program. However, the annual cut-over area of 2,000 hectares should be the goal of timber production to be set for the Caru forestry center, considering the future growth of the economy and

leaving something in reserve.

According to the experience of the Japanese in the settlement at Tomeacu in Para state, in cut-over lands after heavy natural reproduction inferior second growth generate with intolerable coniferous trees such as Lmbauba and so forth. But in the course of several years dominant trees with excellent quality will grow in competition, resulting in a stand composition in 15 to 20 years which will be similar to the former one before cutting. In other words, even extensive forest practices will make it possible to harvest second growth in 20 to 25 years. This result has to be proved by actual experiments but in the worst conditions 25 years of rotation seems to be feasible. On the basis of this assumption 50,000 hectares of working circle was set up in this project. In a rectangle shape measuring 10 kilometers by 50 kilometers, this area will be obtainable which is almost equal to the vast area of Piracambu highlands. But even this area is only a strip of land in the vast primeval forests in the state of Maranhao.

In this region with no example of management of tropical forests on a commercial basis, there is no other way but to estimate the area in an extensive way of natural regeneration. However, an intensive forest management should be introduced to it along with large scale experiments to demonstrate several possibilities of success.

In an experiment site at Turi, it should be possible to succeed in artificial reproduction and growing of saplings of Cedro and Andriroba on a small scale which are resistent to

termites. This valuable result should be applied to a part of a large scale of tree planting, which will be harvested in 10 to 15 years. As already stated, particular interest and attention should be directed to experimental tree planting that will follow the burning of worthless stampages and limbs and several years of shifting cultivation. Trees to be planted are Caribbean pine, Merkusii pine (Pinus Merkusii) and Karui pine (Agathis australis) which are coniferous trees adaptive to the tropical forests.

It should be noted that saplings and crops suffer considerably from drought during July to September in the interior, therefore cutting should progress in a north and south direction to prevent the damage, and annual cutting should be made from the east to avoid sunset glow. Hence the recommendation that permanent roads of branch forest road should be constructed in parallel along the east and west 1,000 meters apart to make the road surfaces as dry as possible during the rainy season will be worthy of note. Perpendicular to the roads, that is, in a north and south direction, cutting should be made 20 meters wide from both sides of the road to a depth of 500 meters; by so doing, a slender rectangle of forest 2 hectars in area will be cut here and there. If 25 years of rotation were employed, width of a unit of rotation will be 500 meters, which will make a regular arrangement of logging belt 20 meters wide and 500 meters deep along the branch roads.

The logging techniques have to be improved further with the increase of crews on the basis of training in the first log-

ging project. An operation unit should be equipped with 6 chainsaws and 3 skidding tractors so that timber stands on the rotation unit may be harvested in 5 days. This means that 0.4 hectare of timber would be cut daily with the volume of 80 to 120 cubic meters, from which 40 cubic meters of valuable logs with having lengths of 18 to 25 meters would be obtained. If the weight of a log exceeded 7 to 9 tons and was beyond the capacity of skidding tractor, a trailer tractor of D-8 class or bucking of it will have to be employed.

Limbs and twigs left will be burnt up to prepare for tree planting. It must be noted that there have been few instances of forest fires in the region that were caused by burning. It is much convenient for the forest practices.

The necessary supply of logs being 500 cubic meters per day, 13 units of logging operation in the same number of logging fields would be necessary, and each unit will have to work independently. If 300 days of logging could be assumed a year, 60 shifts will be made for each operation unit, which will make 780 rotation units in a year in all. It should be noted that an appropriate design of a net-work of forest roads has to be made in planning.

Let us sketch a picture of the forestry center at Caru (see Figure III-5). As already stated there are rolling hilling hills in the forest area with creeks and swampy areas here and there, although the topography looks flat. Forest roads should be constructed on the highlands along the east and west to keep the road surfaces dry. When they were constructed along the

north and south, forest stands on both sides of the roads should be cut widely to allow light and wind come in as mentioned in the first project.

In the center a motor-pool has to be established for a large number of vehicles and equipment such as 80 to 100 chain-saws, 40 to 50 skidding tractor, 15 to 20 mobile cranes with heel-beam, 20 to 30 20-ton trailer truck, 3 20-ton lumber jack, 10 bulldozers of D-7 or D-8 classes, 3 motor graders and 10 dump trucks, in addition to 20 portable houses for crews, 5 ordinary trucks and 5 jeeps for liason purposes. At the same time for the water transportation loading facilities, 10,000 square meters of log yard and 1,000 cubic meters of log pond will have to be constructed at Caru port.

The number of personnel at the center would be 15 clerks, 20 foremen and 300 work crew members in addition to their families and the staff of a commissary, totalling approximately 1,000. But this number might be much decreased, if the center can be reached in less than two hours by car from Pindare city of forest products.

It should be noted that land transportation from Caru or Pindare to Sao Luis will be dominant in future when Route 21 and 22 are completed. Up to that time efficiency of loading facilities at the port will play an important role in cost control of log transportation both by truck and waterway. The most suitable for loading and unloading of logs as well as selection of logs at the log yard at Pindare port or Caru port will be a 20 -ton lumber jack. It is better to design a log yard and

quay there on the basis of this facilities.

The log pond should be 50 meters wide and 200 meters long, surfaces of which should be separated from the river surface and designed to keep at a certain level by a pump. To handle logs a 20-ton cable crane should be established lengthwise which is operated by 3-drum wiches, and the span of it should be extended to the log yard and the quay.

During the dry season the water is 2 meters deep in the Pindare river, and a wooden ship up to 100 tons seems to be able to navigate. If a special steel ship with light draft were available, such a ship up to 500 tons will be able to navigate the river, although dredging and change of the waterway as well as establishment of beacons would be necessary.

The freight rate between Pindare-Mirim and Sao Luis is about 12 curuzeiros per 1,000 kilograms, but the rate would be less than a half of it if the foregoing ship were available under the direct management of the cooperative. In other words, transportation cost of logs up to Pindare is now 18 curuzeiros but that up to Sao Luis would be around 25 curuzeiros by the above-mentioned ship.

In Sao Luis the tide rises and falls twice a day with the depth of around 6 meters. A log transport-ship can reach the quay at full tide to unload logs and leave it at the next high tide. It will take 3 days from Pindare to Sao Luis. At least 8 log transports would be needed to supply 500 cubic meters of logs daily including those in loading and unloading.

Considering the possible shortage of logs due to acci-

dents during the rainy season and others, capacity of log stored in Sao Luis should exceed 40,000 cubic meters, which is equivalent to 130,000 square meters in a log pond and 50,000 square meters in a log yard. An ideal facility for it is a dock-type log yard which will be a log pond at full tide and a log yard at low tide, preventing termite damage and decreasing sinkers. If such a yard proved difficult to construct, a log pond should be constructed next to a log yard. Loading machine suitable for them would be a combination of an amphibious log lifter or lumber jack with a cable crane having a capacity of 20 tons.

3. Forest Resources Development Project to support the Growth of the Wood Industry in the state of Maranhao

A consideration to develop systematically natural forests west of the Turiacu river and along the Gurupi river on the state boundary.

A fact to be borne in mind is that the conditions to develop the forest resources west of the Turiacu river, along those under the direct control of SUDENE, from the side of Pindare are worse than those from the side of the Gurupi river, that is from the side of Belem, capital of the state of Para which is more developed than the state of Maranhao.

Route 22 has been constructed to a point not far from the Gurupi river on the side of the state of Para. If construction of the road were completed (forests on the designed road are already cleared in both sides), the distance between the Gurupi river and Belem would be about 250 kilometers.

However, the authorities of the state of Maranhao seem to be apprehensive about the outflow of logs to the state of Para, and have elaborated a plan to cover all the processing of logs produced in the state, starting from logging to the export of the wood products to other region as well as to foreign countries on the basis of a new port to be constructed on the mouth of the Gurupi river.

Road should avoid low lands and a highway should be constructed along the Piracambu highlands to combine a river crossing of the Gurupi river with Imperatriz, a small town in the interior, to fill the distance of 450 kilometers. Imperatriz is situated along the way of Route 14 which runs through center of Brazil from Brazilia to Belem, and is also a key point on the western side of the great river of Tocantins which flows north to Amazon.

The Gurupi city of wood industry is to be constructed on the side of the state of Maranhao near the intersection of Route 22 with the Gurupi river. There are many reefs and several rapid streams in it which have made the river unsuitable for navigation. Development of the valley has been delayed. Therefore, it will be difficult for Gurupi to construct a city of wood industry with a river port and water transportation, unlike Pindare. But the Gurupi river is high and affords water supply to any industry or hydro-electric power generation.

There is another way to connect within the state this city of wood industry with areas outside the region. It is to construct a road 80 kilometers long on the Atlantic coast up to

Carutapera, a shallow-water fishing port which ocean-going vessels cannot enter. Those responsible for port construction must decide upon a suitable place.

If a suitable place could not be found, manufacturing of pulp and paper, plywood, flooring and lumber would have to be made in Gurupi, from which its products will have to be transported to Belem city by Route 22 for export. In my estimation, the latter would be more advantageous with considerable possibilities.

It will be long after the completion of Route 22 when the third stage can begin. But the progress of development in this stage would be faster than before, due to the accumulated experience and a large number of skilled technical personnel from the previous two stages.

In a region along the Piracambu development highway stones and rocks are easy to obtain and road construction there is more advantageous than in the case of Pindare-Mirim. Except for electric power and other sources of energy there would be nothing to fear in regard to the future of Brazil.

In the third stage a typical over-all development of virgin forests would start. On the basis of conscientious guidance and modern cooperative agriculture under an appropriate control with advanced forest management, fundamental blue prints of a successive growth of manufacturing industry, commerce, mining and so forth should be elaborated with the cooperation of many technical personnel from various fields of industry after sufficient investigation were made, in order to

carry out successful development of the state.

In the past once a road were constructed, shifting cultivations were repeated along the road, resulting in the depletion of the resources and spreading of poverty and devastation. To prevent the recurrence of exploitation, rational land use will have to be determined beforehand with systematic road net-work, plus friendly and balanced administrative guidance. In the worst circumstances a series of special legislation has to be enacted to control the regional growth; otherwise all the projects might soon collapse.

We would like to see the success of the project evolve from decisive measures by SUDENE and strenuous efforts of young technical officials concerned.

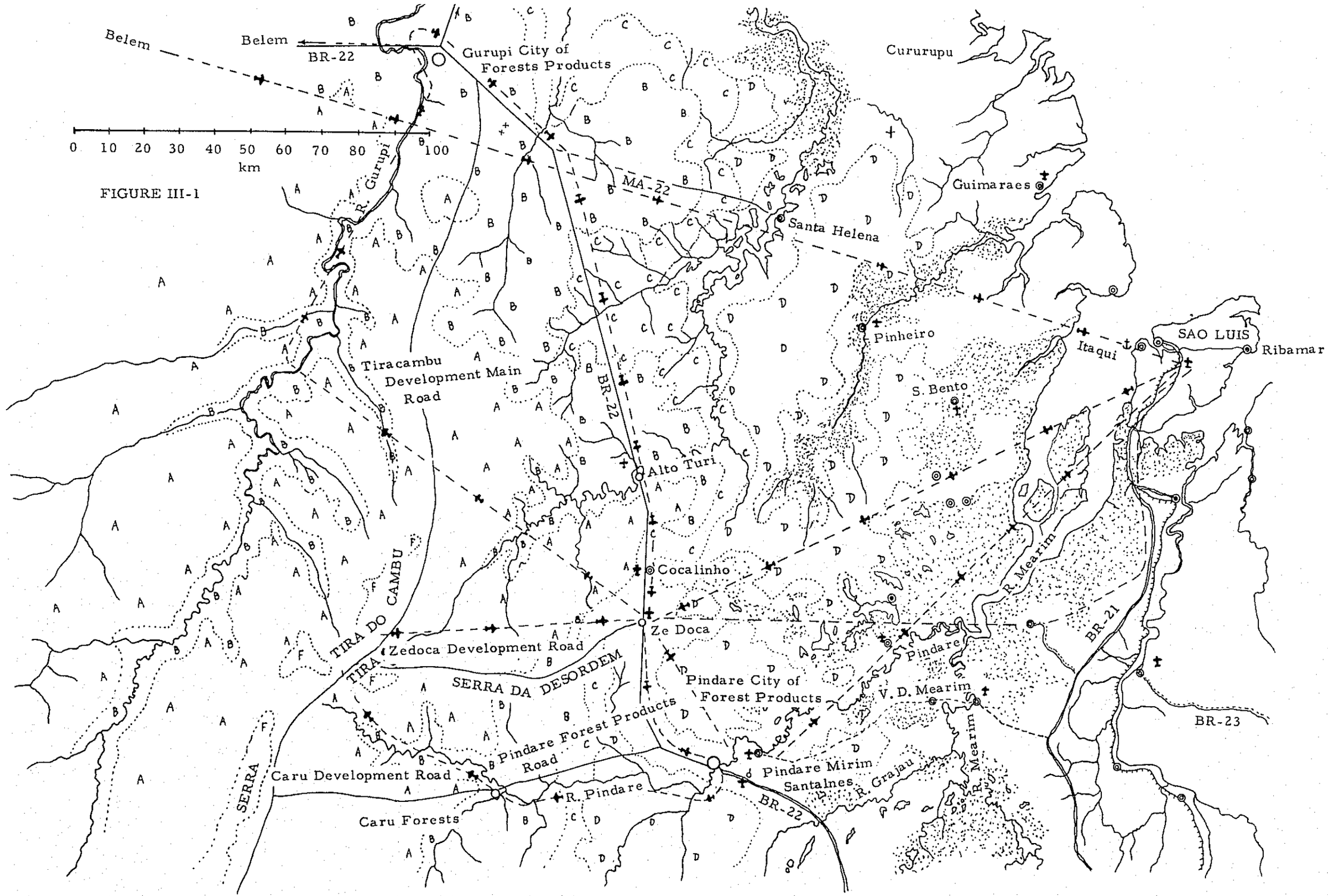

Belem
Belem
BR-22
Gurupi City of
Forests Products
Cururupu
0 10 20 30 40 50 60 70 80 100
km
R. Gurupi
MA-22
Guimaraes
Santa Helena
Pinheiro
SAO LUIS
Itaqui
Ribamar
S. Bento
Tiracambu
Development Main
Road
BR-22
Alto Turi
TIRA DO CAMBU
Cocalinho
R. Mearim
BR-21
Ze Doca
Zedoca Development Road
TIRA
SERRA DA DESORDEM
Pindare City of
Forest Products
Pindare
V. D. Mearim
BR-23
Pindare Forest Products
Road
Caru Development Road
SERRA
R. Pindare
Pindare Mirim
Santalnes
R. Grajau
R. Mearim
Caru Forests
BR-22
to IMPERATRIZ

FIGURE III-1

FIGURE III-2

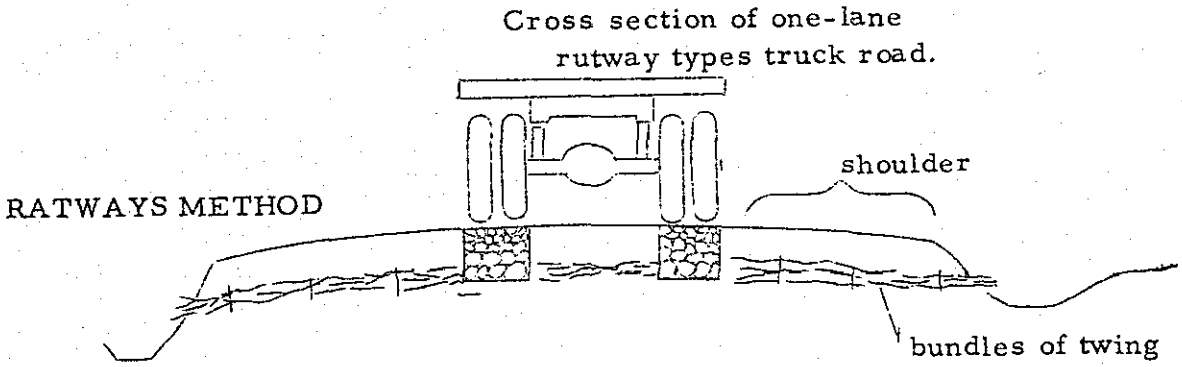


FIGURE III-2

FIGURE III-3 Water level of Pindare city

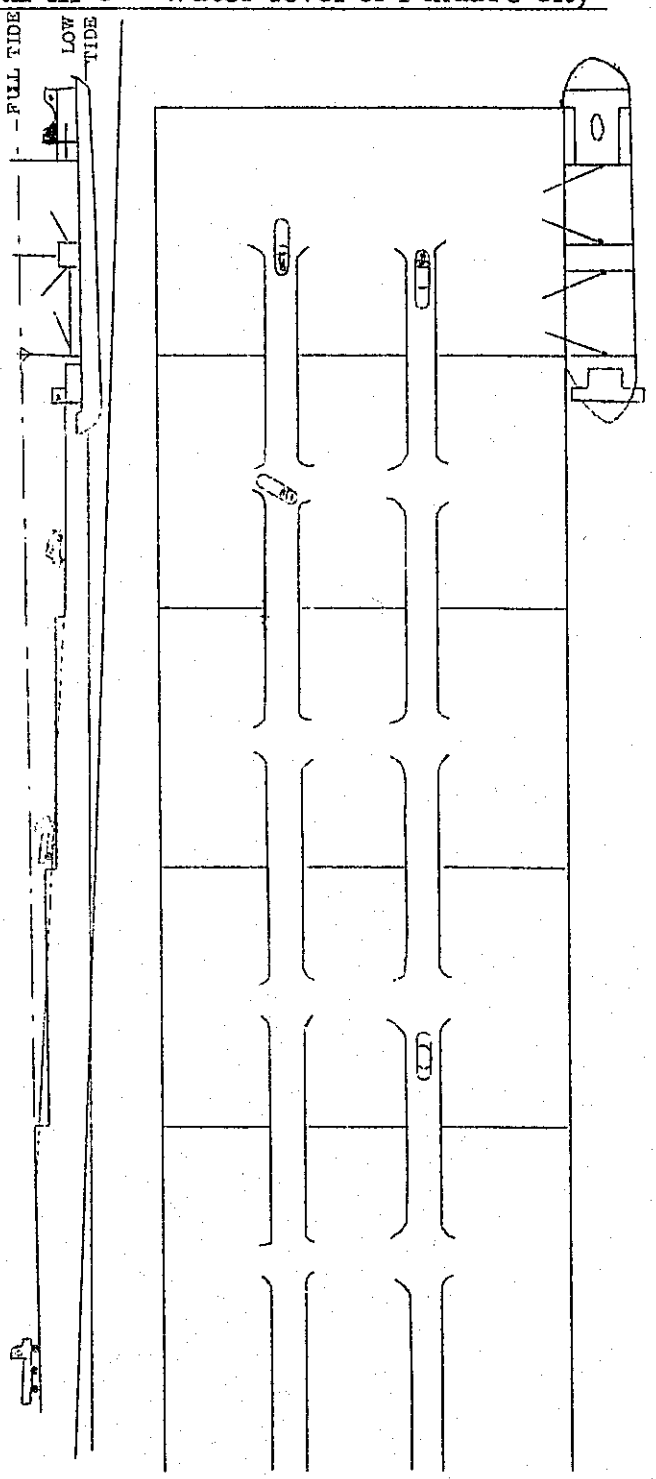


FIGURE III-3 WATER LEVEL OF PINDARE CITY

FIGURE III-4
Outline of Logging in the Sustained-yield Unit with shifting cultivation (Modification of the settlement program of GIPM)

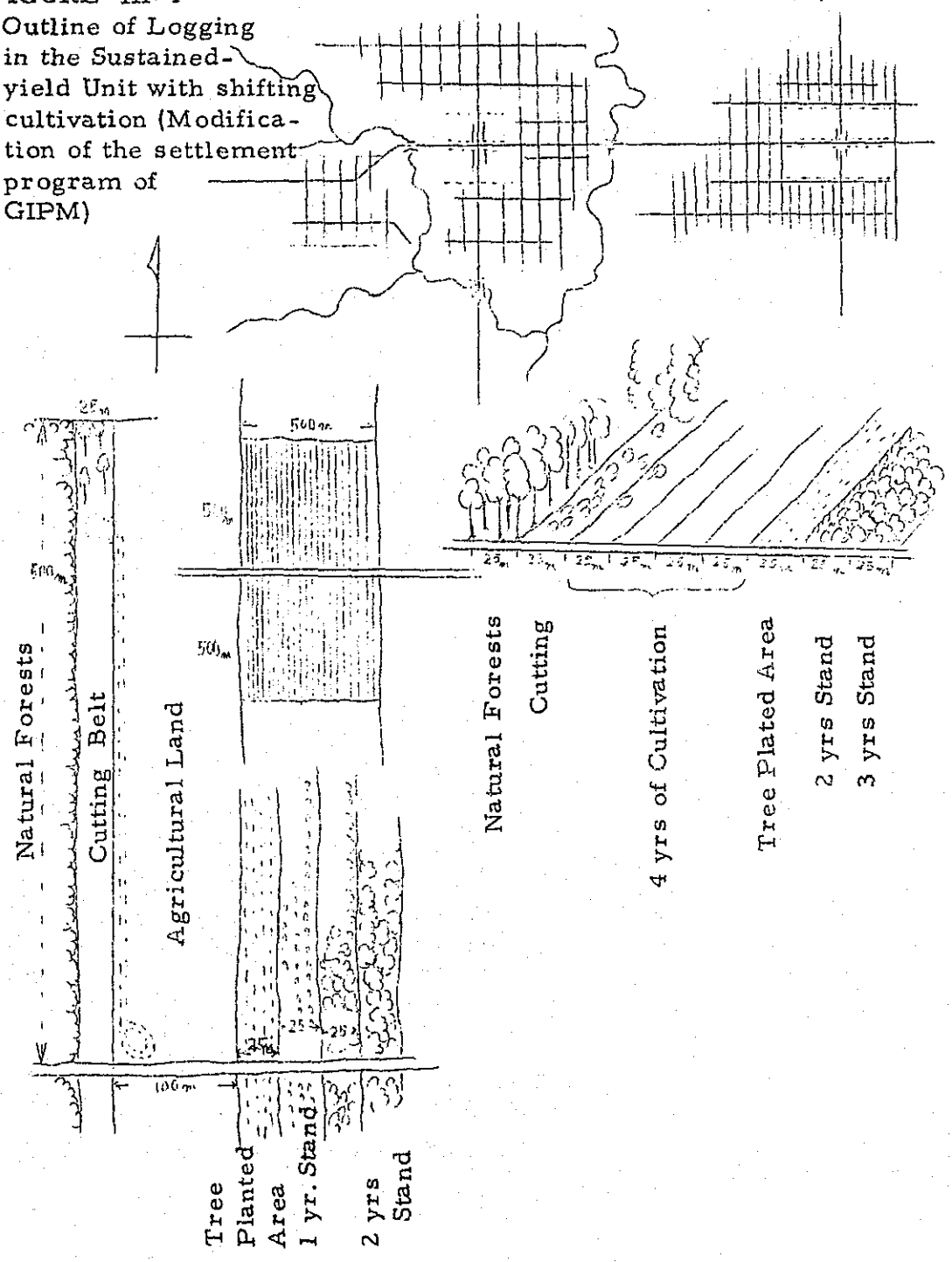


FIGURE III-4

Foot Note of GIGURE III-4

Settlement with a radial shape should be modified to that of a rectangle shape. In the center of it is a kitchen garden for each family and outside the settlement sustained-yield forests should be established, accompanied by shifting cultivation under joint management. In consequence its shape might become irregular, according to the topography. To each house 50 hectares of forest with two stands having each 500 meters square should be allocated (see Figure III-3).

Pilot Project (Pilot unit with daily output of 30 cubic meters)

Equipment:	6 chain-saws, 1 skidding tractor a D-6 crawler tractor 2 10-ton trucks a crane or loader
Personnel:	11 machine work crew members, 22 apprentices and a leader. The machine group is organized in the cooperative.
Capacity:	chain-saw: 2.5 cub. m./hr. for felling and bucking. 6 hours of operation produce 15 cubic meters.

FIGURE III-4

If 2 chain-saws were used, 30 cubic meters per day. In case of felling only, a chain-saw can produce 30 cubic meters per day. So with 4 chain-saws, 120 cubic meters perday.

skidding tractor: 30 cubic meters per day (each trip 4 cubic meters)

or

loader: 30 cubic meters

truck: 3 round trips a day to Cocalinho base

A logging team can harvest one unit of forest stands in 3 days. If 150 days of operation were feasible during the dry season, logging of 50 units will be possible. In other words, one model nucleo of 50 houses will be enough for the first stage of trial logging (if all weather road were constructed, they will be able to harvest 100 units from 2 nuclei)

After the first project

If the project were successful, number of sustained-yield unut and logging unit could be increased.

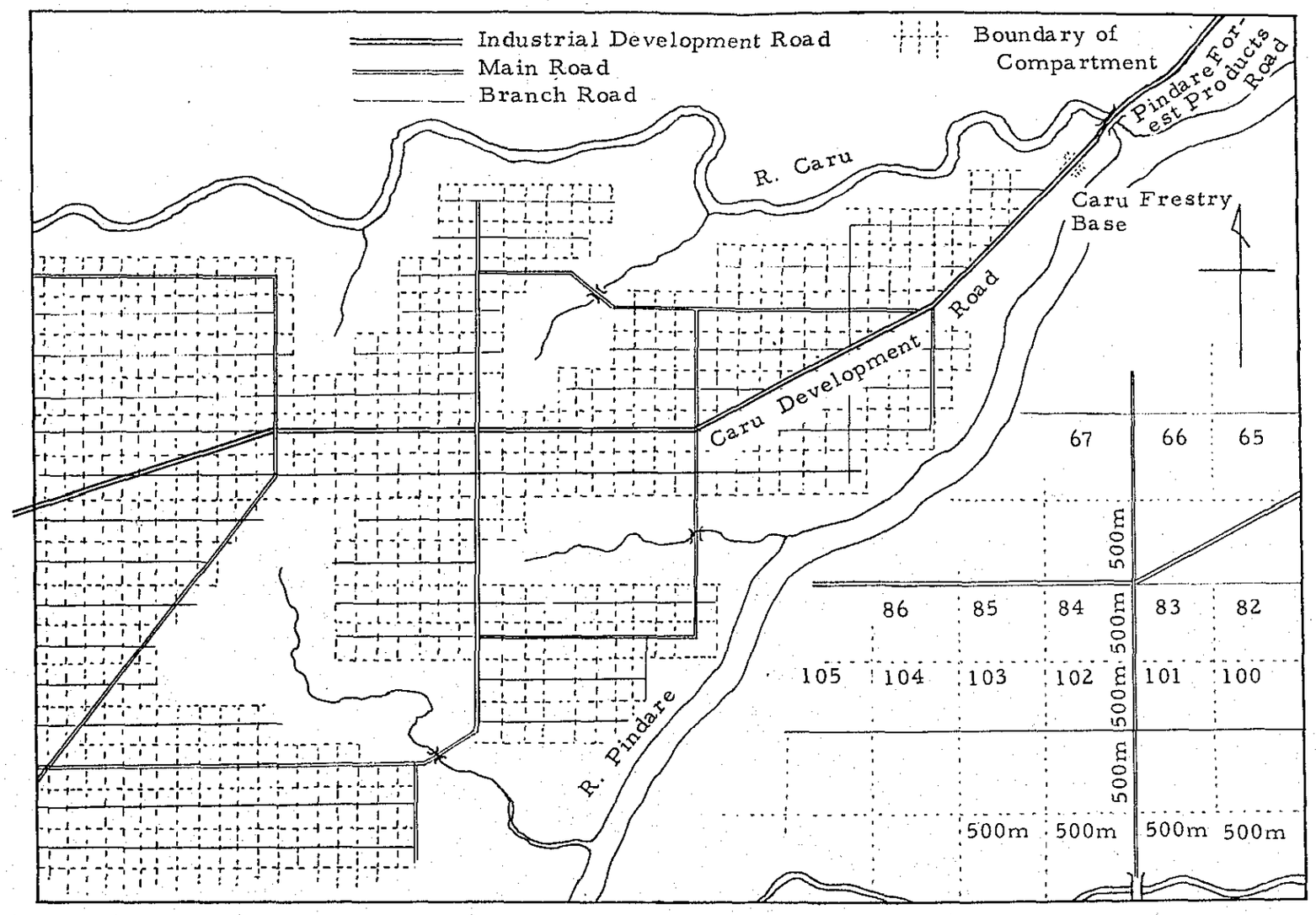
In this way from only 20 nuclei with 1,000 families, 10 logging units can be organized which will be able to harvest 300 cubic meters daily (if all weather road were constructed, logging will be possible even during the rainy season).

If settlement of 25,000 families could be achieved as

was initially planed by the SUDENE and about 10, 000 families would adopt the sustained-yield system with shifting cultivation, daily output of 3, 000 cubic meters will be attained throughout the year.

Even with the present settlement of 1, 000 families the supply of logs will be increased as much as several times in future, when improvement of tree species were attained by silviculture of Cedro, Andiroba or Carib bean pines (if growing stock per hectare of these species were assumed 200 cubic meters, each logging unit can harvest about 170 cubic meters per day: each unit 500 $m^3/3 \div 170\ m^3/day$). If 10 units were serviceable, 1, 700 cubic meters will be harvested per day.

GIGURE III-5


Industrial Development Road
Main Road
Branch Road
Boundary of Compartment
Pindare Forest Products Road
R. Caru
Caru Frestry Base
Caru Development Road
67
66
65
500m
86
85
84
83
82
105
104
103
102
101
100
R. Pindare
500m
500m
500m
500m

Chapter IV Some supplementary Comments for the Economic Development and Understanding of the Problems

In this chapter the processes that have reached the abovementioned physical problems will be clarified from the economic viewpoints. In addition, some supplementary comments will be made on the types of requirements necessary to realize the further development of the state of Maranhao in relation to the present state of development.

1. Economic Valuation of Forest Resources along Route 22 traversing the state of Maranhao

The forest area of Brazil occupies a half of the land area of South America and is the second largest in the world, next to Russian forest land, with an area three times as large as the whole land area of Europe.

The forests of Brazil may be grouped under the following four types: (1) Tropical Forests on the Atlantic coast, (2) Southern pine Forests, (3) Forests on Dry Area, and (4) Amazon Forests. Obviously, the economic value of forests on dry area is low.

The most valuable tree species is the parana pine (Araucaria angustifolia), forests of which are located in the state of Parana, Santa Catarina and Rio Grande do Sul. In former days many such pine forests were also in the state of Sao Paulo but they were exploited with the rapid progress of

land development. It is estimated that even in the state of Parana, all of the parana pine forests will be depleted in fifteen years. Along with the destruction of forest resources, erosion has taken place, problems of which have been among the subjects under discussion.

The most valuable forest resources in Brazil being found in the parana pine forests, enormous quantities of logs from them have been utilized in this country, on which, it is estimated, a half of the whole sawmills in Brazil depend and further big quantities have been exported. Much attention should be paid to the fact that the plywood, pulp and paper industries also have been concentrated in the region of this tree species, enjoying a monopoly of the market in this country. Actually, the pulp and paper mills in the northeastern region have been provided capital by the southern pulp industry.

There is another tree species which has considerable potentialities in the forest resources of Brazil, although it was omitted in the above classification. It is the Eucaliptus originating in Australia and it has recently come to be recognized as being capable of preventing depletion of forests. The possibility of reforestation of Eucaliptus has been discussed, and it is expected that Eucaliptus forests will contribute much to the growth of pulp resources.

As far as the tropical forests on the Atlantic coast are concerned, they were completely exploited during the heavy initial development of the country and of their original forms no trace remains. It is only in the southern area of the state

of Bahia that forests still exist, being composed of Tocarando (Rose Wood), Cedro (Cedrela) and Peroba (Paratecome) and so on.

It has been widely recognized that regional development in Brazil has been made in the south, with Sao Paulo as the nucleus of it, Rio de Janeiro and the east around Minas Gerais. Following them are Salvador, Recife and Fortaleza in the industrial developments on the Atlantic coast. From the viewpoint of location of a wood industry, forest resources south of Salvador will be the most promising, next to the southern forest resources.

Finally is the forested area of the Amazon river basin covered by tropical rain forests having an area of 240 million hectares. In these forests are valuable trees such as Mahogany, Cedro and others; but the forest resources in the Amazon basin, being far from the advanced regions of the country, have been only little exploited. However, in accessible areas in the basin reached by a waterway chiefly, destructive exploitation has been under way, extending to a width of several hundred meters along the rivers. Lastly, shifting cultivation, which is the dominant type of land use, has been made without control after burning up the cover of the land, even when a road was opened. Under these circumstances it is extremely necessary for the government to lead the farmers with through-going administration and technical extension services if advantageous development of the forest resources is to be achieved. The forest resources along Route 22 in the state of Maranhao being

located in a corner of the east end of the Amazon basin also face similar problems.

2. Measures to be taken with the development of Forest Resources along Route 22 in the state of Maranhao

Although there are many unfavorable conditions in the development of forest resources along Route 22 in the state of Maranhao, we reached the conclusion that our development project would bear good fruit without fail, the reason being that for the most part our approaches were compatible with the attitude of SUDENE which has carried out its own development program.

It is noted that manpower of farmers available for the development here is better in quality than that in the Amazon basin. In fact labor supply has been increasing, with more farmers entering the state, having been driven out of the dry region in the northeast by intermitten drought. Moreover, the government has recognized the necessity of affording the farmers an opportunity of employment from the social and strategic viewpoints of developing the state.

What is important here is to work out measures to prevent destruction of the productive capacity of land in the forest region consequent upon the traditional extensive way of shifting cultivation accompanied by depletion of forests. Actually the Maranhao group of SUDENE (GIPM) has been making utmost effort to counteract the destructive shifting cultivation with ideal and modern agricultural techniques. It is along these

lines that we recommend the rational type of land use, including development of forest resources, such as will be advantageous to the limited number of leading industries in the state. In reality it is also conductive to attracting the strong potential manpower of the farmers who come to Route 22 to seek adequate employment.

The right way of forest development has to be consistent with the actual agriculture that is important for the purpose. It goes without saying that forest expllitation that extracts valuable trees and resorts to uncontrolled burning and clearing of forests that destroy the land should be suppressed so as to encourage the farmers to settle down there.

The staple agricultural and forest products in 1964 from the state of Maranhao registered 70 thousand tons of raw cotton, 420 thousand tons of rice, 114 thousand tons of mandioca, 264 thousand tons of milho, 130 thousand tons of babacu, 772 thousand cubic meters of logs and 6,119 thousand cubic meters of lumber. Not only rice and babacu, the dominant agricultural crops along Route 22, but also banana, milho and mandioca should be cultivated. Starting from the conventional farming that has been exploitable, conservative forestry should take part in an arrangement that would ensure a large scale working circle of farming and forestry. For this purpose technical extension service should be given with guidance for soil conservation as well as assistance for erosion control and road construction.

The area of the state of Maranhao occupies about 4 per

cent of the total land area of Brazil, of which the total area of Gurupi, Pindare and Baixo Mearim is only 22 per cent. However, a new system of agriculture and forestry that is recommendable to these areas will be of tremendous significance in creating a new approach adaptive to the development of the Amazon river basin.

The existing average arable land of the farmers in the state of Maranhao is too small in area. Those farmers with less than 10 hectares amount to 40 per cent of the total number of farmers of the state, or 13 per cent in the case of the whole country. This situation has been caused by their lack of farming techniques and shortage of agricultural capital. However, it is desirable to lead them gradually to adopt modern agricultural methods.

In the logging project discussed in the previous chapter, a blue print of new Pindare- Mirim was introduced, to which a remark will be made.

In 1966 the population of the Pindare-Mirim country was 14,200, of which 8,000 persons of 1,196 families were living in the city of Pindare-Mirim. The number of industrial establishments with more than five employees was counted 19, of which rice-polishing mills were 13, sawmills 2 and brickyards 2. In miscellaneous industries including commerce, 300 people were engaged and in agriculture 200 families.

The city of Pindare-Mirim, a key position now on Route 22, was under the control of a chieftain of Indios up to

1839. It was after that when agricultural development started. In 1881 a British railway company came in to establish a sugar camp which for years enjoyed a brisk market. With the outbreak of the First World War the company evacuated, leaving equipment which has been neglected and is now in ruin.

The staple products of this city are babacu, river fish, sugar, tobacco, cotton, rice, mandioca, bricks, mango and sweet potatoes. This being so, the agricultural development project of the government to this region should aim first of all at the establishment of a rice center to improve techniques of cultivating rice and its quality as a commodity. The next step should be the development of an edible oil industry. In this project establishment of warehouses and reorganization of the marketing procedures will have to be taken up. But in all this, the most important policy for the government will be the investment of capital to improve the soil of rice fields with a view to promoting employment of farmers. It will have to be a series of basic investment including adjustment of farm roads and permanent rice paddy fields, establishment of a nursery to secure high-grade seedrice, and improvement of irrigation, all of which are essential to elevate the commercial value of agricultural products. Of course, positive activities of farmers' cooperatives is also essential. Concurrently, investment in the industries related with agriculture, or at least opening a way for it, will also be needed.

The fact is, a ratio of three hundred merchants to two hundred families of farmers is abnormal in a remote place

like the one under review, where business has been on the decline. It is suggested that measures be taken to encourage farmers' desiring to work or to find beneficial employment in other regions and be afford guidance in culture, and this could be done by organizing a club for them; and training in up-to-date techniques could be facilitated by establishing a vocational school for them.

On the other hand the Maranhao group of SUDENE (GIPM) seems to be considering development in a region along Route 22 with Zedoca and Pindare-Mirim as the commercial centers of it. This approach has to be given due consideration.

Route 22 is likely to have a military purpose but economically speaking, it connects a development roads from Recife, the state of Ceara and Piaui with the Gurupi river valley through Teresina, Caxias, Codo and Bacabal which are all main basis for the regional development. From this standpoint it will be more important to consider a definite plan that takes into account an interrelationship of capital of enterprises in Bacabal with a population of 37,000, Pedreiras with 13,000, other key position, Sao Luis which is the capital of the state and development on Route 22. In particular, it is most important to design a development scheme to elevate the value of Pindare-Mirim as a future base by inviting private capital from influential quarters in the state who have been in cooperation with the capital from Sao Luis (Figure IV-1).

3. Position of State of Maranhao in the Economic Development and Direction of its related Regional Development

The state of Maranhao had a population of 2,490,000 in 1960, which is 3.51 per cent of the population of the whole country, giving an average density of approximately 7.5 capita per square kilometer. A census was carried out in Brazil in 1872, 1890, 1900, 1920, 1940, 1950 and 1960, and the trend of the population by state around the state of Maranhao is set forth in Figure IV-2. This shows the average increase of population of the states being equal to the state of Maranhao. It is estimated that during the decade from 1960 to 1970 the population of the state of Maranhao will show a sharp increase as in the state of Rio de Janeiro. Sao Paulo.

It is necessary, however, to make further analysis of the potential growth of cities. Sao Luis which is now the center of the state of Maranhao came under the administration of the Portugese governor-general in 1535, 35 years after the discovery of Brazil by Pedro Alvares Cabral. It was attacked by the French and the Spanish in 1615 and was occupied by the Dutch in 1641. In 1653 missionaries from the state of Bahia were appointed to develop the state, attaining success in 1778. A railway was established in 1907 up to Caxias. According to the Encyclopedia dos Municipios Brasileiros (Rio de Janeiro 1959 - Institute Brasileiro de Geographia e Estatico), there were 6 textile mills, 7 food processing mills, 14 chemical factories and 15 printing houses, totalling 105 establishments.

The census in 1960 lists 2,440 industrial establishments with an output of about 500 million yen or $ 1.38 million in all.

The city is as large as Aomori in northern Japan, Utsunomiya north of Tokyo, and Kochi in Shikoku. However, industrial development of it has been left far behind these cities. As is illustrated in Figure IV-3, it was developing once with Sao Paulo, but nowadays it is almost on a level with Manaus in the Amazon basin, and Teresina which is the capital of the neighbouring state of Piaui. As is illustrated in Figure IV-2, development of Brazil has been dependent upon the industrial development of the state of Sao Paulo, while in the north and northeastern region of the country development has been much retarded. Above all, Sao Luis which was the pivot of the whole Amazon river basin, having been called the country of Maranhao, had provincialism with the well-known group of Maranhao literature. It has been under the application of the Urban Preservation Act to keep scenic beauty as a Portugese colonial city. It can be said that this brilliant history might hinder possible development of it. It is just recently that a technical school was established in the city, although there has been a college of literature with a high level of culture. More people in the state are men of energy, compared with those of the state of Para.

Figure IV-4 indicates the progress of urban population of cities in which Sao Luis is included. It is conspicuous that Sao Luis has delayed in development in comparison with not only Fortaleza but also Teresina and Belem, becoming clas-

sified with Manaus. Figure IV-5 illustrates a distinct difference between the coastal city of Sao Luis and the inland city of Teresina. During the period of 1872 to 1890 the development of Recife, Fortaleza, San Luis and Belem had come down and at last stopped around the time of worldwide panic, while Teresina and Manaus had been growing.

Another fact we learned from the field investigation is that the development of inland transportation has been remarkable in Brazil in recent years, while the coastal cities have controlled unexpectedly small markets. This relationship could be proved by an example obtainable from the state of Ceara which has an intimate connection with the state of Maranhao (Figure IV-6).

Much of the terrain around Sao Luis island with the shape of a peninsular as seen from the air is swampy, the area of it being as large as the Kanto plain around Tokyo with towns and cities dotted here and there. In the interior beyond it several distributing centers developed with roads connecting them. A considerable volume of commodities are transported by trucks, not only from Recife but also from Sao Paulo.

From the beginning, development of the state of Maranhao has been made on the line connecting Sao Luis with Teresina, Caxias, Code and Rosario, by the river Itapecuru and a railway running along the river. Development started comparatively early in the valleys of the Paranaiba, Itapecuru and Mearim rivers. Victoria Mearim and Bacabal are examples of the development. It is estimated from

a large blank space on the map that in the south and along the valleys of the rivers Pindare and Gurupi, development has been much delayed. It seems that the progress of regional development in the past was determined by the stability of rivers as a transportation route.

From this viewpoint development along Route 22 will not be easy, and lack of forethought and deliberation with regard to adequate construction works may be the cause of inundation of the road between Bacabal and Pindare-Mirim during the rainy season.

It is praise worthy that the inland transportation has been developed with much enthusiasm. However, there are some points in it indicating that over-all consideration was not comprehensive in the planning stage.

On the other hand, the decline of coastwise shipping is so vital that we can not overlook the problem in the development of Brazil. For instance, Belem, which is an important port of the Amazon river valley, has been disliked by trading companies due to unsatisfactory conditions on the waterway around it, old customs of trade, bureaucracy of the custom office there, and low labor efficiency in loading and unloading. A set of these adverse situations is a big bottleneck to any economic development.

It can be said that dark clouds hover over the sky of the economy of Brazil; but it is needless to cite the criticism of professor Paul Prebisch that to overcome the crisis a stabilized food supply has to be ensured and foreign trade

increased. Development of foreign and home trade in every coastal city is strategically of great importance.

Therefore, if development of the state of Maranhao were carried out independently from other regions but attaching much importance to the inland connection, it will be difficult to expect fundamental improvement from it.

Basic strategy of the development of the state of Maranhao necessitates that industrial development of the coastal city of Sao Luis should be carried out first, extending the influence of it to the cities and towns of the interior. Therefore, development of Itaqui port now in progress and construction of a new industrial center around it would be the foundation of development of the state of Maranhao. We were told about the latter at the state committee SUNDEMA, and this development of a new industrial center is still in the planning stage.

4. Administration to establish Wood industry in Sao Luis

From the foregoing commentary the reason why Sao Luis has been selected as a key base of a wood industry will be readily understandable. To summarize:

(1) Sao Luis has potentialities as a city,

(2) an adequate residential area is obtainable for engineers and managers of the industry,

(3) it will be able to play a fundamental role for the development of the forest resources along the Amazon valley when there are too many problems in Belem,

(4) public investment will contribute much to establish and operate a pulp plant and a plywood plant on a sound basis under the new industrial city planning,

(5) conversely, without an integration of the wood industry, development of Sao Luis will be almost impossible,

and

(6) it is now the South that controls the foreign trade of wood products, but the geographical location of Sao Luis is favorable for exporting the products to the United States of America and Europe due to the considerably shortened distance between them (see Figure IV-7)

With the above comments in mind, the following supplementary items as to the administration of the wood industry in Sao Luis are given.

(IV-A) Logs to be manufactured now in Sao Luis come chiefly from the Paranaiba and Itapecuru valleys via Rosario, and lumber comes from the South. On the other hand, to Fortaleza a large volume of logs have been shipped from the state of South Bahia. Therefore a more profitable way to import logs will be needed. (see Figure IV-8)

(IV-B) Under the present capacity of transportation facilities, continuous import of logs from the Itapecuru and Paranaiba valleys will

be possible also in the future. If, however, a large volume of logs has to be obtained, forest resources in the Amazonas valley or the interiot of the state of Maranhao will have to be developed, and this necessitates close attention being paid to the exclusive use of log transport-ships and logging labor organization. A long range and stepwise project would be indispensable to harvest logs from the Pindare and Gurupi valleys.

(IV-C) The integration of the wood industry in Sao Luis should be made as a part of the new city planning there.

(IV-D) Under the present conditions, local labor should be employed for unskilled service. The main services to operate the industry will have to be done by a group of competent workers who have been trained in other regions. Furthermore, education would be necessary for the workers to fit them for their duties, so an engineer to lead them should be invited from some advanced country, for instance, Japan. In judging apptitude for manual and administrative assignments, we formed the opinion from association with many Brazilians we met that they had an easy-going way of thinking on matters gen-

erally, and this leads us to call attention on the problem, emphasizing the fact that success of the porject depends upon the degree of effort and competence of the employee.

5. Marketing Project of Wood Products

It is a well-known fact that without sale business can not stand up. It is marketing that would be a cause of worry in the integration of the wood industry in Sao Luis. As can be easily understood, ambiguous expectations of possible demand is one thing, whereas the continous operation of the industry on the basis of collection of bills accepted for the sales of the products is quite another. In other words, positive results can come only from positive efforts.

What is most desirable to be understood here is the characteristics of the project. For instance, the South has been playing a dominant role not only in foreign trade and in introduction of foreign capital, but also in a series of undertakings in domestic markets due to its favorable resources and monopolized industrial power. Fortaleza has been conducting trade with the state of Bahia and the Amazonas valley with rich forest resources on the strength of its expansion power and activities of marchants there. We found that prices of logs there are lower than those at Belem where logs are produced. In other words, price level of logs is lower in the consumers' territory than at the source.

An new pulp plant recently built at Belem and employing

120 workers has been producing 10 tons of two kinds of paper daily, its market reaching as far as Brazilia. Seventy per cent of the raw materials of the mills depends upon low quality hardwood and the rest upon wastepapers. This is a remarkable example of success.

A pulp plant which we recommend be built in Sao Luis has a capacity of producing 100 tons of pulp per day. Expenses for the project is assumed to come from private capital being supported by SUDENE. In order to build a plant with that capacity, a definite resolution to start with even no capital, would be desirable to work out the project. At the same time it must be prepared for a challenge that might be made by southern capital.

There are other difficulties in this problems. In Brazil the quality of paper in use is lower than we expected; but it seems that this is a matter of custom as people there are satisfied with it apparently. Obviously it will not be easy or simple to elevate suddenly the consumption level of good paper in all aspects of daily life.

Even in large cities like Sao Luis and Bacabal, very thin paper which looks like wrapping paper is in common, the monthly average consumption of paper per capita being two kilograms. In a small village named Altturi, which was built to develop forest resources at the end of Route 22, we found that rough brown paper was used for wrapping, writing and other daily uses, the monthly consumption being two kilograms in the average family. In addition, a comparatively large

amount of newsprint is consumed here, 70 per cent of which is imported from foreign countries.

Papers in use are transported from Sao Paulo and Recife by road. Being difficult to produce grand pulp to manufacture newsprint from forest resources in the Amazonas valley where only hardwood forests are growing, the production of newsprint by a new pulp plant here will not be able to meet the shortage of it.

If they are unduly hasty in finding a way out of the difficulties, many setbacks will arise. First of all, marketing capacity of a manager of the plant will come to the fore. Even in a large plant like this under government control, it will be difficult for him in general to set aside his capacity of marketing, if manufacturing processes demand the greater part of his time and attention. It is under these circumstances that government assistance should be extended to the marketing phase of the project.

One such form of assistance could be exporting backed by the government, and another that of positive purchase of as much the products as possible by the federal and state governments.

As to the purchase by the federal and state governments, it will not be impossible to institute an inspection system for all staple agricultural products including rice, with an obligation to use stout paper bags to contain them. In the state of Maranhao 420 thousand tons of low quality rice is produced annually, which is one of the most important products of the

state.

On the other hand, it will not be easy to export the paper to other regions of the country, as the shipping expenses, for instance, to the South would be as much as shipping to foreign countries. Therefore, paper markets in Europe and Africa will be favorable for them. Investigation of the paper markets in Europe reveals that Sweden's big share of the market is being steadily diminished by American penetration in recent years. The problem being under the application of assistance of developing countries by OECD, the market in Europe would be larger than in Africa. In this sense efforts should be made to persuade the United States of America to purchase the products from Brazil.

Considering all aspects of outlets of marketing, if success is to be attained, it would be necessary to have 60 to 70 per cent of the products exported or purchased by the government or public entities. The same applies to the plywood industry. The low level of home consumption of the products will demand export and in this case the opening of new export markets will be needed, one way of achieving it being to seek possible cooperation with Japanese companies.

6. Summary

The state of Maranhao is located administratively along the western boundary of the northeastern region of Brazil, occupying naturally an eastern corner of the Amazon river basin. It will be completely meaningful to make a plan of

regional development based on wood industry, discussing the possibility of it with an aim to give life to the salient features of the region.

The history of development of the Amazon river basin is long, going back many years, but no efficient measures for it have been worked out. Nevertheless, the northeastern region of Brazil became famous for its effective development in the early stage of opening up the country. In contrast with the Amazon basin where social conditions are still controlled by natural environments, economic society of the northeastern region where European emigrants have taken the lead has been successful in operation of more artificial controls.

A sound foundation on which to work out a regional development policy such as the state of Maranhao is now contemplating could advisedly be on the lines of the above-mentioned economic society by making use of the forest resources in the Amazon basin.

Our social and economic investigation leads to the conclusion that establishment of a wood industry around a kraft pulpplant in the state of Maranhao will make it quite possible with collective power between the industries concerned to carry out agriculture, industrial and urban development in the state, and in consequence will bear fruit in constructing a base for further development. These development procedures should be instituted in parallel with development of the forest resources along Route 22.

It is from this standpoint that physical plans are un-

folded in chapter 2 and chapter 3. In this chapter in conformity with the foregoing chapters, supplementary items for administration are clarified under the present regional development. Summing up systematically the outline of the policy, it will necessarily follow that:

(1) Development of the state of Maranhao has been supported by the inland growth. However, to achieve economic and social advances for the state of Maranhao in this age of rapid development, Sao Luis should make a restart as an industrial city to follow Fortaleza.

Sao Luis, which is located on the Atlantic coast between South Brazil and advanced European countries with positive inhabitants and respected high culture, has a number of merits to qualify it as an industrial center with a trade port. If a new industrial community were opened in Sao Luis with development of Itaqui port, it will be oil resources in Litoral Nordeste area now under development and a wood industry complex with abundant forest resources in the Amazon basin that will support future growth of the city. Should it happen that an oil development program could not be arranged, the future of the state of Maranhao will depend upon the success of the development of the wood industry now under consideration.

(2) It is suggested that a wood industry complex with a

pulp plant as the center of it be established in Sao Luis. After investigating findings of the Ohmi survey team that aimed at constructing a pulp plant and so forth, we reached the conclusion after the field investigation that the scale of the plant as was designed by the team would be plausible, but as to the manner of operation and location of the plant, its conditions must be constrained. The Ohmi report suggests the possibility of establishing a pulp plant on Route 22 and logging the forest resources in the interior of the state of Maranhao, particularly forests along the Pindare and Gurupi river valleys.

Investigating in detail the economic conditions of the scheme, a wise step will comprise making use of the conventional marketing system of timber. Route 22 has no power to attact techno-structure (a new word used by professor J. K. Galbraith) and skilled labor of the wood industry, but Sao Luis is rich in culture and will be able to attract necessary man-power within the state at any time.
At present a greater part of the logs consumed in Sao Luis are transported along Route 21 connecting with Teresina and a railway. In addition a much bigger volume of logs is transported to Fortaleza from the Amazon river valley via the offing of Sao Luis. And Sao Luis will be able to make the

best use of the conditions without any investment. Under these circumstances the order of development of the project in instituting a wood industry in Sao Luis should start at first by making use of the logs coming into the above markets regularly and developing the forest resources along Route 22 from Pindare-Mirim which is the base of logging in the project. Then, extend an investment to a large scale development of the forest resources along the valleys of the Pindare and Gurupi rivers only after the management of the industry has acquired a satisfactory routine and become stablized.

(3) Integration of the wood industry in Sao Luis will be effected best on the basis of social investment of a new industrial city planning. Development of the forest resources in the Amazon river basin is to attack one of the most difficult problems that the contemporary human being is facing. It will be wrong to leave everything in charge of a medium-sized business company in this important investment project. Such basic investment to establish the plants should be made by the government as a part of the new industrial city planning.

(4) Input of labor, Techniques and Materials for Operation of the Wood Industry

A point worthy of stressing as to conditions of labor and techniques is to train skilled technical and

managerial personnel in other regions. When such a group of nucleus has been secured, it will not be difficult for them to collect excellent but comparatively low-wage manpower.

Concerning the input of logs, the first thing to do in parallel with the development project of the forest resources in the area connecting Sao Luis with Route 22 will be to recognize the greatest importance of transportation between Sao Luis and Teresina. The second point claiming deliberation is water and marine transportation, especially along the Amazonas river valley. For this purpose attention should be paid to the building of wood transport-ships. If this project were realized, export of wood chips to foreign countries (for instance, Japan) can be planned.

(5) Project of Production

This vital aspect of industry depends upon the manufacturing programme of each plant and successful marketing of its products. For this purpose demand for the products by the government will be most necessary. Further, the government should offer aid to promote the export of the products to foreign countries where a market has been opened. Secondly, in parallel with the inspection system of agricultural products, obligatory use of rice bags and purchase of the wood

products by the state is also desirable.

There is, however, the risk of possible collision with the marketing system of southern capital. As compatibility of both is essential for achieving sustained prosperity, causes for apprehension must be removed.

(6) It is suggested here that projects be established for land use and farm management including utilization of forest resources along the valleys of the Pindare and the Gurupi rivers in addition to the city planning of new and old Pindare-Mirim.

First of all, difficulty of development of the Amazon forests consists in the impracticability of shifting cultivation with depletion of forest resources there. However, we can not support sudden utilization of modern techniques of farm management.

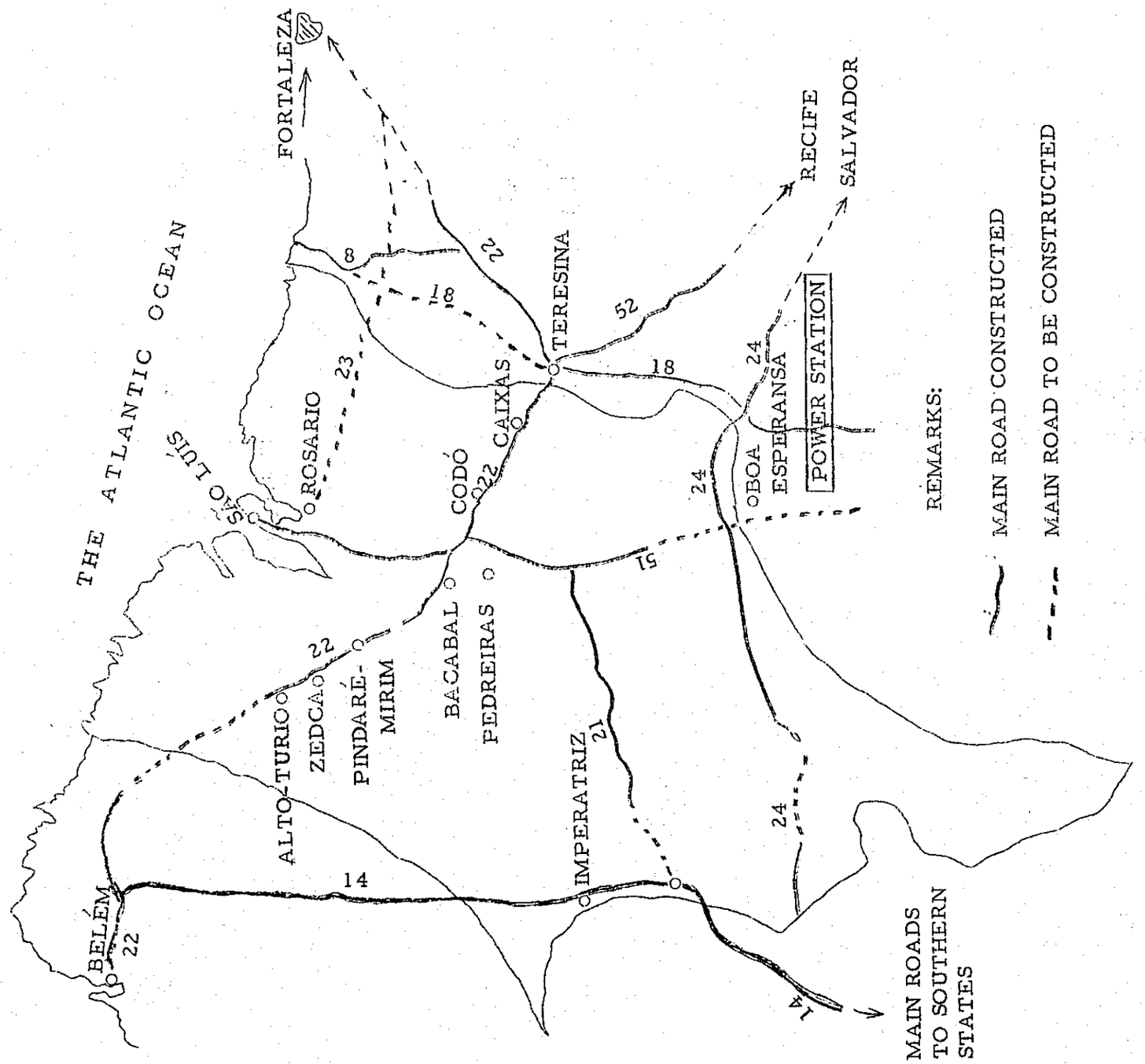
It will be indispensable first of all to recognize the status quo of agriculture and forestry in the region. Actually, dominant land use there is for raising rice and babacu on a very small scale by individual families. To remedy this a land management project to shift cultivation on a comparatively large scale, and repeated in stages consistent with good forestry will lead to praiseworthy results.

(7) City Planning of Pindare-Mirim

City planning of Pindare-Mirim should be com-

prised of a system that links with Teresina, Caxias, Codo, Bacabal and Sao Luis, improving their closed, isolated characters of the conventional project up to this time. In addition, adjustment of the marketing system and improvement of quality of the agricultural, forestry and aquatic products, which could be facilitated by forming centers of their production bearing its trade-mark should be undertaken.

Finally, engineering works by public investment, particularly improvement works of river in addition to construction of roads and bridges should be promoted to increase employment, which is an investment for future development.



REMARKS:

MAIN ROAD CONSTRUCTED

MAIN ROAD TO BE CONSTRUCTED

ROAD DEVELOPMENT MAP
OF THE STATE OF MARANHAO

TABLE IV-1-a ROAD DEVELOPMENT MAP OF THE STATE OF MARANHAO

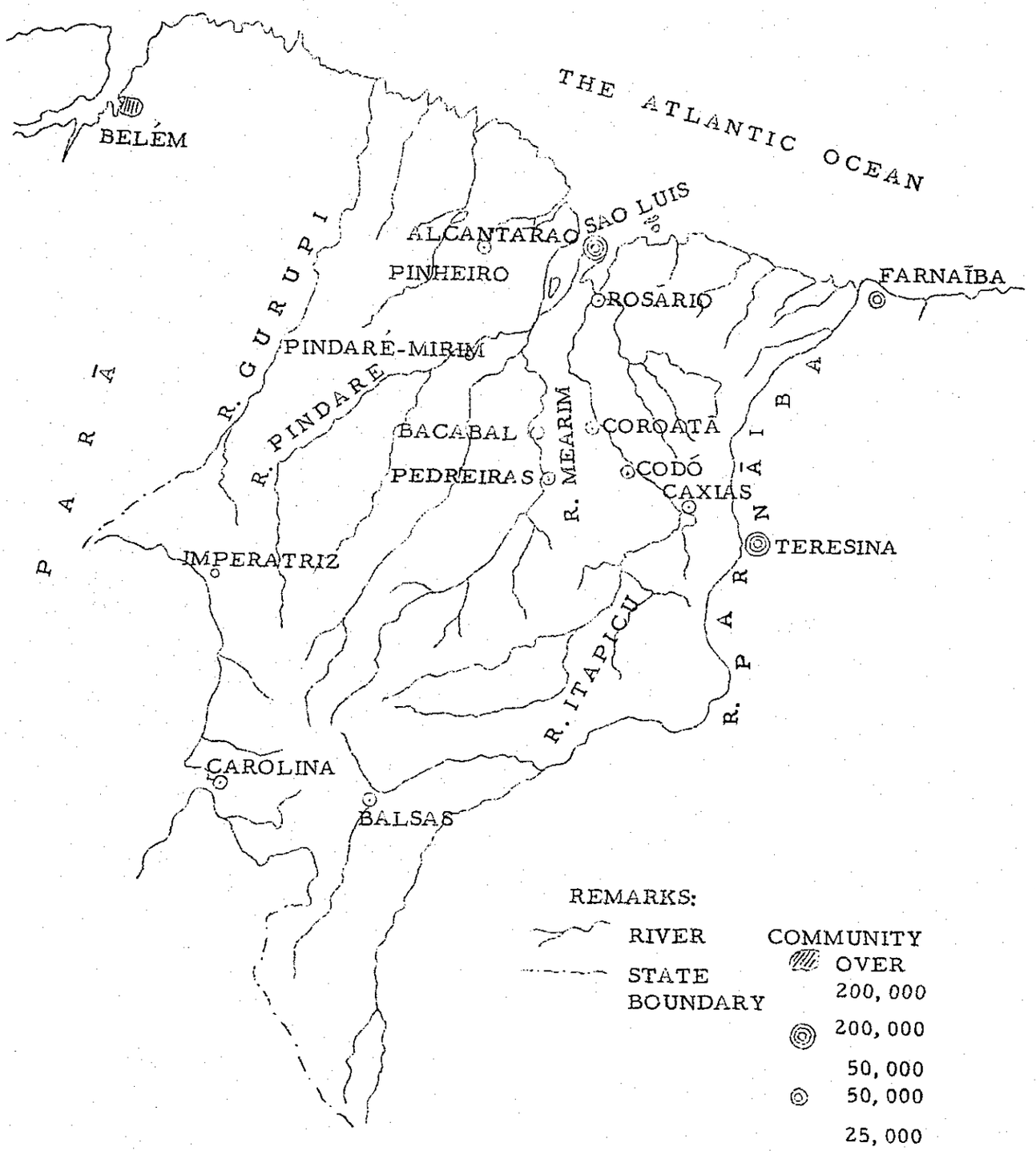


TABLE IV-1-b MAP OF MARANHÃO

MAP OF MARANHAO

TABLE IV-2 GROWTH OF POPULATION BY STATE AND COUNTRY

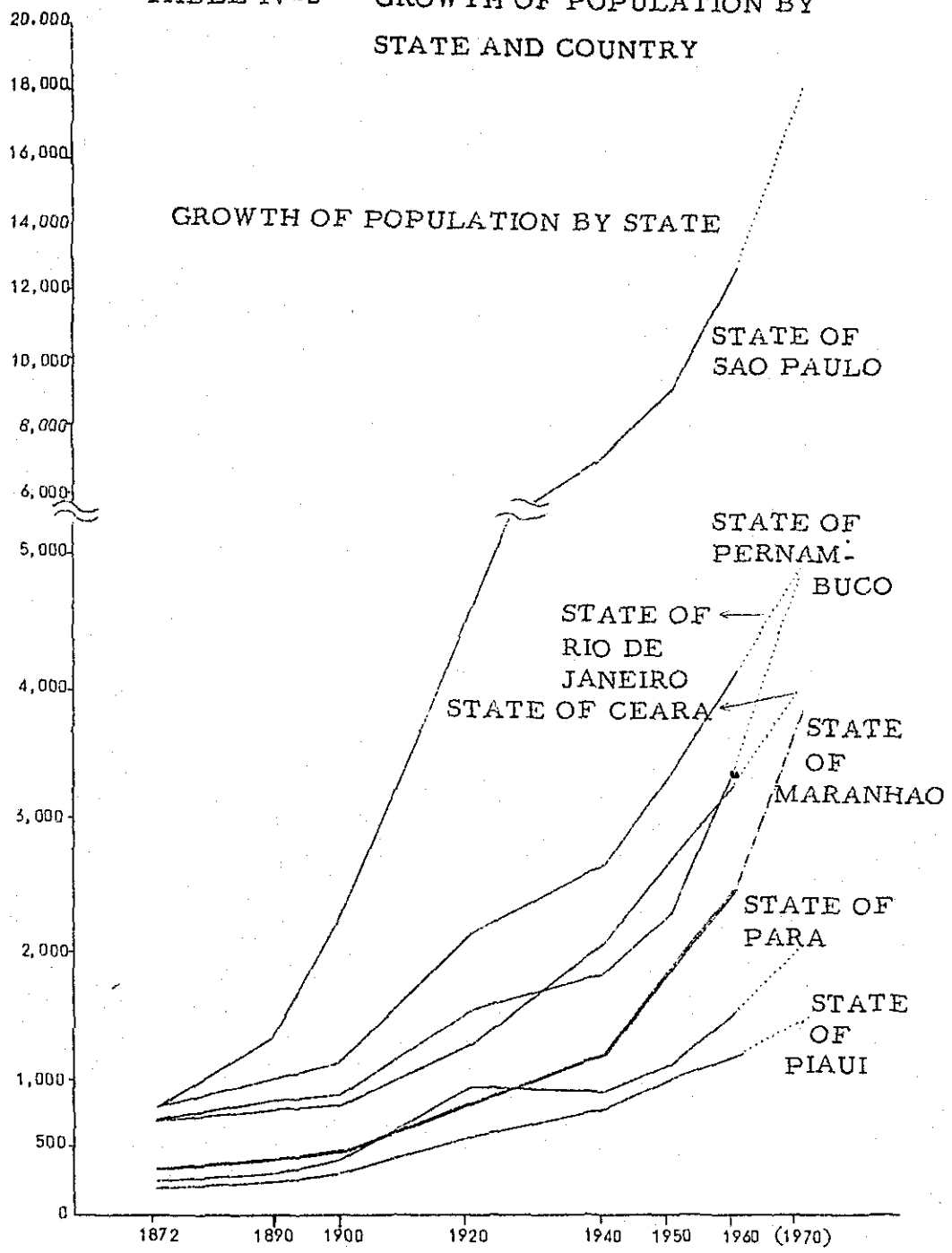


Table IV-2

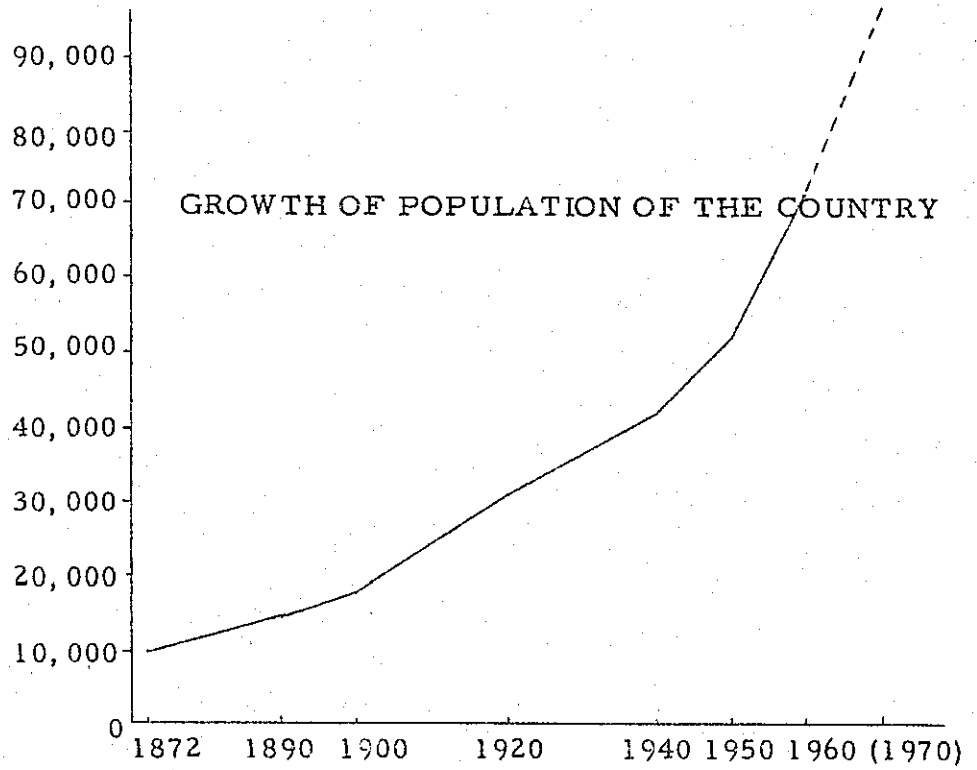

GROWTH OF POPULATION OF THE COUNTRY
90, 000
80, 000
70, 000
60, 000
50, 000
40, 000
30, 000
20, 000
10, 000
0
1872
1890
1900
1920
1940
1950
1960
(1970)

TABLE IV-3

TRANSITION OF POPULATION RATIO

BETWEEN RIO DE JANEIRO AS THE BASE

WITH LEADING CITIES

Year	SÃO LUIS	TERESINA	RECIFÉ	FORTALEZA	BELÉM	MANAVS	SAO LVIS
1872	11	-	42	15	22	10	11
1890	5	5	21	7	9	7	12
1900	4	4	13	5	11	6	29
1920	4	3	20	6	20	6	50
1940	4	2	19	10	11	6	75
1950	5	3	22	11	10	5	92
1960	4	6	24	15	12	5	115
(1970)	4	5	26	21	13	4	144

REMARKS: FIGURE OF 1970 IS ESTIMATED

Table IV-4

TABLE IV-4-a

GROWTH OF POPULATION IN LEADING CITIES

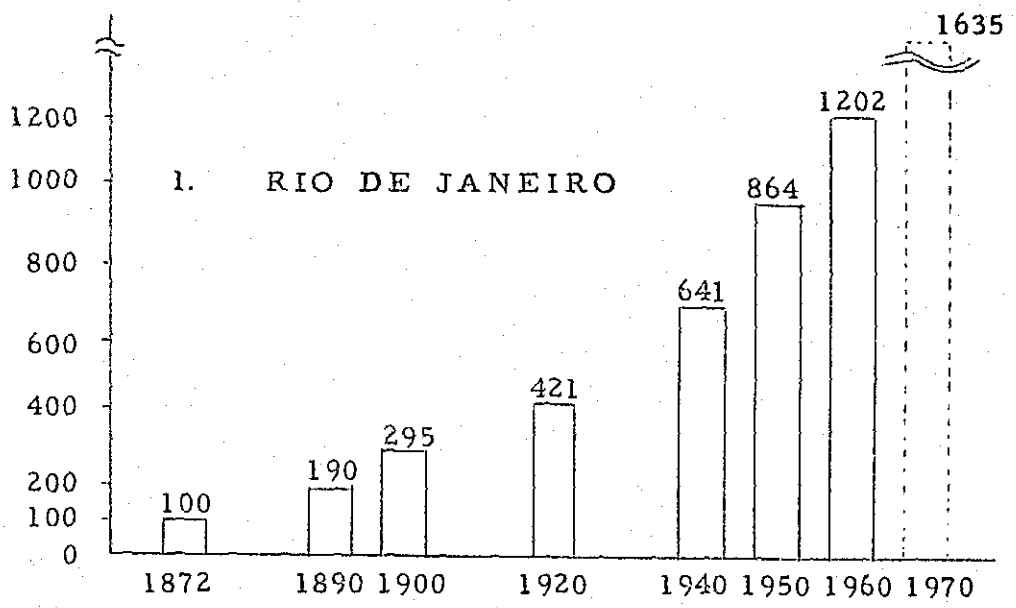
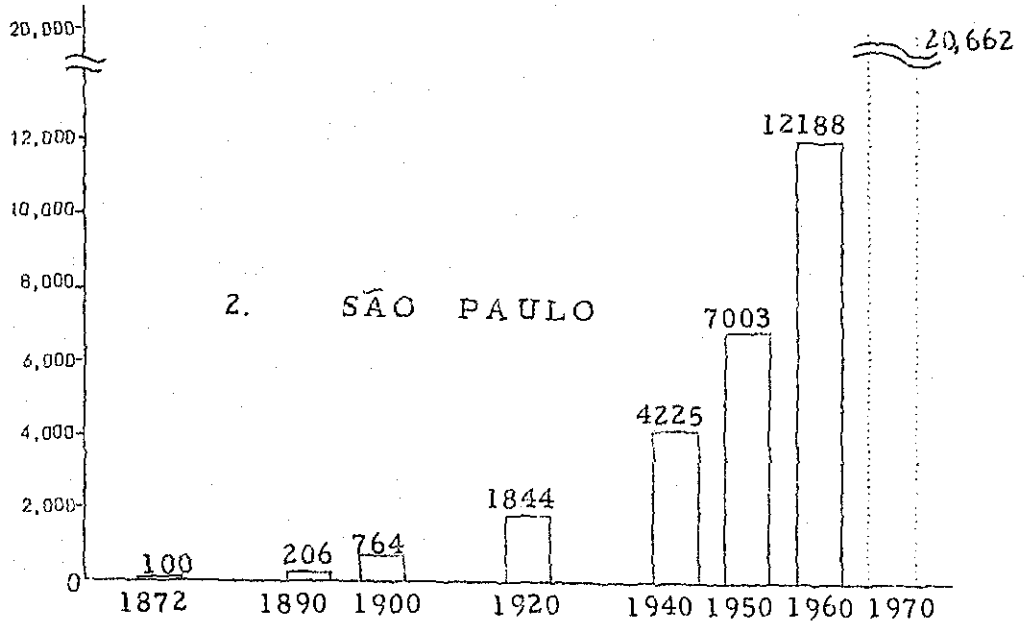


Table IV-4


20,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2. SÃO PAULO
100
206
764
1844
4225
7003
12188
20,662
1872
1890
1900
1920
1940
1950
1960
1970

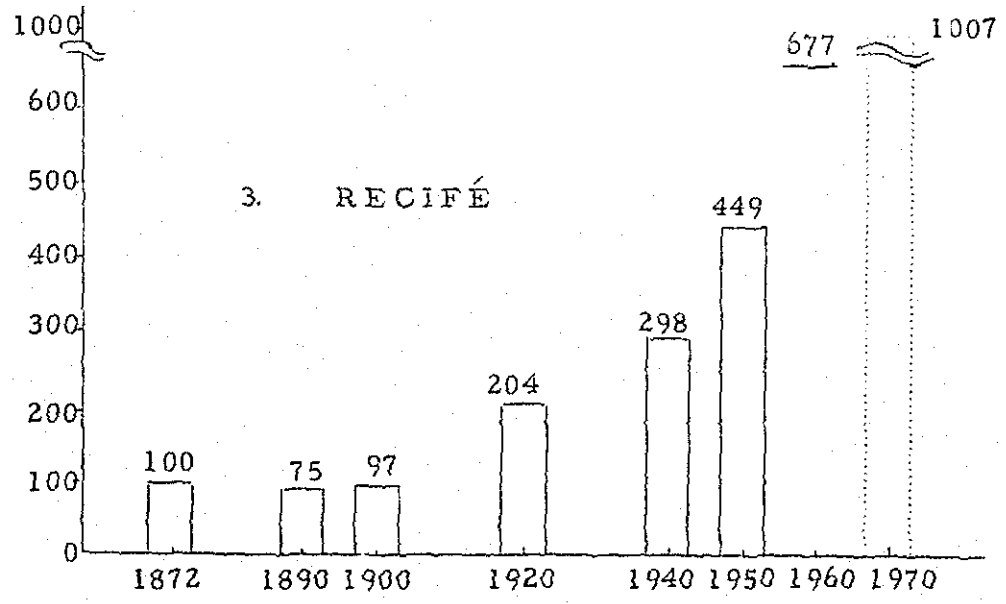
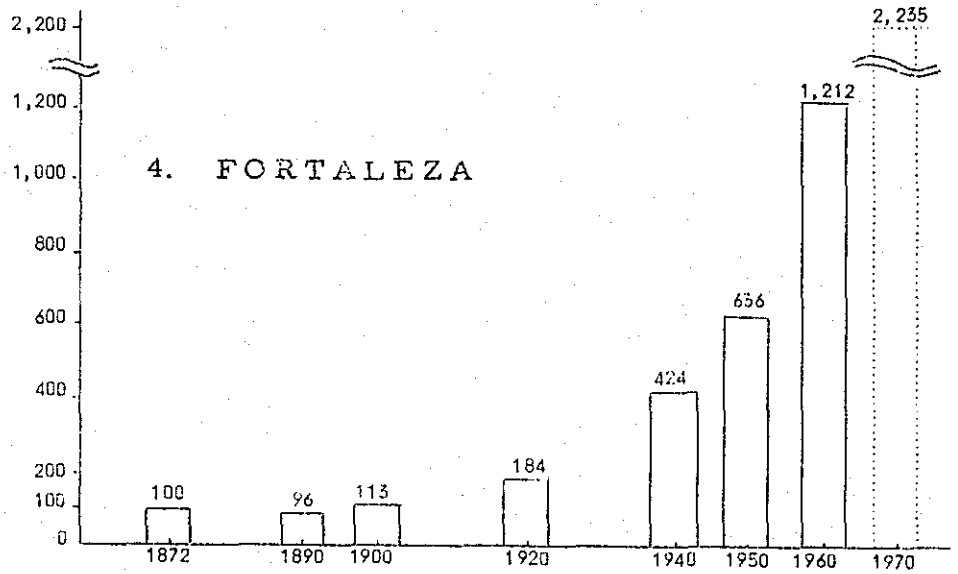

1000
600
500
400
300
200
100
0
3. RECIFÉ
100
75
97
204
298
449
677
1007
1872
1890
1900
1920
1940
1950
1960
1970

Table IV-4-a


4. FORTALEZA
2,200
1,200
1,000
800
600
400
200
100
0
100
96
113
184
424
656
1,212
2,235
1872
1890
1900
1920
1940
1950
1960
1970

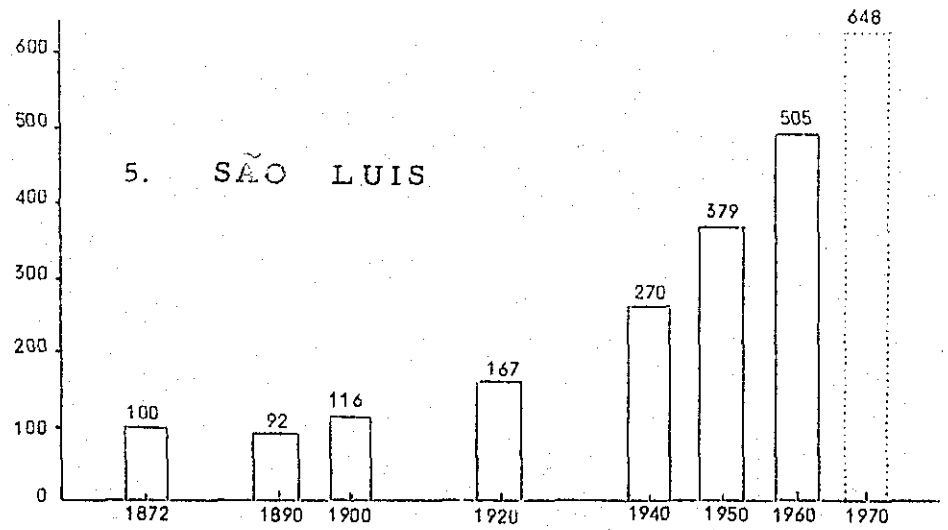

5. SÃO LUIS
600
500
400
300
200
100
0
100
92
116
167
270
379
505
648
1872
1890
1900
1920
1940
1950
1960
1970

Table IV-4

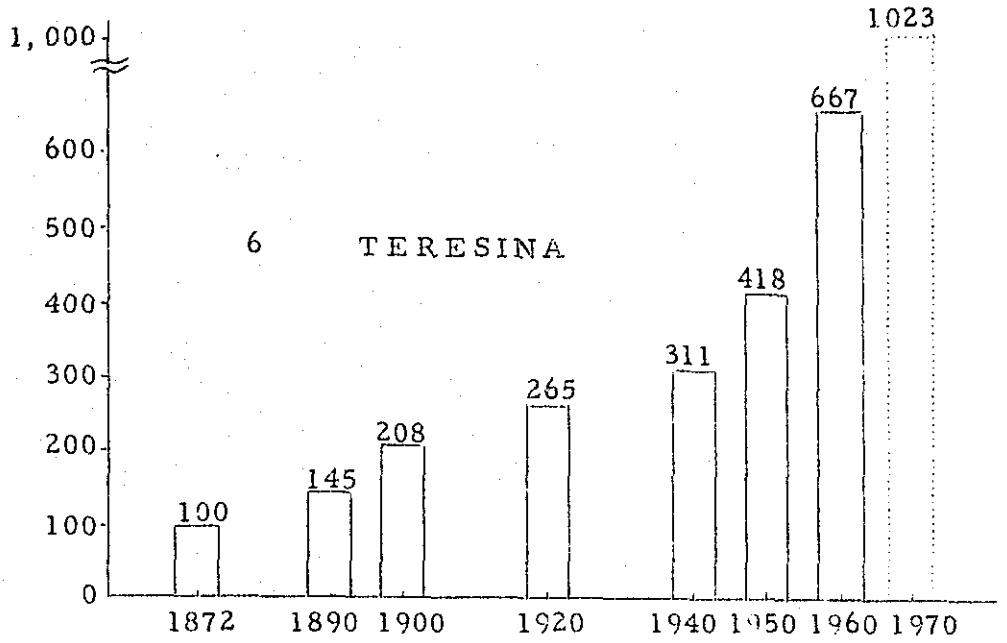
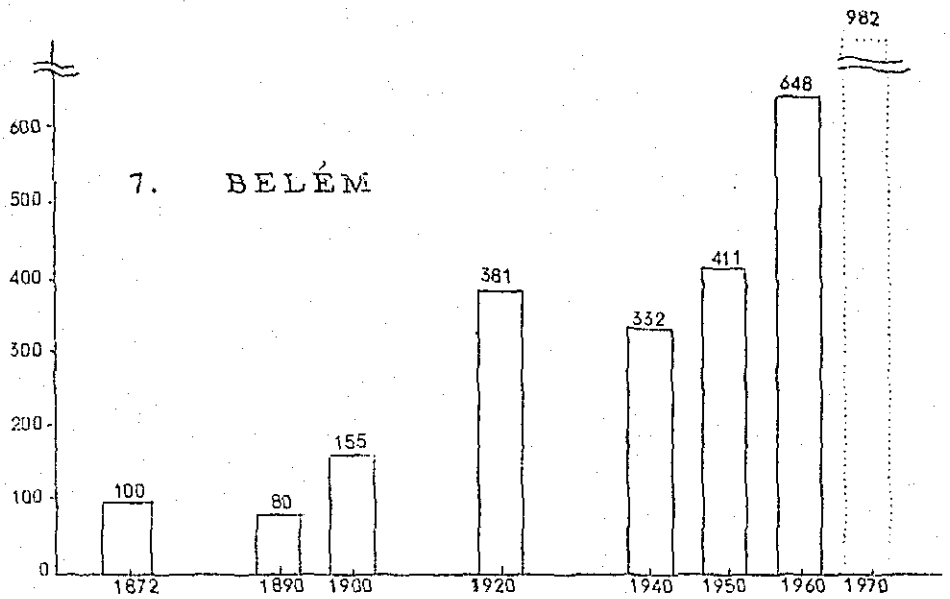


TABLE IV-4-b

Table IV-4

TABLE IV-4-c



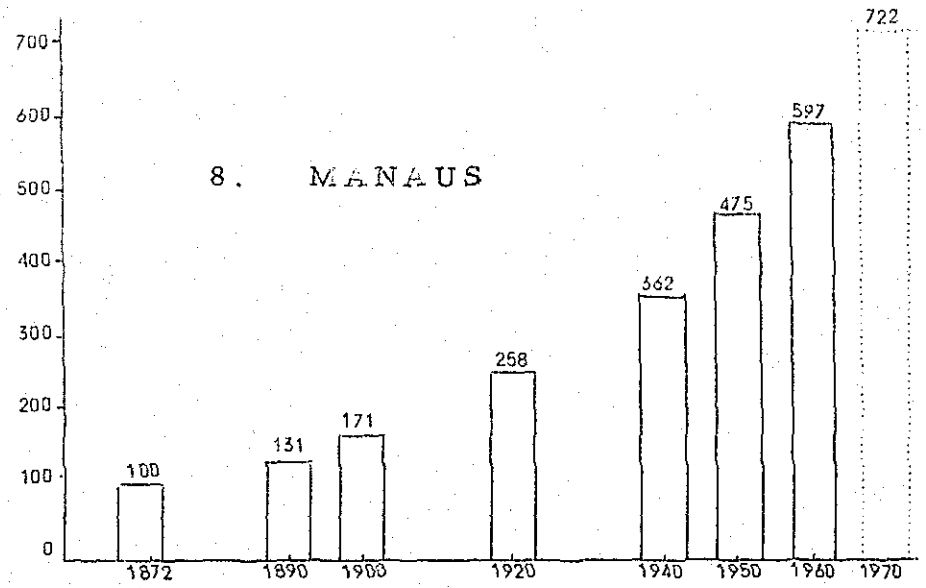


TABLE IV-5 RATIO OF POPULATION OF LEADING CITIES TO THE PREVIOUS CENSUS

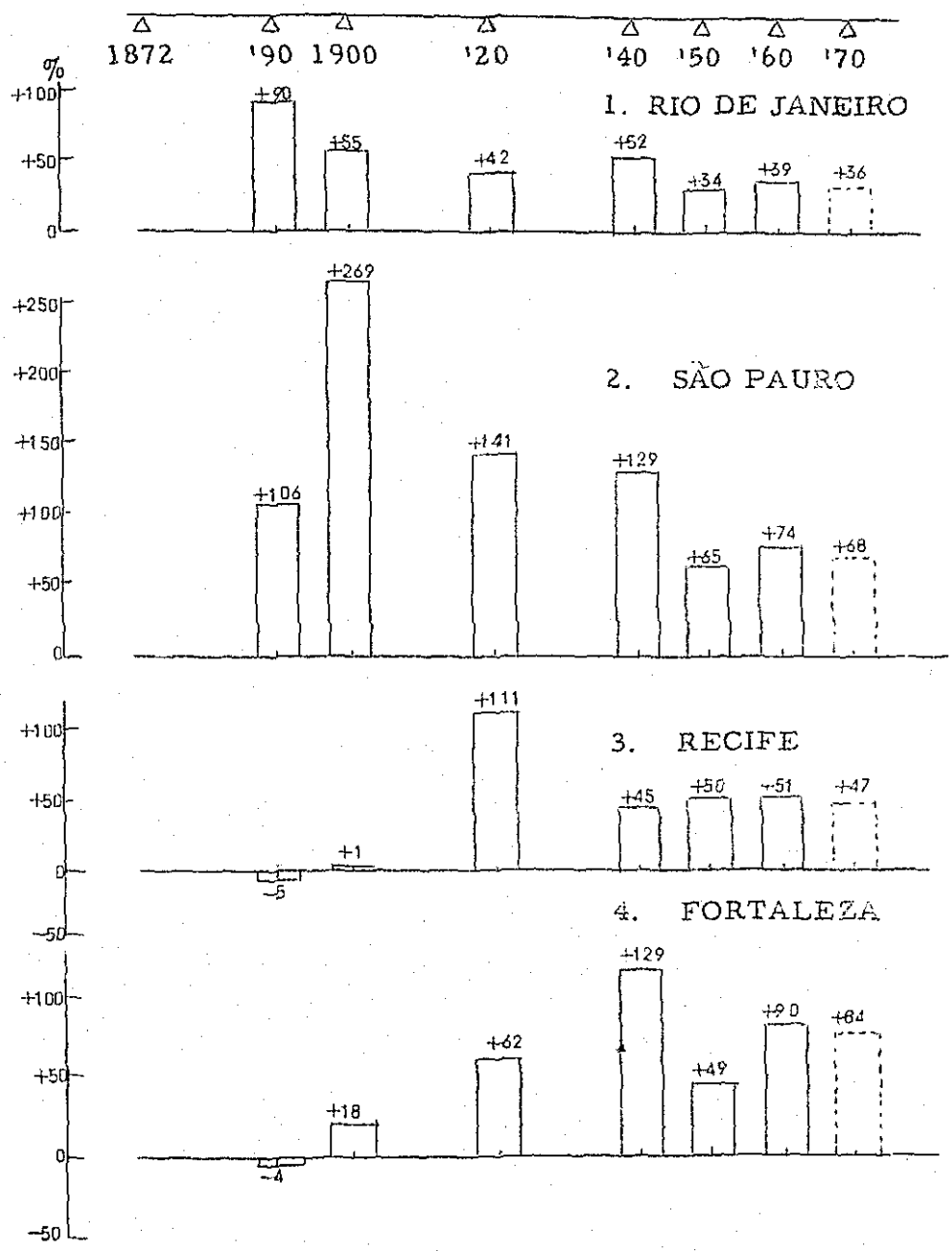
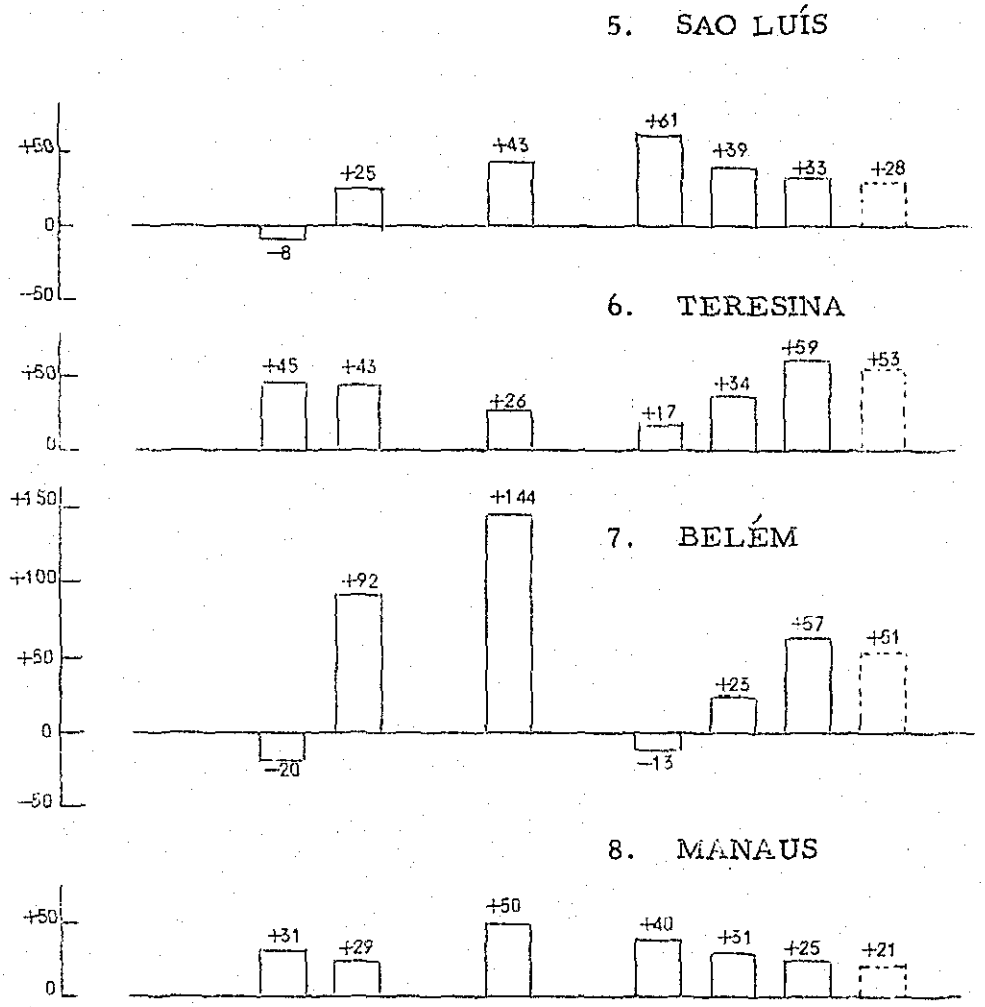


Table IV-5


5. SAO LUÍS
+50
0
-50
-8
+25
+43
+61
+39
+33
+28
6. TERESINA
+50
0
+45
+43
+26
+17
+34
+59
+53
7. BELÉM
+150
+100
+50
0
-50
-20
+92
+144
-13
+25
+57
+61
8. MANAUS
+50
0
+31
+29
+50
+40
+31
+25
+21

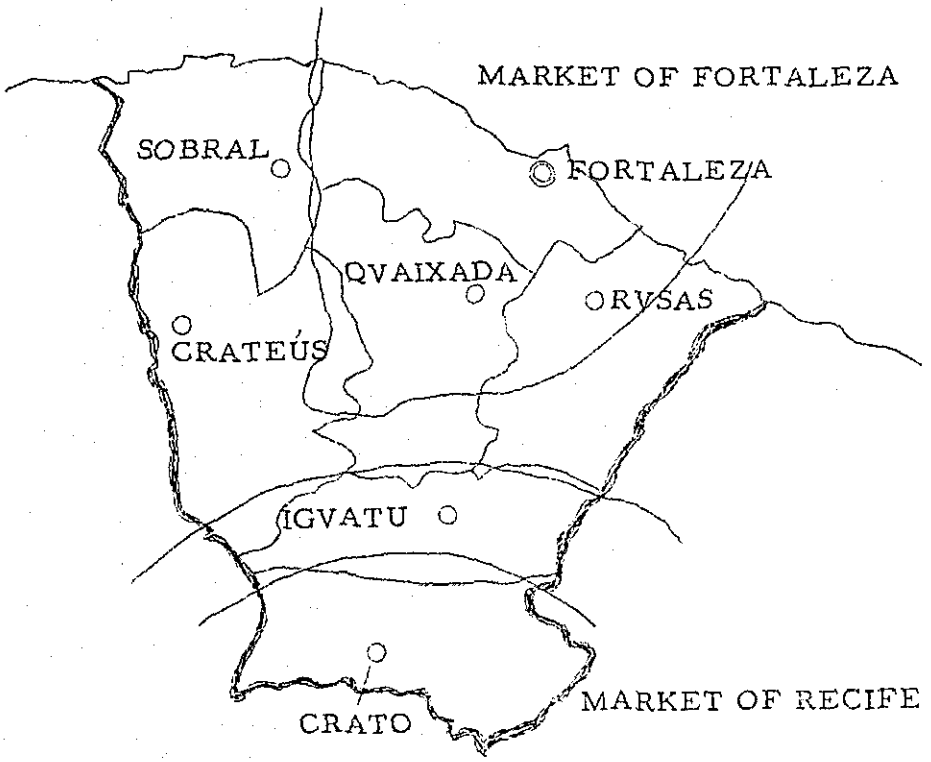


TABLE IV-6 SPHERE OF WOOD MARKETS BETWEEN INLAND AND COAST MARKETS

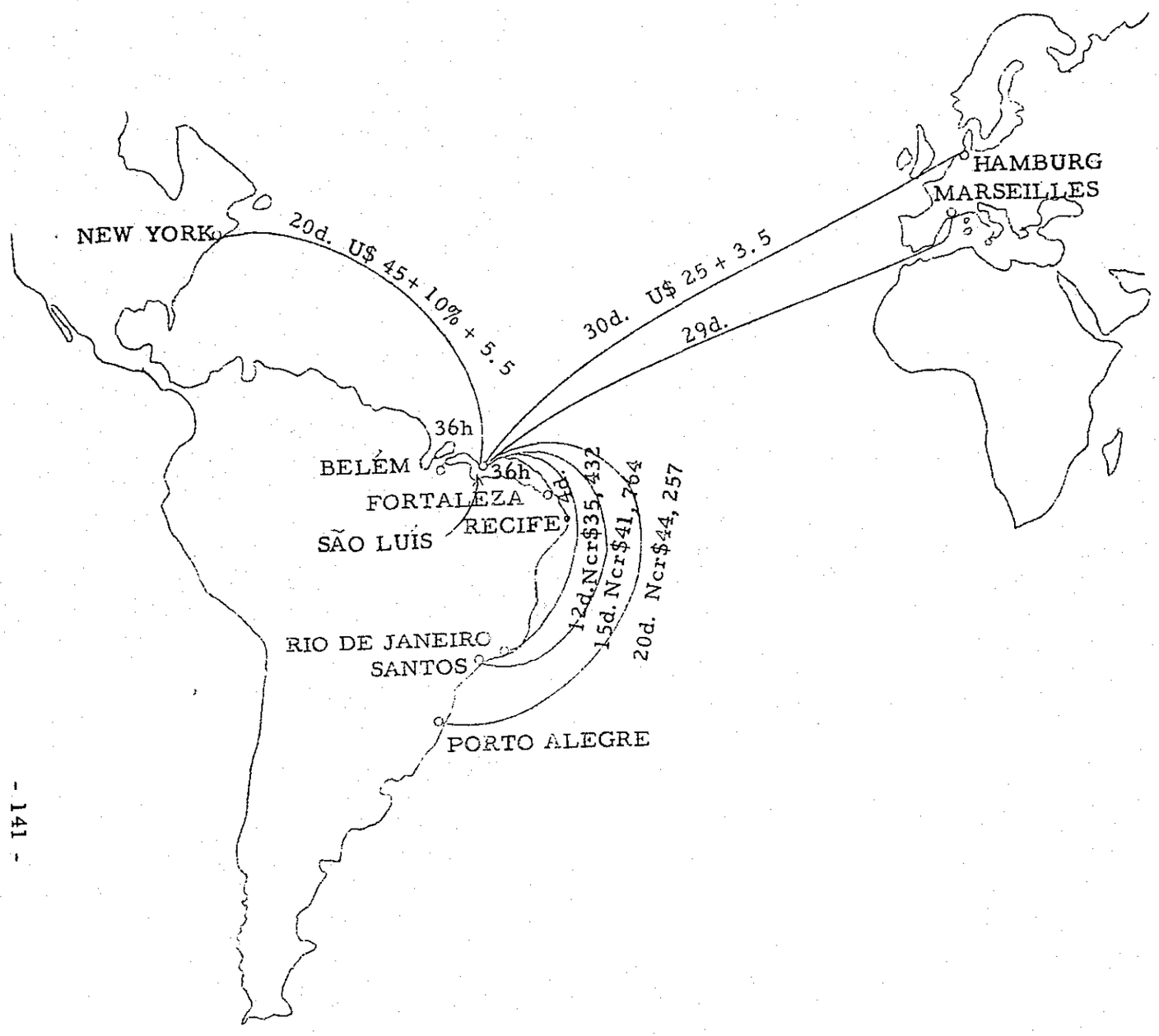


TABLE IV-7 DISTANCE AND TRANSPORTATION COST BETWEEN SÃO LOUIS AND LEADING PORTS.

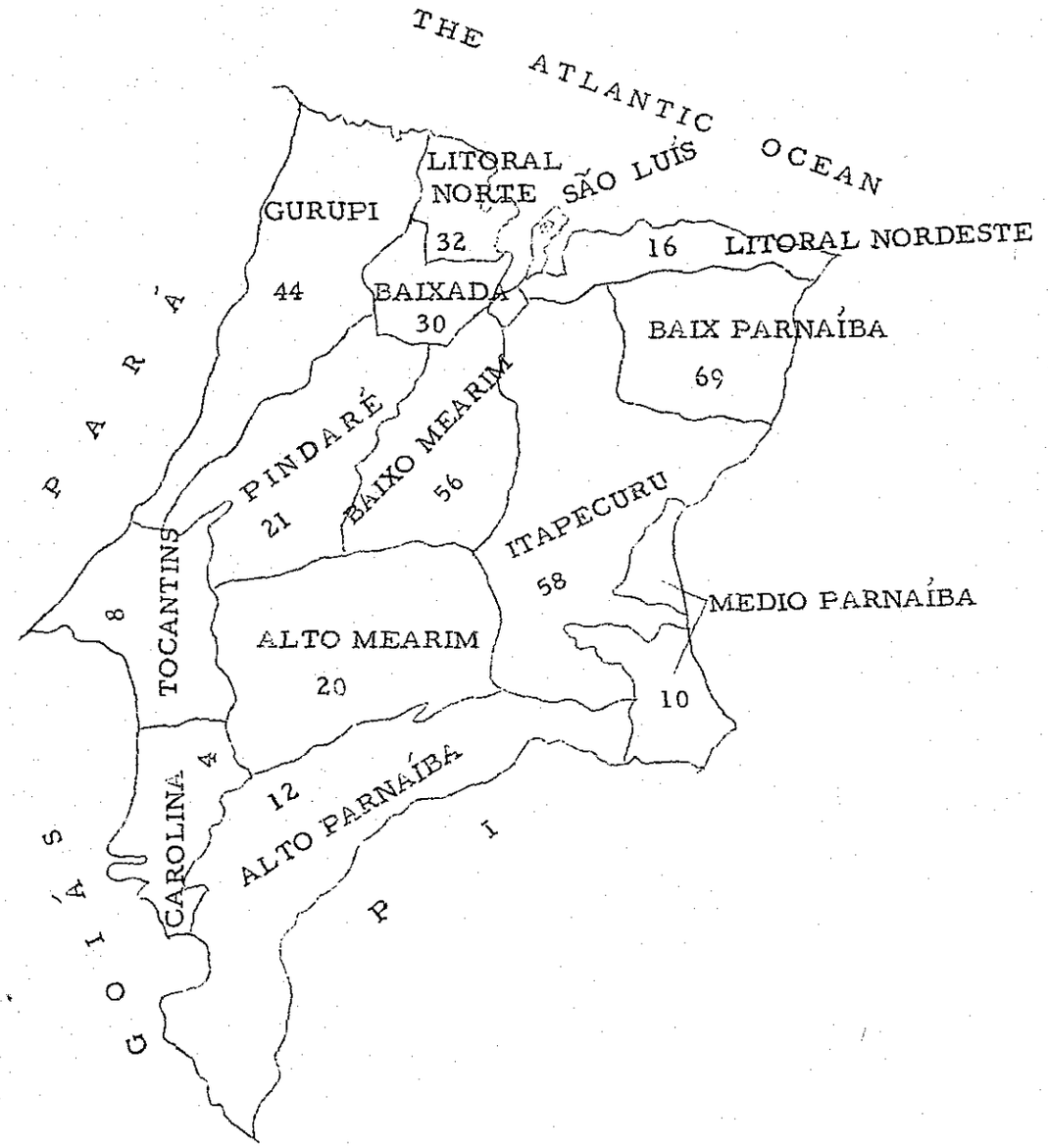


TABLE IV-8 AREAS AND DISTRIBUTION OF POPULATION IN THE STATE OF MARANHAO IN 1964 (UNIT = 1.000)

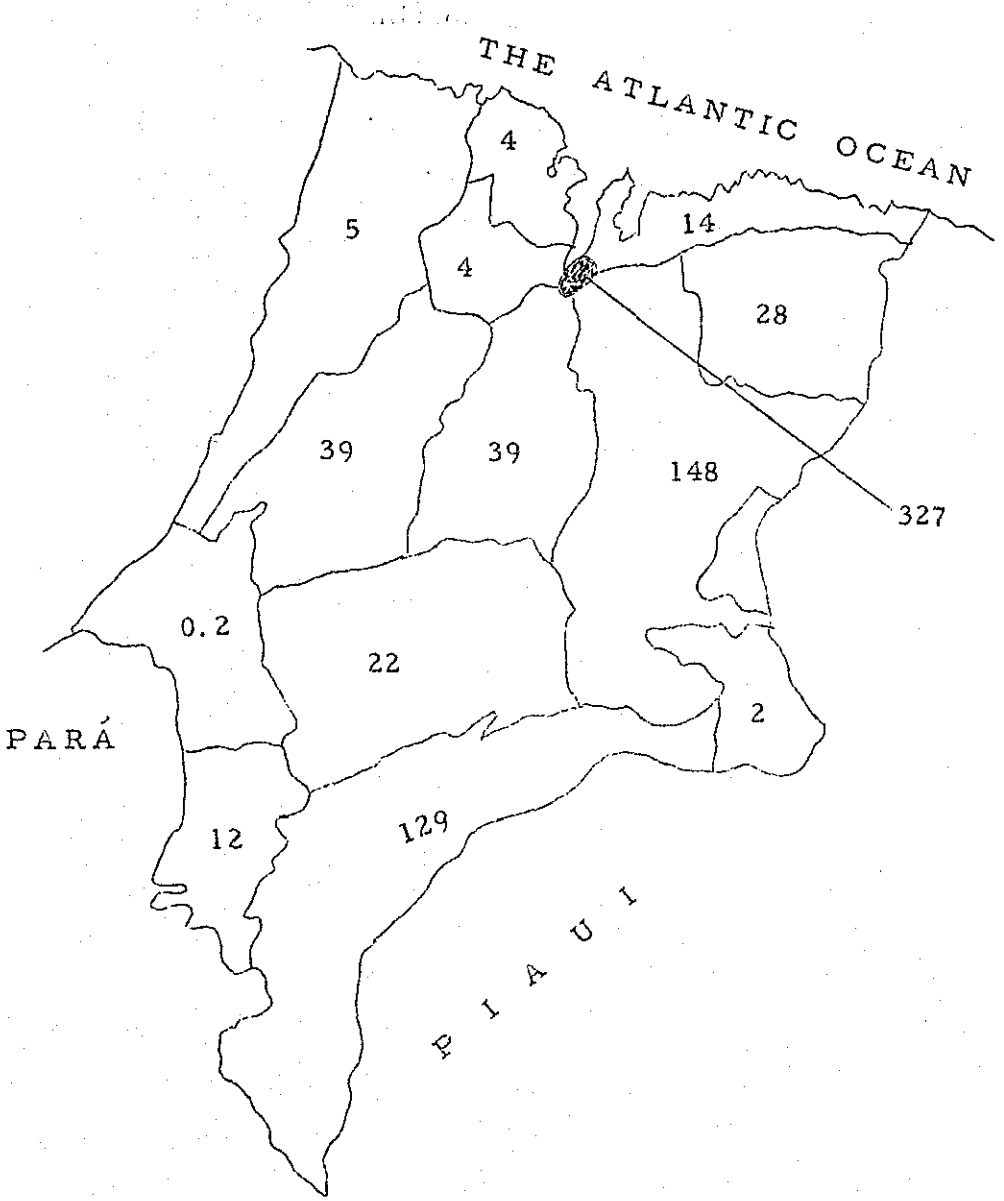


TABLE IV-9 LOG PRODUCTION BY AREAS IN THE STATE OF MARANHAO.

(UNIT = 1,000 Cubic Meters)

Kraft Cooking and Bleaching Experiment of Brazilian wood

Principal Researcher:	Tadashi Yamamoto
Experiment Place:	Central Research Institute Jujo Paper Company
Experiment Period:	March 4, 1968 - April 22, 1968

1. Introduction

On the request of the Government Forest Experiment Station, Ministry of Agriculture and Forestry, kraft cooking and bleaching experiment were carried out to determine the adequacy as pulpwood and the quality of bleached pulp about various test pieces of tree species obtained by Takeshi Uemura, chief of the Wood Technology Division, Government Forest Experiment Station, in the state of Maranhao, Brazil, totalling 58 in all.

2. Experiment

For the foregoing 58 samples, on the basis of the specific gravity at the air dry condition determined by the station, the following classification was made to make experiment.

	Specific gravity air dry condition	Average specific weight at air dry condition	Average moisture contents	No. of samples	Total
Group A	0.146 - 0.346	0.267	10.8%	21. 26. 29. 31. 49	5
Group B	0.347 - 0.410	0.391	11.5	23. 27. 28. 32. 45. 46. 48. 102	8
Group C	0.411 - 0.579	0.550	11.8	12. 13. 14. 17. 22. 24. 25. 36. 38. 41. 47	11
Group D	0.580 - 0.885	0.812	11.6	1. 3. 8. 15. 18. 19. 20. 35. 39. 40. 43. 44. 53. 101. 103	15
Group E	0.886 - 1.295	1.026	11.5	2. 4. 5. 6. 7. 9. 10. 11. 16. 30. 33. 34. 37. 42. 50. 51. 52. 54.	18

2-2 Moisture contents

The moisture contents of the samples are indicated in Table 1, ranging from 9% to 13%.

2-3 Method of cooking

(1) As was mentioned in 2-1, the samples were classified under the five groups and each group was cooked in two autoclaves, totalling 10 cookings in

all.

(2) As chips obtained were more dried than those in ordinary pulp production, they were put in water 24 hours before cooking.

(3) In order to confirm the extent of cooking by tree species, two or three chips from each tree species were suspended with a steel wire in an autoclave and the pulping result after cooking was examined by both touch and eyes. Although samples were classified under five groups for cooking, the pulping adequacy was determined according to each tree species.

(4) As a cooking condition a normal cooking liquor with 25% sulfidity was used and the details of cooking experiment are set forth in Table 2.

2-4 Bleaching condition

Bleaching was carried out by the five stage process of Cl_2-NaOH-CaHypo-NaOH-CaHypo. The details of it are illustrated in Table 3.

2-5 Pulp beating

The pulp beating was made to evaluate their properties by a Sprout-Waldron Laboratory Refiner. The consistency of pulp for beating was 1%.

2-6 Evaluation of pulp quality experiment

As a rule, experiment was carried out in accordance with the Tappi Standard.

(a)	Kappa No.	Tappi Standard	T236m-60
(b)	Sheet density	"	T411m-40
(c)	Brightness	"	T217-48 (the Hunter Reflectometer was used)
(d)	Opacity	"	T425-44 (")
(e)	Burst factor	"	T403m-53
(f)	Tear factor	"	T414m-49
(g)	Breaking factor	"	T404m-54
(h)	Folding endurance	"	T423m-50

3. Results of experiment

The results of experiment are set forth in the following Tables and Figures.

3-1 Botanical names of Brazilian wood and exteriority are shown in the Table 1

3-2 Data of kraft cooking are shown in the Table 2

3-3 The bleaching data are shown in the Table 3.

3-4 Data of pulp beating are shown in the Figure 1.

3-5 Data of bleached pulp quality are shown in the Table 4.

3-6 Relations between specific gravity and quality are shown in the Figure 2.

4. Consideration of the results of experiment

4-1 Characteristics of the pulpwood

Distribution of specific gravity at the air dry condition of the samples under experiment covers a wide range, ranging from 0.146 for light one to 1.295 for heavy one, and those with high specific gravity occupy more than a half of the samples (see the Table 1). Similar wide distribution was observed in color and hardness.

4-2 Adequacy for cooking

The all tree species used in the present experiment were all well pulped. Although it is difficult to say it definitely because degree of cooking is different among the species, it seems that Group B and Group D are easy to cook, while Group C and Group E hard to cook. For the cooking, the addition of active alkali of 18% to 20% oven dry wood, which is a little more than in the case of kraft cooking of beech and oak of the northern Honshu, Japan, and is almost equal to the case of Japanese red pine, seems adequate. Pulp yield is lower than the Japanese beech and oak in the above district, and almost equal to the Japanese red pine (see the Table 2). The residue

of Group-1 is more than others with an appearance of pith.

4-3 Bleachability

Group A. Group B and Group D could be bleached to the brightness higher than 80% through the five-stage bleaching process of Cl_2-NaOH-CaHypo-NaOH-CaHypo, while Group C and Group E were hard to bleach, the brightness obtained being less than 80%, respectively. Especially, the brightness up to the third stage Hypo were much worse than others. Apparently, however, it will be possible to improve the brightness of Group C and Group E over 80% by adding chemicals to the first and third stages. At any rate bleachability of tree species from Brazil were worse than that of the Japanese hardwood kraft pulp or Japanese red pine kraft pulp (see the Table 3)

4-4 Quality of pulp

The quality of Group C showed an equal numerical value to that of the Japanese beech kraft pulp or oak krafr pulp. The more specific gravity Brazilian wood samples have, the more tear factor and s-value and the less density, breaking factor, burst factor and folding factor they indicated. Compared with Japanese red pine kraft pulp, those except for s-value showed worse results.

5. Reference

Kraft Digesting and Bleaching Experiment of the Brazilian Wood Materials, Research Report No. 3022, Central

Research Institute, Jujo Paper Co., January 31, 1966.

Table 1

Botanical Names of Brazilian Wood and its Exteriority

No.	Local Name	Specific gravity at air dry condition	Moisture contents (%)	Color
1	Barroto	0.869	11.4	Dark brown
2	Paudarco (amarelo?)= Tabebuia serratifolia (Vahl.) Nich vel aff. (Bignoniaceae)	0.954	11.4	Dark brown
3	Piqui (Piquia)= Caryocar villosum (Aubl.) Pers. (Caryocaraceae)	0.890	13.0	Light brown
4	Guabiju	0.991	12.4	Brown
5	Tauaribranco= Eschweilera or Lecythis sp. (Lecythidaceae)	0.932	12.0	Brown
6	Burangi	1.038	11.4	Light brown
7	Cumaru=Coumarouna odorata Aubl. vel aff. (Papilionaceae)	1.027	10.4	Brown
8	Piquirana=Caryocar glabrum vel aff. (Caryocaraceae)	0.798	10.4	White
9	Jatoba=Hymenaea sp. (Coesalpiniaceae)	0.934	12.0	Red brown

Table 1 Botanical Names of Brazilian wood and its Exteriority

No.	Local Name	Specific gravity at air dry condition	Moisture contents (%)	Color
10	Tatajuba=Bagassa guianensis Aubl. (Moraceae)	0.984	11.8	Yellow
11	Cravo=Lauraceae (Ocotea?)	1.043	12.0	Deark brown
12	Andiroba=Carapa guianensis Aubl. (Meliaceae)	0.530	12.5	Red brown
13	Guanandi=Lonchocarpus sp. (Papilionaceae)	0.527	12.5	Light brown
14	Urucurana=Guatteria sp. (Annonaceae)	0.512	12.0	Gray
15	Mangue=Parinari or Licania sp. (Rosaceae)	0.838	12.6	Brown
16	Orelha de macaco= Coumarouna odorata vel aff. (Papilionaceae)	0.944	10.4	Brown
17	Cutiuba=Qualea or Vochysia sp. (Voehysiaceae)	0.480	11.2	Brown
18	Inbare=Brosimum paraense huber (Moraceae)	0.775	9.6	Red
19	Angelim=Andira inermis (SW.) H.B.K. (Parilionaceae)	0.776	12.0	Brown

Botanical Names of Brazilian Wood and its Exteriority

Table 1

No.	Local Name	Specific gravity at air dry condition	Moisture contents (%)	Color
20	Sucupira=Bowdichia sp. (Papilionaceae)	0. 906	10. 4	Dark brown
21	Enbira=Ceiba sp. (Bombaceceae)	0. 346	11. 0	Gray
22	Fava de paca	0. 515	10. 5	White
23	Mutamba=Guazuma uimifolia Lam (Sterculiaceae)	0. 363	9. 5	Light brown
24	Inga	0. 641	12. 5	Gray
25	Paupombo=Anacardiaceae or Burseraceae	0. 579	11. 8	Yellow
26	Embireira branca= Apeiba so. (Tiliaceae)	0. 146	10. 0	White
27	Vigueiro or Burra leiteira=Sapium sp. (Euphorbiaceae)	0. 408	11. 0	Gray
28	Embauba preta= Cecropia sp. (Moraceae)	0. 356	10. 5	Light brown
29	Embauba branca= Cecropia sp. (Moraceae)	0. 163	12. 0	White
30	Pausanto=Zollernia paraensis Huber (Papilionaceae)	1. 295	11. 1	Black
31	Pararaubo=Simaruba amara Aubl. (Simarubaceae)	0. 339	12. 0	White

Table 1 Botanical Names of Brazilian wood and its Exteriority

No.	Local Name	Specific gravity at air dry condition	Moisture contents	Color
32	Cedro (branca ?)= Cedrela sp. (Meliaceae)	0. 442	12. 4	Light brown
33	Vermelinho= Eschweilera sp. (Lecythidaceae)	1. 035	12. 2	Dark brown
34	Conduru=Apocynaceae (Aspidosperma ?)	0. 962	13. 0	Light brown
35	Sacupenbinha=Dialium guianense (Aubl.) Sandw. (Cacsalpiniaceae)	0. 865	10. 6	Yellow
36	Estopeiro=Lecythidaceae sp.	0. 611	12. 5	Light brown
37	Sapucaia=Lecythis sp. (Lecythidaceae)	1. 050	10. 8	Brown
38	Cravo amarelo=Octea sp. (Lauraceae)	0. 642	13. 0	Yellow
39	Louro=clarisia racemosa R. et P. (Moraceae)	0. 748	12. 0	Yellow
40	Cupuacu=Theobroma sp. (Sterculiaceae)	0. 885	12. 0	Light brown
41	Faia (Lourofaia ?)= Roupala sp. (Proteaceae)	0. 540	9. 5	Brown
42	Goncalo alves= Astronium fraxinifolium Schott. (Anacardiaceae)	0. 986	9. 6	Red

Botanical Names of Brazilian Wood and its Exteriority — Table 1

No.	Local Name	Specific gravity at air dry condition	Moisture contents (%)	Color
43	Amescla=Protium or Couepia sp. (Rosaceae)	0.806	12.5	Brown
44	Genipa rana=Gustavia angustata (Lecythidaceae)	0.813	12.5	Light yellow
45	Paparauba branca= Simaruba amara vel aff. (Simarubaceae)	0.410	12.0	White
46	Jacaranda=Jacaranda copaia ver aff. (Bignoniaceae)	0.408	12.0	White
47	Cutiuba (Cupiuba?)	0.470	12.5	Brown
48	Cedro bravo=Cedrela odorate vel aff. (*Meliaceae*)	0.364	11.8	Light brown
49	Pente de macaco= Apeiba sp. (Tiliaceae)	0.339	9.0	Gray
50	Quebra machado= Lecythis sp. (Lecythidaceae)	?	12.0	Light brown
51	Massarandubinha	1.168	14.2	Dark brown
52	Massaranduba *vermelha*= Manikara bidentata vel aff. (*Sapotaceae*)	1.095	12.6	Light red
53	Vaca amarela= Apocynaceae (Aspidosperma?)	0.786	11.4	Light brown

Table 1 Botanical Names of Brazilian Wood and its Exteriority

No.	Local Name	Specific gravity at air dry condition	Moisture contents (%)	Color
54	Casca fina=Aspidosperma sp. (Apocynaceae)	0.994	12.0	Light brown
101	Louro=Lauraceae	0.757	11.0	Yellow
102	Paparauba amarela= Simaruba amara vel aff. (Simarubaceae)	0.374	12.6	White
103	Envireira	0.730	12.4	Brown
104	Andiroba=carapa guianensis Aubl. (Meliaceae)	0.570		

Remarks: Specific gravity at air dry condition is the obtained from samples having about 12% of moisture by Solid Method
(with data obtained by the Government Forest Experiment Station)

Table 2 Results of Kraft Cooking for the Brazilian Wood Materials

No. of Cooking		* Specific gravity	Moisture contents	Amount of chemicals			Cooking conditions					Cooking results					
				** Active Alkali	Sulfidity	Liquor to wood ratio	Maximum temperature	Maximum pressure	Time to maximum temperature	Time at maximum temperature	Total cooking time	Total yield	Reject	Screened yield	Kappa No.	Unbleached Brightness	Pulping adequacy
			%	% as Na_2O	% as Na_2O	l/kg	°C	kg/cm²	h m	h m	h m	%	%	%	No.	%	
1st experiment	*** Group-A	0.146 - 0.346	10.8	16.6	25	9.70	170	7	1.30	2.00	3.30	47.0	1.08	45.9	34.7	-	
	G - B	0.347 - 0.410	11.5	17.9	25	6.95	170	7	1.30	2.00	3.30	46.7	0.03	46.7	25.0	-	"
	G - C	0.411 - 0.579	11.9	17.9	25	4.97	170	7	1.30	2.00	3.30	45.2	0.11	45.1	27.3	-	"
	G - D	0.580 - 0.885	11.6	17.9	25	3.95	170	7	1.30	2.00	3.30	43.5	0.36	43.2	21.6	19.1	"
	G - E	0.886 - 1.295	11.5	17.9	25	3.50	170	7	1.30	2.00	3.30	40.4	0.32	40.1	25.8	-	"
2nd experiment	*** Group-A	0.146 - 0.346	10.8	20.5	25	10.63	170	7	1.30	2.00	3.30	45.0	0.32	44.7	29.1	22.1	-
	G - B	0.347 - 0.410	11.5	18.85	25	5.63	170	7	1.30	2.00	3.30	45.4	0.03	45.4	22.4	23.4	-
	G - C	0.411 - 0.579	11.9	18.6	25	4.13	170	7	1.30	2.00	3.30	44.6	0.01	44.6	23.8	19.4	-
	G - D	0.580 - 0.885	11.6	18.85	25	3.24	170	7	1.30	2.00	3.30	43.2	0.10	43.1	17.4	-	-
	G - E	0.886 - 1.295	11.5	18.85	25	2.76	170	7	1.30	2.00	3.30	40.7	0.45	40.3	24.0	19.5	-
**** Comparison	Soft wood kraft NBKP-pulp	-	-	19.0	25	5.0	170	7	1.30	1.30	3.00	45.4	0.6	44.8	26.7	28.7	-
	Hard wood kraft LBKP pulp	-	-	14.5	25	4.0	170	7	1.30	1.30	3.00	50.1	0.4	49.7	17.8	26.7	-

* specific gravity is a value at the air dry condition

** the amount added to oven dry wood in %

*** classification was made according to the specific gravity at the air dry condition

**** Bleached softwood kraft pulp in comparison was red pine from Iwate Prefecture on March 15, 1967 (Research Report No.3289)

Bleached hardwood kraft pulp in comparison was mixture of beech and oak chips made at the Research Inst. Jujo Paper Company, on October, 1966 (Research Report No.3282)

		Total
Group-A	No.21, 26, 29, 31, 49	5
Group-B	No.23, 27, 28, 32, 45, 46, 48, 102	8
Group-C	No.12, 13, 14, 17, 22, 24, 25, 36, 38, 41, 47	11
Group-D	No. 1, 3, 8, 15, 18, 19, 20, 35, 39, 40, 43, 44, 53, 101, 103	15
Group-E	No. 2, 4, 5, 6, 7, 9, 10, 11, 16, 30, 33, 34, 37, 42, 50, 51, 52, 54	18

Table 3 Conditions and Results of Bleaching

Bleaching / Materials	C		NaOH		Ca - Hypo					NaOH		Ca - Hypo								
	Amount of chemicals added	Remaining amount of chemicals unreacted	Amount of chemicals added	PH	Amount of chemicals added	Amount of NaOH added	PH	Remaining amount of chemicals unreacted	Brightness	Amount of chemicals added	PH	Amount of chemicals added	Amount of NaOH added	PH	Remaining amount of chemicals unreacted	Total amount of chlorine added	Total amount of chlorine consumed	Bleached brightness	Total amount of chlorine added Kappa No.	Total amount of chlorine consumed Kappa No.
	%	%	%		as av.Cl_2 %	%		as av.Cl_2 %	%	%		as av.Cl_2 %	%		as av.Cl_2 %	as av.Cl_2 %	as av.Cl_2 %	%		
Group-A Kappa No.=29.1	5.82	1.00	2.0	12.1 ~ 9.2	2.0	0.25	11.7 ~	0.05	76.8	0.2	11.6 ~ 10.9	1.2	0.2	11.7 ~ 9.15	0.52	9.02	7.45	82.4	0.310	0.256
Group-B Kappa No.=22.4	4.48	0.38	2.0	12.1 ~ 10.1	2.0	0.25	12.0 ~	0.29	77.3	0.2	11.6 ~ 11.2	1.2	0.2	11.7 ~ 9.4	0.48	7.68	6.53	82.6	0.343	0.291
Group-C Kappa No.=23.8	4.76	0.78	2.0	12.1 ~ 9.8	2.0	0.25	11.3 ~	0.04	67.3	0.2	11.6 ~ 10.5	2.0	0.25	12.0 ~ 8.7	0.98	8.76	6.96	74.9	0.368	0.293
Group-D Kappa No.=21.6	4.32	0.66	2.0	12.4 ~ 10.3	2.0	0.25	11.6 ~	0.38	76.0	0.2	11.7 ~ 10.9	1.2	0.2	11.85 ~ 9.75	0.74	7.52	5.74	81.7	0.348	0.266
Group-E Kappa No.=25.8	4.80	0.50	2.0	12.3 ~ 10.0	2.0	0.25	11.5 ~	0.05	71.6	0.2	11.7 ~ 10.9	2.0	0.25	12.4 ~	1.11	8.80	7.14	79.8	0.367	0.297
Comparison																				
Softwood NBKP	5.34	0.14	2.0	13.7 ~ 9.9	2.4	0.22	12.2 ~ 7.3	0.102	80.9	0.1	11.0 ~ 10.5	ClO_2 1.05	-	3.00 ~ 3.17	0.123	8.79	8.43	88.3	0.329	0.316
Hardwood LBKP	3.56	0.433	2.0	12.55 ~ 11.2	1.0	0.22	11.5 ~ 9.3	0.186	81.7	0.1	11.5 ~ 10.65	ClO_2 0.526	-	3.3 ~ 3.25	0.206	5.086	4.261	87.4	0.286	0.239

REMARKS:

(1) Bleached softwood kraft pulp is compariosn was red pine from Iwate prefecture on March 15, 1967. (Research Report No. 3289)

(2) Bleached hardwood kraft pulp in comparison was mixture of beech and oak chips made at the Research Inst. Jujo Paper Co., on October, 1966. (Research Report No. 3282)

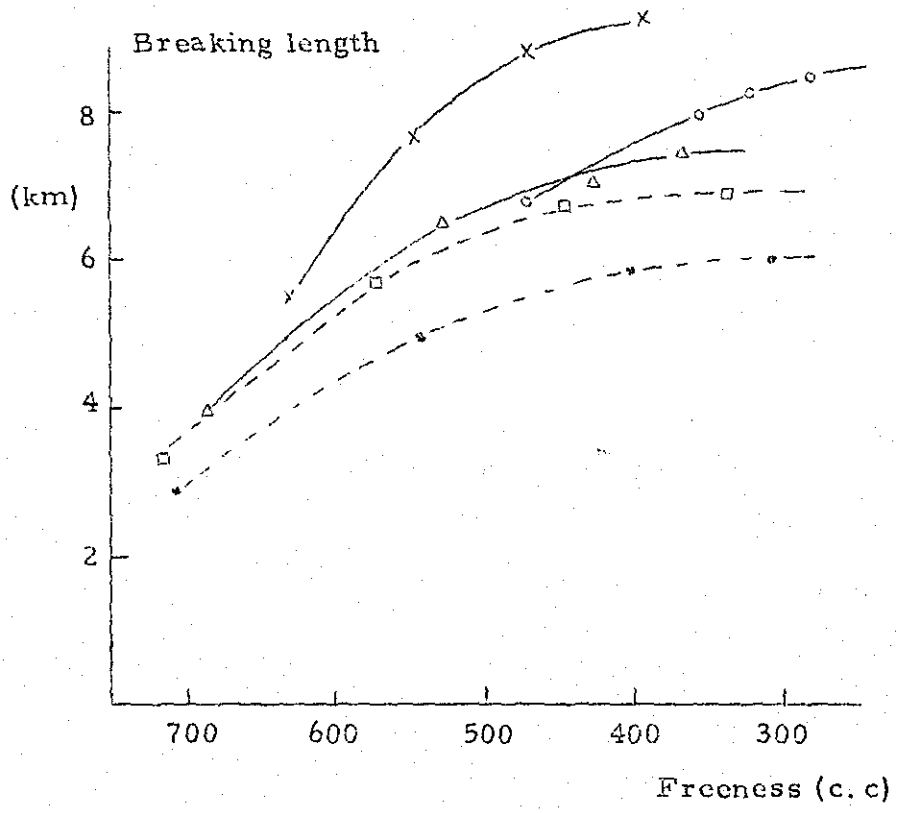
(3) The Amount of clorine added (%) = Kappa Number x 0.20.

(4) Temperature, time and pulp consistency at each stage are as follows.

		Cl_2	NaOH	Ca-Hypo	NaOH	Ca-Hypo
Temperature	°C	Room Temp	60	35	60	35
Time	hm	1.00	0.30	3.00	0.30	4.00
Pulp Consistency	%	3	10	10	10	10

(5) The quantity of pulp used for bleaching test is oven dry unbleached pulp 130g. each.

FIGURE 1 Characteristics of Kraft pulp Beaching of Brazilian Wood



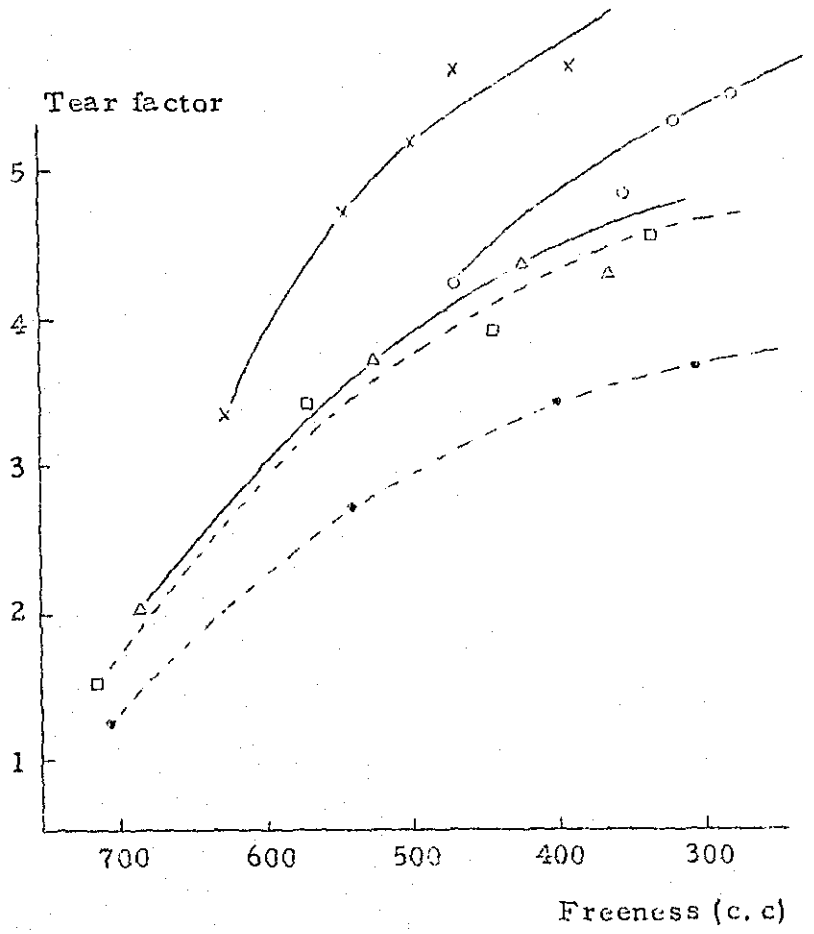
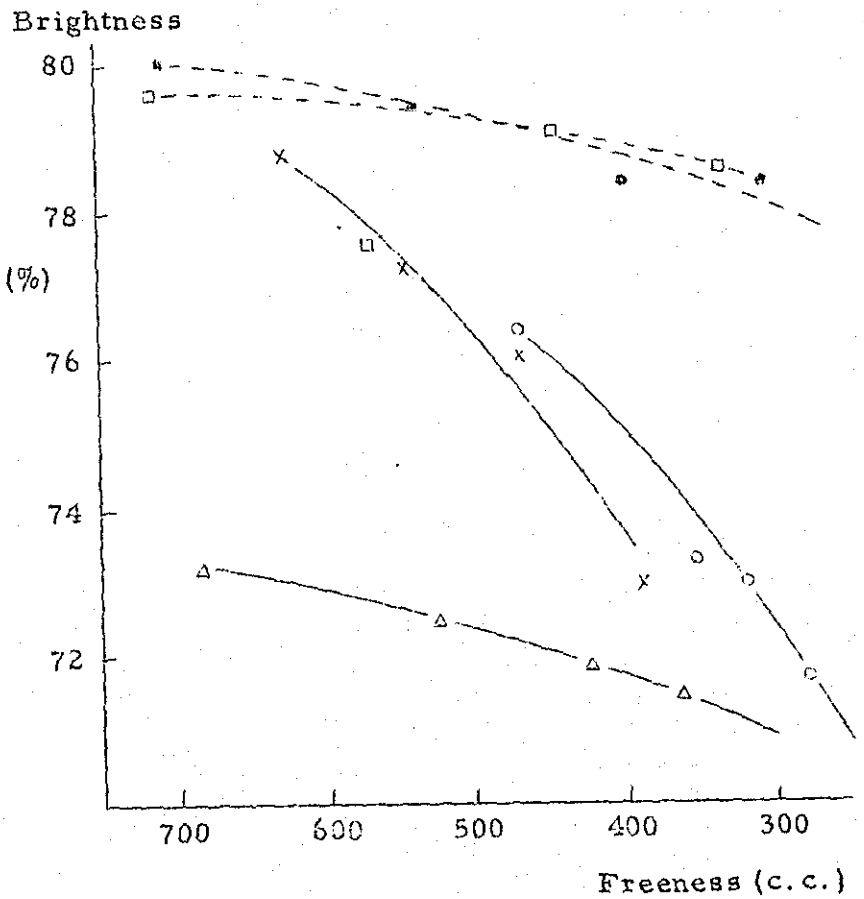

Tear factor
5
4
3
2
1
700
600
500
400
300
Freeness (c. c)

FIGURE 1 Characteristics of Kraft pulp Beaching of Brazilian wood



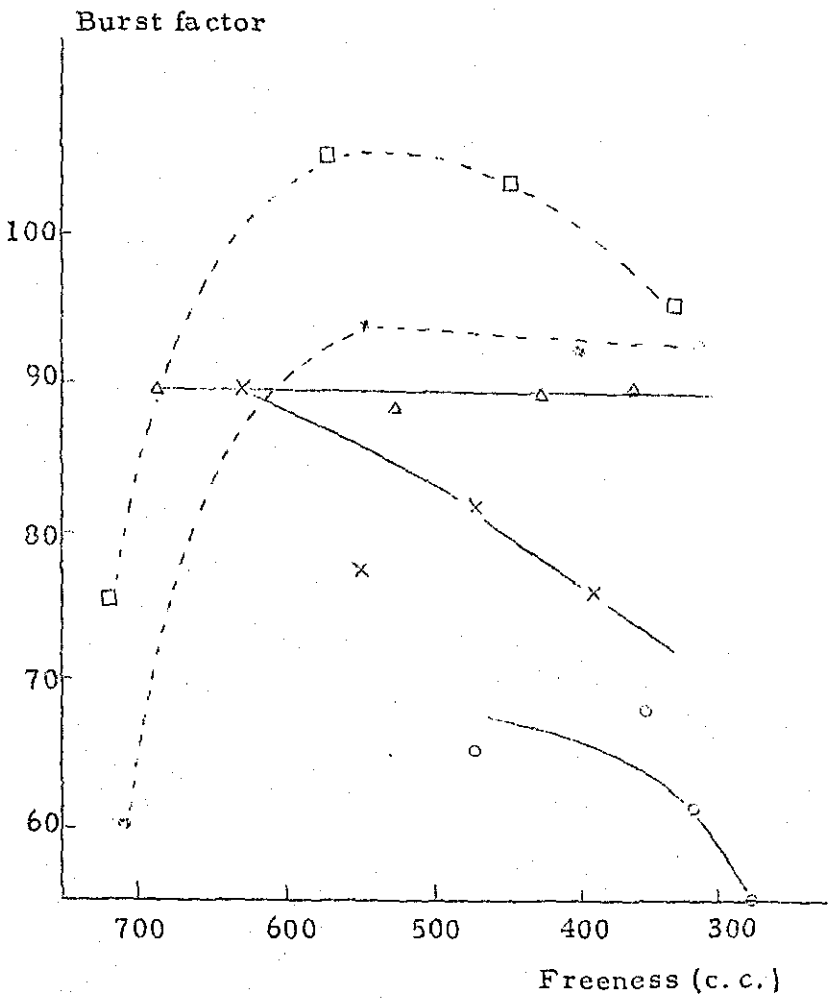

Burst factor
100
90
80
70
60
700
600
500
400
300
Freeness (c. c.)

FIGURE I Characteristics of Kraft Pulp Beaching of Brazilian Wood

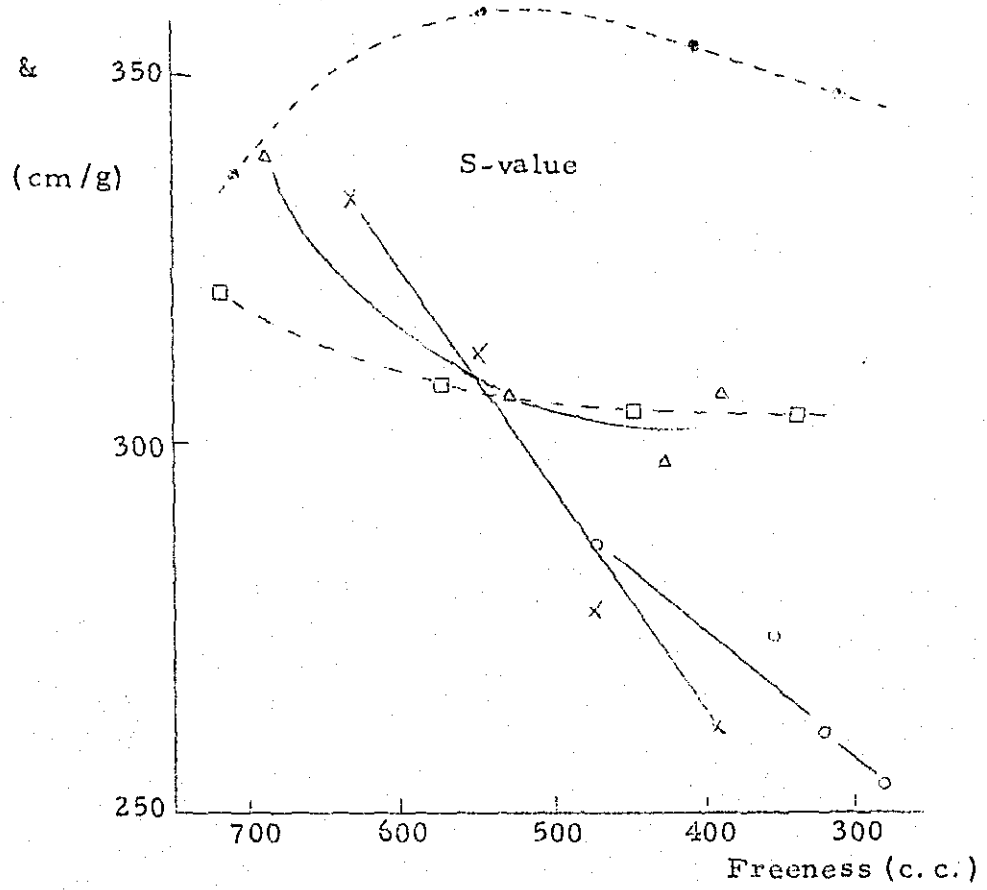


Table 4 Testing Results of the Bleached Pulp Quality

Pulp \ Testing Items		Cooking Results					Bleaching Results			Testing Results of the Bleached Pulp Quality								
		Total yield	Reject	Screened yield	Kappa No.	Unbleached brightness	Total amount of chlorine added	Total amount of chlorine consumed	Bleached brightness	Freeness	Brightness	Opacity	S-Value	Sheet density	Burst factor	Tear factor	Breaking length	Folding endurance
		%	%	%	No.	%	%	%	%	c.s.f. c.c.	%	%	cm^2/g	g/cm^3			km	
Brazilian Wood Materials	Group-A (2nd)	45.0	0.32	44.7	29.1	22.1	9.02	7.45	82.4	470	76.4	73.5	286	0.787	4.15	65.1	6.74	745
										400	74.8	72.8	274	0.796	4.82	66.0	7.53	1550
	Group-B (2nd)	45.4	0.03	45.4	22.4	23.4	7.68	6.53	82.6	628	78.8	76.9	333	0.760	3.34	89.7	5.48	156
										400	73.7	72.3	264	0.837	5.83	76.8	9.20	2450
	Group-C (2nd)	44.6	0.01	44.6	23.8	19.4	8.76	6.96	74.9	685	73.2	77.3	339	0.624	2.02	89.4	3.94	17
										400	71.7	75.1	301	0.721	4.45	89.3	7.30	685
	Group-D (1st)	43.5	0.36	43.2	21.6	19.1	7.52	5.74	81.7	715	79.6	75.3	320	0.559	1.01	75.1	3.31	6
										400	78.9	74.2	304	0.653	4.28	100.9	6.80	282
	Group-E (2nd)	40.7	0.45	40.3	24.0	19.5	8.80	7.14	79.8	705	79.8	76.4	336	0.511	1.25	59.8	2.88	3
										400	78.7	77.8	353	0.580	3.42	92.7	5.80	73
Comparison	Bleached Softwood NBKP Kraft Pulp	45.4	0.6	44.8	26.7	28.7	8.79	8.43	88.3	725	–	–	242	0.603	2.76	263.5	4.12	117
										400	–	–	194	0.738	7.60	117.0	10.0	4800
	Bleached Hardwood LBKP Kraft Pulp	50.3	0.8	49.5	17.8	26.7	5.086	4.261	87.4	704	–	–	368	0.575	1.38	83.8	3.77	6
										400	–	–	296	0.712	5.09	117.0	7.13	700

REMARKS:

(1) Bleached softwood kraft pulp for the comparison purpose was produced from imported red pine from Iwate prefecture to the Jujo Mill on March 15, 1967 (see Research Report No. 3281).
Bleached hardwood kraft pulp was produced from mixture of beech and oak chips made half and half basis at Jujo Forest Office in October, 1966 (see Research Report No. 3282).
To bleach softwood and hardwood pulp ClO_2 was applied on the 5th stage. In the case of bleached softwood and hardwood kraft pulp for the comparison purpose.

(2) Beating was carried out by a Sprout Waldron Refiner with beating consistency of 1%.

(3) Opacity is the figure adjusted to oven dry basis weight of 65 g/m^2.

Relation between Specific Gravity and Quality FIGURE 2

Remarks: The above red pine and beech and oak used $c\ell_2$ at the fifth stage of bleaching.

- ○ Brazilian wood
- × Domestic red pine
- △ Beech and oak from Northen Japan

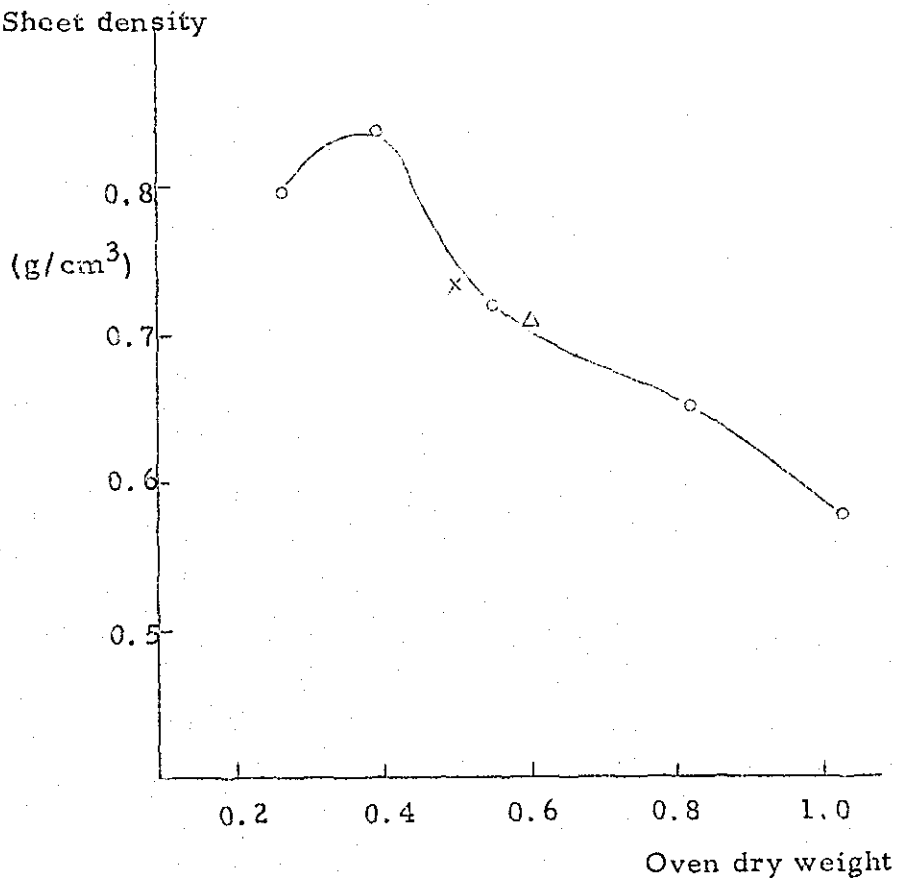
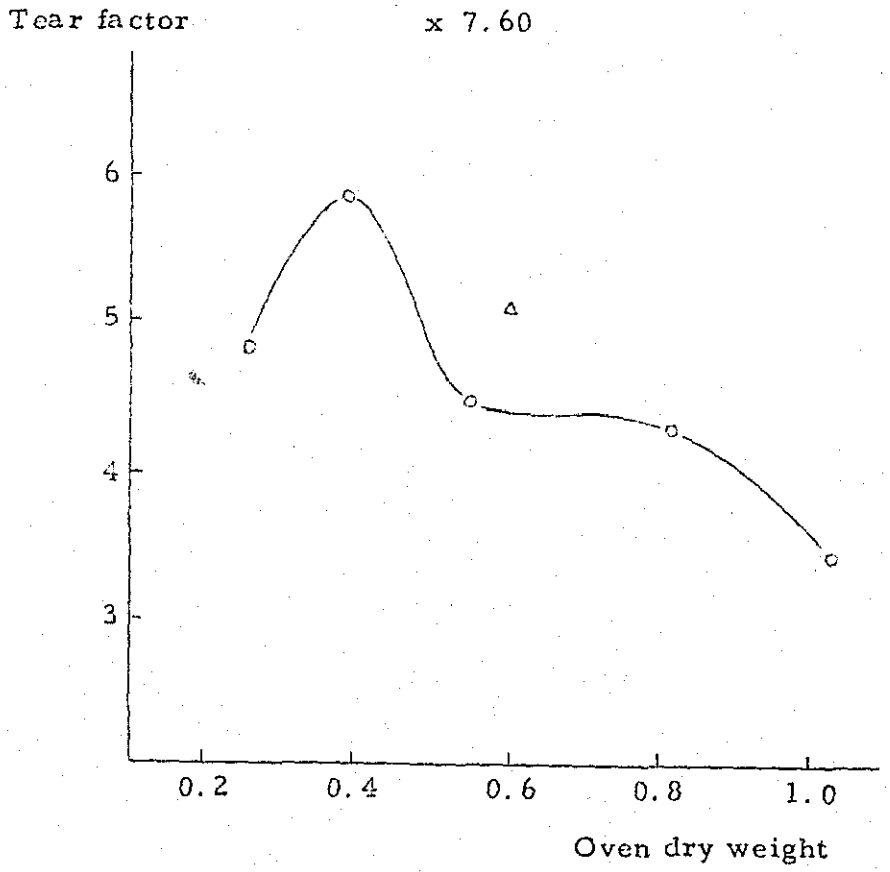


FIGURE 2 Relation between Specific Gravity and Quality



Relation between Specific Gravity and Quality FIGURE 2

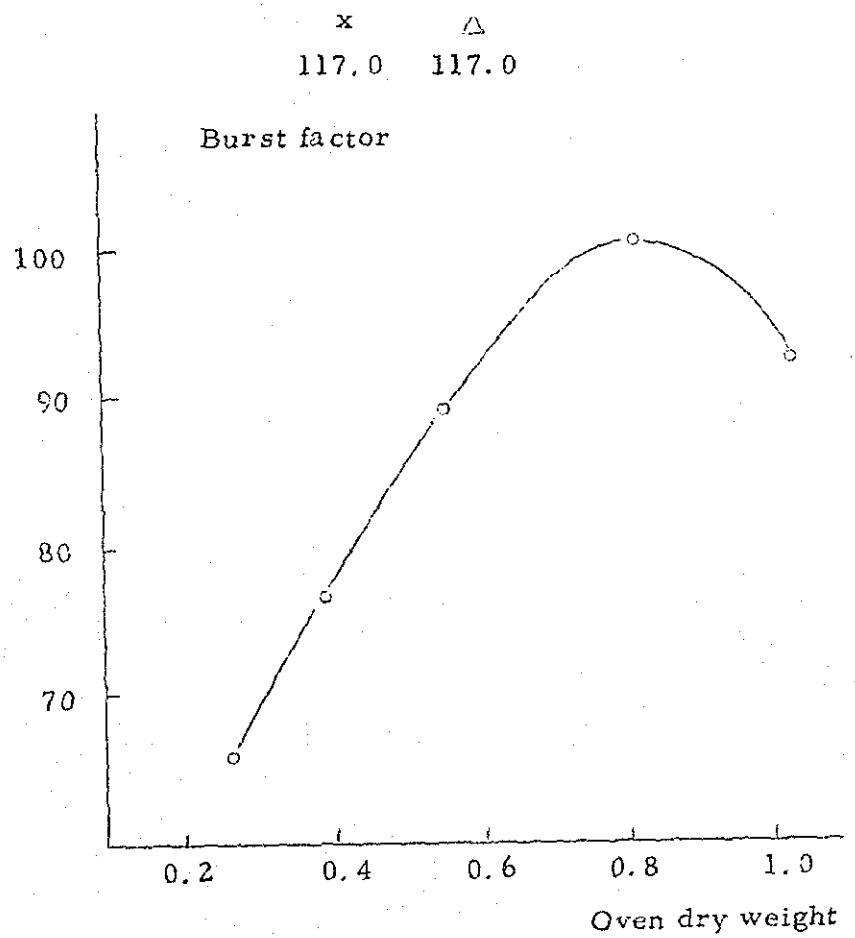
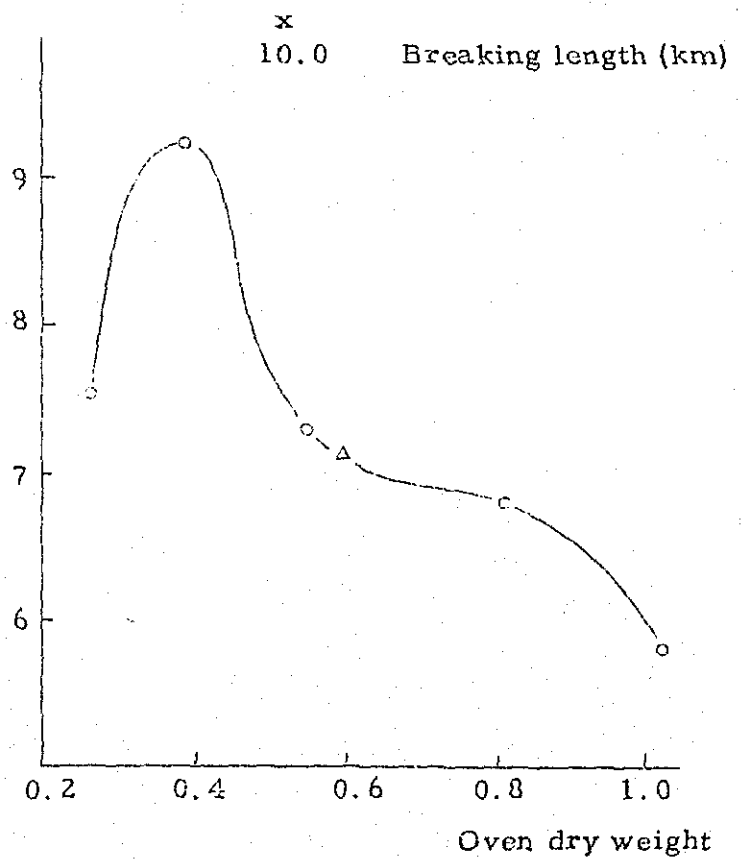


FIGURE 2 Relation between Specific Gravity Quality



Relation between Specific Gravity and Quality FIGURE 2

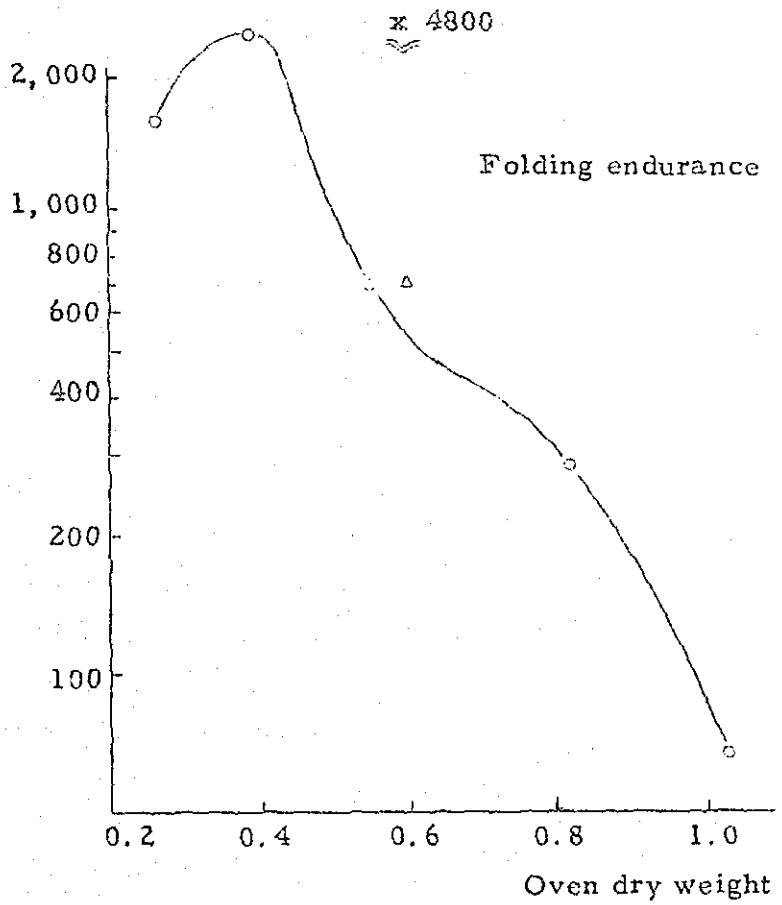
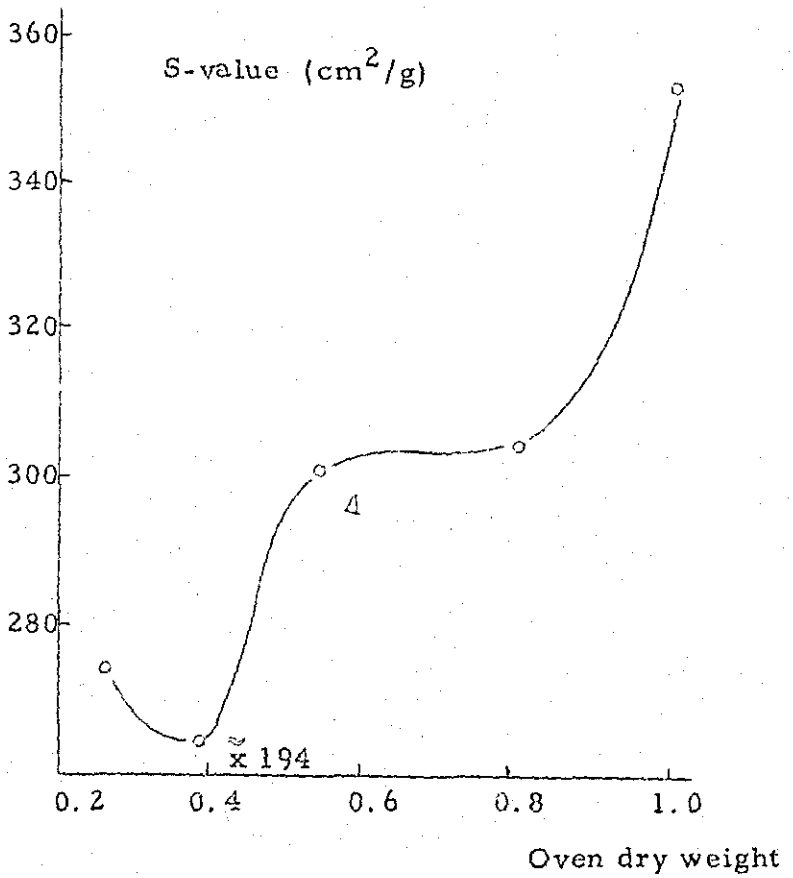


FIGURE 2 Relation between Specific Gravity and Quality



Relation between Specific Gravity and Quality FIGURE 2