

R E P O R T
O N
THE SURVEY FOR THE DEVELOPMENT PLAN
OF THE FOREST RESOURCES IN PERU

MARCH 1964

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

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P R E F A C E

The Government of Japan, in response to a request from Peruvian Government, entrusted to the Overseas Technical Cooperation Agency (OTCA) the task of conducting a preliminary survey in Peru to help the implementation of the Development Plan of the Forest Resources. The OTCA fully realizing the importance of the Development Plan of the Forest Resources in Peru organized a five-member team of experts and dispatched it to Peru on October 15, 1963 for about 35 days on-the-spot survey under the leadership of Dr. K. Kitahara, Assistant Professor of Tokyo University.

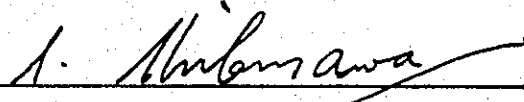
The OTCA which was established on July 1, 1962, serves as an executing agency of the Japanese Government to conduct Japan's Government-level technical cooperation to Asia, Near and Middle East, Africa and Latin America. Its principal activities are acceptance of overseas trainees assignment of technical experts, establishment of overseas technical cooperation centers and conduction of preliminary surveys for development projects.

It is my sincere hope that this report will prove to be useful in the field of the Development Plan of the Forest Resources in Peru and will also help to foster closer technical ties and better understanding between Peru and Japan.

Lastly, on behalf of the OTCA, I wish to take this opportunity to express our greatest appreciation and sincere thanks to the various agencies of Peruvian Government for their precious help and cooperation given to the Survey Team, without which it would not been possible for the Team to conduct smoothly the survey on the spot.

March, 1964

Shinichi Shibusawa
Director General



Overseas Technical Cooperation Agency

THE REPORT
ON
THE SURVEY FOR THE DEVELOPMENT PLAN
OF THE FOREST RESOURCES IN PERU

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OVERSEAS TECHNICAL COOPERATION AGENCY

TOKYO, JAPAN

I. The Introduction

The Survey Team for the Development Plan of the Forest Resources was dispatched to Peru by the Japanese Government and stayed there from October 15 to November 19 1963.

The Team visited Lima, Paramonga, Iquitos, Pucallpa, Tingo Maria, Puno and Arequipa, investigating forests, saw mills, particleboard plants, paper mills and furniture plants thanks to the excellent assistance and kind guidance by an engineer of Forest Bureau.

We are grateful for the kindness shown by many people, publicly and privately. It is true that we were able to go anywhere without any trouble and difficulty even in Amazon districts is largely due to the kind help by many Peruvians.

We also appreciate the opportunity to study the tropical forest and forest products from scientific and economic standpoints. For, the tropical forests shall be taken a close up evaluation all over the world in the future as to the utilization of their resources as the wanting of wood is considerably increasing.

In Peru, there are many serious problems due to the many species in tropical forest and difficult transportation over the Andes Mountain Chain, especially during the rainy season. What is worse, there is very wide low jungle. But it is necessary to study how to utilize the natural resources from both scientific and economic points of view.

From these points, we would like to give some comments and suggestions on this particular question. Because the time of staying in Peru was very short, it is hard to understand the problems in detail without having faults and errors. We hope, however, that this report

might help in some ways in utilizing the resources and developing forest industry.

The members of the Team are as follows:

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I I. F o r e s t r y

1. Afforestation

The wood resource of single species is needed as raw materials for wood industries.

In Amazon districts there are many species, which cause many difficult problems of how to use them, after cutting from virgin forest. The standing stock of useful species is very poor when it is utilized with modern wood technology. At the same time, it is necessary to consider future resource of wood to maintain wood industries well and develop it.

For this purpose we have some comments on afforestation in Amazon districts.

We have so much rainfall and so good high temperature that the afforestation of reasonable species which suit for wood industry in the future is possible. We shall certainly have many troubles in the afforestation as undesirable species may grow out naturally in the tropical area. However, when we think of the next generation, some measures must be taken to be through the troubles.

It is a very difficult problem to select an adequate species for plantation, especially in the tropical area. (It is difficult even in the temperate zone country like Japan) As to this question, our suggestions are as follows;

Eucalyptus plantation seems to have possibility to flourish in high jungle near Tingó Maria or other similar mountains after clearly cutting natural trees to use as raw material for particleboard.

Needless to say, some parts of them should be used in other wood industries. On the other hand, the improved poplars should be highly considered. We must select some improved poplars suited for the tropical and the semi-tropical climate. We can improve them with some efforts in relatively less years as done in the other countries. Eucalyptus and improved poplar have good properties for modern wood technologies, especially for fiberboard, particleboard, plywood and so on. Besides, their cutting age is very short, and both volume and weight growth are relatively better.

It is another problem to take up Cetico as raw material for pulp and paper in Amazon districts. We saw the Government's efforts to plant Cetico. Cetico seems to be a very good species for pulp and paper industries, as it grows in the pure forest near the riverside of the Amazon River. The pure forest of Cetico is seen only in narrow land along the riverside, and is soon to be consumed in a short time when Cetico is used in large pulp or paper mills as raw materials. We must have plantation of Cetico near the mills to ensure the supply of raw material. It seemed to us that the necessary conditions shall be many for the growing of pure Cetico stand in spite of very wild species. If it is correct, more efforts in research on afforestation of Cetico should be done immediately.

However that may be, we must pay attentions and make efforts to reduce the species of wood in the jungle area in order to use them as raw materials for wood industries in the near future.

2. Logging

Now, manual labour is used mainly on felling and logging in Peru, and the method of logging is primitive and inefficient.

Mechanization of logging is the best to make it efficient and the cost down. For example, hatchet and hand saw should be changed to chainsaw. In Japan, the amount of work performed by chainsaw is worthy of 200 per cent of that by ax and hand saw, and the cost of logging becomes 25 per cent down in hardwood forest.

The logging cost has the very important meaning specially in the virgin forest. It is necessary to reduce the logging cost as much as possible when lumber is used in wood industries.

The skidding forest products by yarder or tractor will be desirable in the forest with no sharp inclination, but the simplified logging method for level forest shall be also convenient in the mountain forest by constructing a forest road net. It will be economically possible to use skidding with wire rope in the mountain, where forest road is too expensive. But training of wiring in forest is of importance and insufficient training and knowledge may bring danger during the operation. In Japan, the designer is required to have a license issued by the society.

III. Wood Industry

The wood resource in Peru is very rich as we have imagined. But the species of wood are very numerous as one hectare has about 250 different species. The specific gravity of wood, varies greatly from very high to very low, therefore properties of woods give great variety in the case of utilizing them.

When wood is used as raw material for industry, it is necessary to gather the same species in proper quantity at one place in a certain period as the same products in proper quantity must be sent to the market. In Amazon district, we have so many species of wood as mentioned before that it might be extremely difficult to gather a proper quantity of the same wood in some place.

In Japan, we have about 300 species in ordinary forests which are not planted and only take up 50 species among them as very important ones with commercial value. But the number of the most important species is rather limited and the volume yielded per hectare is relatively high in forest. We can gather some species in proper quantity to one place, in spite of gathering from some districts, either by truck or train. We, then, can make mass production with relatively low cost in wood industries. In Amazon districts, there are many rivers and low lands, and the rainy season makes the matter worse. We can not easily open up a road through forests without investing a large capital. We cannot transport wood by land, but only by snaky river. In other words, the transportation takes a very long time and safety cannot be guaranteed. In this case, it could be the other difficulty in wood technology.

At present, the most important species, such as Cedro, Caoba, Alfaro and so on, are sawn to lumber. The products are sent to North America and Lima over the Andes Mountain Chain. But we must gather raw material from a long distance to saw mill, for the species are scattered here and there and we cannot find out them more than 4 or 5 trees in 1 hectare. Near the main city or town, for example, Iquitos and Pucallpa, have been cut and extinguished in the near riverside. And we must cut them up the Amazon River, and transport by raft, spending a very long time on the natural stream. These conditions make production cost very high.

It is the same in case of particleboard and fiberboard industries as in saw mill industry and it gives worse influence on them. For example, Mapressa Particleboard Plant faces the difficulty of using many species of wood with various specific gravities. When many species are used, cutting property and compression shrinkage in hot press are different by each case, and industrial conditions will not be determined. In Japan, we also use about 40 species as raw material at the same time in particleboard industry and we have often faced the technical difficulty to fix the industrial conditions. At present we have almost solved this technical difficulty with our study and research. In Europe, this difficulty is very easily solved, for they have very few species in their countries. Therefore we must study wood technology by our own efforts considering our own national circumstance.

In the country where many species exist, small scale of wood industry will be recommended because it is hard to gather the same kind of raw material in large quantity in a period as already mentioned.

It is true especially in case of sawing, handicraft and furniture manufacturing industries.

At first some wood research laboratories should be established for the study on physical and chemical properties of each species, in order to utilize them without failure. For example, compression, tension, bending, cleavage, impact, abrasion and cutting properties of each species must be thoroughly studied.

In Japan every prefecture has an experimental station or research institute, and the Japanese Government has established a central research institute in Tokyo. It is worthy of special mention that Hokkaido Prefecture, the northernmost island of Japan, has special forest products research institute. There people are working on fundamental research on the utilization of forest products, and are studying the production of the factories. For example the institute has its own sawmill, plywood, fiberboard, particle, furniture, flooring, drying and hydrolysis of wood factories. It sells its products. The obtained results of research are contributing not only to Hokkaido Prefecture but also to all other prefectures. At the same time it has dispatched many engineers to local manufacturing companies and they are playing important parts in improving wood technology there as they have both research and practical knowledge on it.

The Japanese Government also is encouraging to study mechanical and chemical research on a large scale.

Japanese universities sends annually about 400 students, who studied wood technology and pulp and paper manufacturing engineering, to department of forest and forest products.

Thanks to these research institutes and engineers a way of using new species became possible. In Japan, for example, Buna (Fagus Crenata Blume) was not used at all about twenty years ago, though its volume was very large in forest. The Ministry of the Agriculture and Forestry began to study its use in co-operation with the Government Forest Experiment Station and universities. It established factories of sawing and drying in several districts and succeeded in a few years in finding out the way of its use, mainly in furniture manufacturing and flooring industries. Now, Buna is one of the most important wood species in Japan.

Secondly some comments shall be mentioned on wood technology in Peru.

1. Sawmill

There are many sawmills of various scales near Iquitos, Pucallpa and Tingo Maria. The species of timber are mainly Cedro, Caoba, Aquano and so on and they are gathered from far distant districts by raft only during the wet season. The mills struggle against difficulties to get timber in required quantity. The difficulty shall become more and more serious in the future.

In Amazon districts, there are many species, and the properties of wood are variable. We, consequently, may find out some species suitable for a proper utilization. For example, we can use some hard woods for some small parts of electric apparatus, but its quantity is permitted to be not large.

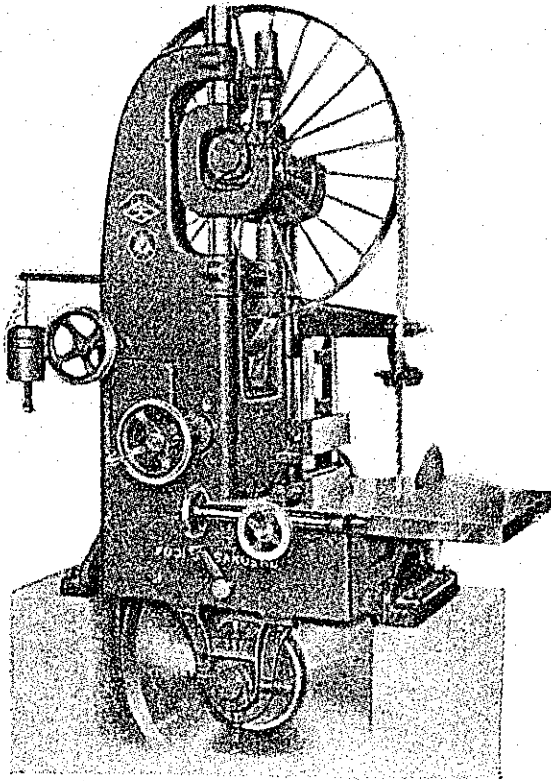
It shall be very economically important to make a sawmill where many different species of woods are sawn for many purposes.

The products shall have various sizes from large to small and density from hard to soft. And then, they should be artificially dried. Any woods with the possibility of being used when dried to equilibrium moisture content should be put on a market especially in Lima's market, for the West coast of Peru is wanting for lumber.

A research laboratory may be able to give many useful advices as to how to use woods. It shall be correct when the fact is considered that about fifty species are used according to their properties in Japan.

For this purpose, the establishment of a special sawmill should be planned. Of course the head band saw is needed, but resawing band saw should be set properly to produce the lumber in various sizes, and its scale should not be so large in order to avoid the difficulty of gathering timber as raw material.

But the preciseness of sawing machine should be high, and teeth setting operation should be correct. The saw blade should not be so thick, as the sawdust does not bring any benefit and profit. Circular saw is not suitable to produce lumber in a precise size, and produces saw dust very much. At least some band saw, with a strong body and precision (Fig. 1) should be used. The accuracy of products is important in enlarging the market demand.



In this case a quantity of one lot in small, and stock in warehouse should be large. A kind of lumber must be given to user in any quantity and at any time when it is wanted. The whole lot can run around for some period.

From this viewpoint, Tingo Maria has very good industrial conditions, for there are many species and the forest is high jungle. Besides, the town is the nearest from Lima, the largest market in Peru.

The sawmill shall not be able to open its steady and fortunate way by itself in future unless it makes an effort to use not only main species which are being used at present but also any other unused species.

2. Drying

If wood is used adequately, it should be dried beforehand. There is no good market if wood is not artificially dried. The reason is understood with a practical manner, and its explanation is omitted here.

In Peru we saw no dry kiln for wood. The sawn lumber is produced in Amazon districts, far from main markets and is transported over the Andes Mountain Chain. It takes a long time, and wood is dried during transportation. Then, it is further dried during storage in a warehouse, because it contains very low relative humidity in West coast. But when wood is used in such a place where it has low relative humidity and the temperature is high, appropriately as in Lima, the wood should be artificially dried, for the equilibrium moisture content of artificially dried wood is less than that of naturally dried wood. It means less shrinkage during the use. The warp, checks in wood surface, gaps of joint and so on are caused by changes of moisture content of wood, and these defects make the market narrow.

There are many species in Peru, and the drying conditions of each species should be known, for the distinctive property of artificially drying is different from one another. First of all property should be tested in a laboratory through routine practices. It is not difficult and will be easily done if the people who are handling and in connection with wood only wish so.

If wood is dried in Amazon districts, its weight becomes less, and that means it makes the load lighter in transportation. We

can transport 40 per cent more when the moisture content of wood is reduced from 80 per cent to 10 per cent. The transportation costs very high in Peru, for the sawn lumber must be carried over the Andes Mountain Chain, and it is seriously considered how to reduce the cost. The drying of wood is one of the best methods for it.

But the dried wood will absorb moisture during storage in Amazon districts before transporting to the West coast, especially in the wet season so some measures should be taken to prevent it. The moisture content will become fifteen or eighteen per cent during the rainy season if wood is stored in the open air. Its figure deserves serious consideration when compared with that in the West coast, because it will be 10 per cent there.

It is the best to dry the wood in the West coast, near the main market, judging from the standpoint of using, for the moisture content will hold the same figure when the wood is dried to 10 per cent, and 10 per cent is the best moisture content of wood for using. In this case, we can transport the wood with much water over the Andes Mountain Chain.

In Japan, *Buna* (*Fagus crenata* Blume) has been having a good market since the drying method was established as mentioned already. It is a very important fact when new species of wood starts to be used on a market.

3. Plywood and the Other Improved Wood

In Peru plywood industry is very new and its scale is very small. We visited one veneer plant in Iquitos and one plywood plant in Pucallpa, and both are under construction.

The scale will be controlled by quantity of raw material to be supplied. In Amazon districts trees are big and the diameter of a log is very large. Their properties for plywood will be good if they are carefully selected. The raw material wood in some quantity, however, will not be easily gathered as is the case of saw mill. This means that the scale should be small, as long as the plywood is manufactured with only one species. In this case, two or three species of wood have to be used as raw material. In other words we produce veneers with the surface and back of one species and the core of another one. Surface veneer shall be made of very good wood with very attracting figure and grain, and back veneer of the same species of wood, but core of the wood of different species.

In Hokkaido, the northernmost island of Japan, we are using hard wood as the raw material of plywood, but the core veneer is made from lauan wood imported from the South East Asian countries. The produced plywood has been exported to North America as hard wood plywood, and its business is very good.

In Amazon districts there are some species with good shape and fine grain, which can be used for the surface veneer. At the same time we can find some species not used yet for the core and back veneer.

The surface veneer will be made with a rotary lathe or slicer. The flitch used in slicer will be produced in sawmill. The machine depends upon properties of raw wood.

In this case the productivity is usually considered to be low, but it is not so when the technology is on a high level. In Hokkaido Prefecture, the production is one million square feet per laborer per month. The export of hard wood plywood was 296×10^6 square feet with a value of 30×10^6 U.S. dollars in 1963.

In the case of plywood the properties of wood for cutting and adhesion should be studied as soon as possible in a laboratory and university institutes. Plywood industry shall be set on the fundamental research as the other wood industry. Only wood technology can open the way to plywood industry in future, for the conditions are different in each country.

4. Particleboard Industry

We visited a new particleboard plant (Behr system board). The plant has very good machines and the designs of particleboard is nice, too.

In general, particleboard industry should be undertaken in a country with less wood resources. When the industry is undertaken in a country rich in wood resources, it can not expand its activity, because ordinary particleboards have almost the same properties as natural wood though some of them have been improved. The use of particleboard is mainly for the core material in improved wood. In other words, particleboard should be dressed with other material

(veneer, plastics or paper), even when it is used for building. But we must often use it as building material without dressing. In this case, the density (specific gravity) should be high and thickness of surface chip (flake) very thin. For, the surface of particleboard has a tendency to become rough when it is exposed in the high humidity air or is used for a long time in low humidity even if it is coated with paint. The hot-pressed surface chip swells by absorption of moisture. The swelled chip catches dust in the air, and the surface becomes dirty.

On the mechanical properties particleboard is not so good as natural hard wood. For examples, the Young's modulus of particleboard is one tenth of natural wood; the impact resistance and creep limit are especially low, and particleboard needs to be dressed with some other material when its specific gravity is ordinary or lower and the resin content is not so much. In Peru, specific gravity of particleboard should be made higher than 0.68 and resin content more than 10 per cent when the board is used without dressing for building and the species for the raw lumber are the same as used now. Even in this case, the surface should be coated with paint. The cost is very high when specific gravity and resin content are higher than that. It is not economically practical.

The dressing method depends upon the circumstances of country. The methods in other countries help for reference only. The demand of market decides the method, and wood technique should follow it as much as possible. In Japan, we are dressing particleboard with 0.3 mm veneer in minimum without cross bands. It has

been demanded by users and we have succeeded in this with intensive research and practical tests. In Europe we cannot see such a thin veneer which is, dressed to particleboard.

In Peru, particleboard industry is standing only on the starting line.

A plant with a capacity of 20 ton per day shall be considered too large for the market in Peru for the time being. But lumber is very wanting in the West coast. For example, we saw very few wood coat hangers in hotel and they are bound to metal bar with wire, and every second sleeper of railroads is not long enough in an ordinary length (two short blocks). Then, the market of particleboard shall be feasibly expanded in the near future, but its way will not be easy and only hard trying and efforts can open it and make it successful.

In the Mapressa factories there are many difficult problems as mentioned. The most difficult problem shall be how to control the thickness of particleboard just hot-pressed. In hot-pressing, the resistance of compressive deformation, relaxation of stress, absolute water content (g) (not moisture content %), moisture content, passing out of vapour from board etc. are different by each species. These factors influence the thickness of board just after hot-pressing was done. These influences become more evident when many species are used as raw material. The thickness of particleboard must be controlled by sanding. We must sand off about 1 - 1.5 mm on both faces when we use twenty, thirty or forty species as raw material. It is nonsense from economical viewpoints

to grind off 1 - 1.5 mm, but it must be done to be put on the market and the industry requires a good market present and in future. The control of thickness is very easy if it is possible to use only one species as in Chile. In Chile Insignis pine is the only raw material of particleboard.

The production will have to be enlarged by expanding its market with hard efforts in the near future. At that stage, the narrowest path in production shall be hot-press, for other paths can be taken on the parallel ways. We can attain our purpose to make the production large by both high temperature of hot plate in the hot-press and adding more hardener to synthetic resin (urea-formaldehyde resin) as binder. But too high temperature of hot plate causes decrease of board thickness by previous stress relaxation and damage to chips (flakes) in outer layer of particleboard. As a result, bending strength and tensile strength perpendicular to surface decrease considerably. Then we should use more hardener for synthetic resin by spraying separately or controlling catalyzer (for example NH OH for hardener NH Cl in urea resin).

5. Fiberboard

We are very sorry that we could not see any fiberboard industry. Peru should develop the industry in the future, for much standing storage is available in Amazon districts though there are too many species, but necessary conditions on species in fiberboard industry are less than in particleboard industry. When we defibrate raw chip in the defibrater, we must have some bundle of fibers, single

fibers and fines at the same time as raw pulp for fiberboard. The bundle of fiber is frame, single fiber is muscle and fine is filler in forming wet sheet. The proportion of them decides the freeness of raw material (raw pulp), condition of hot pressing and properties of fiberboard, and it is one of the most important conditions in this industry. A good fiberboard cannot be produced unless they are carefully proportioned in raw pulp.

Then we can use many species at the same time with the results obtained by research in Peru though it might not be done easily.

The plant, however, is more expensive and the scale (capacity) is larger than that of particleboard, and its market is different from particleboard market. Fiberboard is mainly used as building material, but it could be used for the purposes of other industries, for example, automobile, sound box, furniture and so on. The fiberboard used in building should be dressed or printed in color or with figures, and the industry should be accompanied with some treating industries. These industries can make fiberboard industry steady and the market will be extended especially at the first stage of the industry.

Fiberboard is classified as follows; hard board, semi hardboard and insulation board. There is a problem as to which should be produced at first. The insulation board can be produced more easily and cheaply as its low quality is permitted on a market, and its investment is small. The board, however, is demanded in cold and hot districts, for the conductivity of temperature is very low. Besides it, the absorption of sound is very good. But the

market demand in Peru shall be small. Weather in Lima is very mild, and the demand of insulation board shall be small. The board cannot have other uses as semi-hard and hardboard.

The semi-hardboard can be produced with comparatively simple machines and be used for many purposes. It can be dressed or printed. As the result, Peru should start to produce semi-hard board first.

The hardboard is produced with rather expensive machines and requires comparatively larger investment. But its mechanical and physical properties are the best of all, and it is used either for building or for the other industries. In this industry there are two processes of manufacturing, dry and wet. The board produced by dry process has very good property for printing, but its technique is not established yet completely in the world. The main problem is how to control the moisture content of raw pulp just before hot pressing, and the moisture content is one of the most important conditions in deciding the properties of board.

On the other hand, the technique of wet process has been established and is ready to be applied for the factory using many species at the same time. It is very good for Peru. The industry should be accompanied with other treating industries as semi-hardboard.

The world production of hardboard, however, exceeds the demand, and the price is very cheap. Hardboard is exported at a low price especially from North Europe, and Scandinavian nations to the other countries. We must compete with them when import

tax is low. Also it may cost much to transport the products over the Andes Mountain Chain in spite of cheap price of raw lumber.

We must investigate carefully under these conditions.

6. Other Wood Industries

A. Lumber Core Plywood

Lumber core plywood shall be considered other than the industries mentioned above. The machines for it are very simple and cheap. The species of raw material, however, should be one, and cannot be mixed. Wavy defect on the surface will come out soon if many species are used as core strips, penetrating core and surface veneers. The lumber core plywood is often made in a country which has not so large size lumber as plywood raw lumber. We must have drying kilns for raw lumber and hot press for veneering, and the investment becomes comparatively large. What is more, we must arrange surface veneer.

There is a particleboard plant in Tingo Maria, and the general properties of board as raw material of wood industry are superior to lumber core. The utilizations of both are almost the same. The particleboard industry should be given the priority, for it really exists.

B. Wood Preservation

The demand of railroad sleeper is not so great in Peru, but its decay and weathering are the most important problems in the wood utilization and maintenance of railroads. The apparatus is very simple and cheap and the price of sleeper is expensive, so one small injecting plant should be built up. Almost every species

is possible to be used for sleeper when it is treated with preservatives. Only the nail holding power is a problem at the treated wood sleeper.

At the same time, power pole should be treated by injecting preservatives, for the straight and small log for the pole is expensive in Peru.

7. Wood Working

A. Flooring

We saw many fine floorings in the buildings at Lima, and its cutting is very good. There shall be no problems in this industry.

But it should be exported to the other countries like North American countries as Japan does.

Flooring with long strips must depend upon the technique of sawing and drying on a high level, but parquet or mosaic parquet flooring can be made with simple machine and drying apparatus, and its scale is very small.

On the other hand, there are many species which have very fine color or grain and hardness, but we can not gather one species wood in large quantity in a period as above mentioned and the technique of sawing timber is not so good that more parquet and mosaic parquet flooring industries should be undertaken not for domestic use but for exporting.

This is one of the most interesting wood industries which can be started immediately do not require large investment, but artificial drying of green lumber is a fundamental condition, to which we must

pay attention.

If possible, the machine should be imported, but very simple machine, domestic made, shall be available when it has some preciseness.

B. Handicraft

Wood handicraft is very good industry in a country with low labor price and abundant woman labor.

The handicraft production is imagined in Peru. There are many species which have specific gravity from high to low and fine color from dark to light. We can get wood which has proper hardness and good property for cutting.

We, then, must imagine how production shall be better. The selection of the species depends upon what is produced.

Legs of desk and chair, knob or grip, parts of other furnitures and so on are made by milling machine, and raw lumber shall be gathered according to its properties needed.

The scale of this industry cannot be large and should not be large, but we must have many factories here and there on a small scale. It is also convenient for gathering raw material and other conditions, but high jungle shall be better to gather raw material almost all the year around at slow degree.

The green lumber should be dried artificially before milling, and the quantity of wood is very small. In this case, some portable lumber dryer should be used. Its capacity is from a minimum of 1.5 m^3 and its fuel is wood waste in a factory. It does not need continuous operation. The operation will be done only during

daytime. The best points are that it does not need boilerman and inequality of drying is very few, for the room is very small and velocity of hot air is very high.

The price is very cheap.

The market is not good in Peru just now and cannot have hope for enlarging rapidly in the near future, for the demand depends upon other industries. The foreign market, however, has been opened for any country especially in North America when the product has precise dimensions and moisture control.

The semi-finished production, raw parts of furniture, will have the possibility to be exported and Peru has the ability to do it. In this case, the designs of parts shall be sent from importing countries.

The handicraft production can reduce cost of transportation. The cost of transportation is one of the most serious problems of wood industry in Peru.

The troubles in a country which has good wood resources are less than in a country with poor wood resources. There are many possibilities in the future that people can produce any wood products with some research and efforts.

IV. Pulp and Paper Industry

1. Preface

Following is the gist of our findings, together with a few comments which we think will be of interest to the Peruvian Government authorities concerned.

2. Summary of the findings of the Survey Team

- a) The pulp and paper industry in Peru is still at the very initial stage of development; production is small and the quality of the products is extremely low.
- b) For the improvement of the present standard of quality, it is imminently necessary to carry out through-going quality control and to review digestion process. The near monopoly of pulp and paper industry of this country by one company, which has lasted a long time, has also to be reexamined.
- c) Paper consumption in the country is considered to continue increasing steadily, but the total quantity consumed as present is still at a low level. It is improbable for the time being that Peru will become an exporter of pulp and paper in Latin America.
- d) Although the area east of the Andes Mountains is very rich in forest resources, only few species are good as pulpwood out of many species found there. Wood collection is not easy, too. The locality is also extremely unfavorable for establishing mills.

e) Peru is at present devoted for rationalization of more important basic industries, and it seems difficult to obtain big capital investments for pulp and paper industry.

Development of forest resources should be started from wood processing industries, such as plywood and fibreboard, which require less capital investments, as well as power, materials and chemicals than pulp and paper industry.

f) The importance of development of the country's forest resources is big, and the urgent task of the moment is the establishment of an integrated research institute for the development.

3. Problems and measures to be taken

A. Establishment of an integrated research institute

The forests of Peru occupy 56% of the land area of the country, and the forest area, which is about 70,000,000 ha. is the largest among Latin American countries, next only to Brazil.

Therefore, the development of these vast forests in order to achieve industrial production of high value is of a big importance for the progress of the country in the coming years. However, it appears that there are no basic national policies regarding the development of these vast resources. It is in fact true that industrial incentive measures are taken, including tax exemption for machineries and equipments installed in the forest area. However, the Government is entirely dependent on investigations carried out by foreign institutes and by missions despatched by specific foreign industries, as to the concrete measures to be

taken for the development of forests. Furthermore, the valuable reports thus obtained are found in the universities, the banks, Agricultural and Forestry Ministry, the district forest offices or a few business firms, and have been left there without being fully utilized.

In order to correct the existing shortcomings and tackle with the development of the country's forest resources, more positively, it is desired that an integrated forest resources development institute will be established. The institute will handle following matters:

- 1) To draw up the true stock map of the country.
- 2) To collect and file all available literature, data and reports concerning peruvian forest resources.
- 3) To study efficient methods of felling, transporting and lumbering wood by despatching students to foreign countries, and to conduct experiments on, and to propagate and give instructions about, the new technology thus introduced to the country.
- 4) To conduct market researches both within the country and abroad concerning products of wood industries.
- 5) To calculate the growing stock of such species that can probably be utilized for industriable purposes and to carry out experiments to find out their suitability for the required purposes.
- 6) To study the location of mill sites in the areas where industrially usable species are abundant.

B. Transportation Problems

The problem to be urgently solved for the development of the rich forest resources east of the Andes Mountains is that of communication and transportation to that area. Supposing establishment of a bleached sulphate pulp plant with an annual capacity of 30,000 tons in the forest area, the breakdown of tonnage of materials, products and chemicals to be transported annually is roughly as follows;

<u>I t e m</u>	<u>Quantity (ton)</u>
Pulpwood	90,000 - 120,000
Chemicals and other raw materials	6,000 - 11,000
Fuel oil and for coal	25,000 - 40,000
Sub-total	121,000 - 171,000
Product	30,000
Grand Total	151,000 - 201,000

As shown in the table, total quantity of goods that has to be transported amounts to 5 to 7 times that of the product.

Even if pulpwood is excluded, the quantity still amounts to 2 to 2.7 times. These goods have to be transported a vast distance over the Andes Mountains from Lima, the capital of Peru, to the mill, or vice versa.

The above applies not only to a pulp mill, but also saw mills, plywood mills or fibre board mills, in case such mills are established. Also indispensable is the establishment of facilities for the employees near the mill site in order to improve their

living surroundings.

Therefore, without waiting until the completion of road improvement works between Lima and Pucallpa, for which concerted efforts are being made at present, the thorough pavement of the same road or the extension to Pucallpa of the railroad now laid up to Cerro de Pasco should be given serious considerations.

C. Potentiality of establishment of pulp and paper mills

The Peruvian pulp and paper industries mainly carrying out pulping of sugar cane bagasse at present, and paper is made out from this bagasse pulp mixed with imported chemical pulp, mechanical pulp and recovered waste paper. There has been a plan of constructing either a newsprint mill or a chemical pulp mill using Cecropia as raw material, but the plan has not materialized so far. On the basis of our brief surveys this time, we would like to make following recommendations:

- 1) Continued emphasis should be placed on bagasse pulp for some time to come by the Peruvian pulp and paper industry.

The above statement does not exclude the possibility that time will come when forest resources are developed and paper made from pulp using wood as raw material, but it will be when multilateral wood industry including lumber, plywood and fibre-board as well as pulp and paper is developed.

It will take sometime for such a development.

In the meantime, Peru, which produces about 800,000 to 900,000 tons of sugar annually, will be able to produce well over 350,000 tons of pulp, if the total sugar cane bagasse is

made available for that purpose. It will enable the production of 400,000 to 500,000 tons of paper and paperboard by adding some woodpulp. When we compare the above figures with those calculated by FAO which places the Peruvian requirements at 60,000 tons for pulp and 106,000 tons for paper and paperboard for the year of 1965, the importance of bagasse as raw material of paper should never be underestimated. The actual production of bagasse pulp currently produced at Paramonga and other areas is estimated at 45,000 tons a year, and the surplus bagasse is burnt as fuel at the cane sugar mills. Usually the bagasse produced at cane sugar mills is from 1 to 1.2 tons per ton of cane sugar. If the bagasse thus obtained is burnt to generate steam to be used at the sugar mill, there remains about 25% of the total bagasse in case of modern large mills. In case of absolute small mills, there is practically no surplus. Even if there is some surplus, it is too small in quantity to be used at pulp mills, and in most cases it is just thrown away. However, bagasse is a pretty good raw material for the pulp and paper industry, and it is considered as a promising raw material in the future all over the world. The advantages of bagasse are:

- i) That it is supplied in large quantities constantly every year as agricultural by-product.
- ii) That bagasse fibre is physically in between those of coniferous and broad leaved woods, with the result that paper made out from it has sufficient strength for all purposes.

Superior paper can be made by mixing wood pulp.

Disadvantages are:

- i) That superior paper can not be made without expelling pith which occupies about 25% in bagasse.
- ii) That bagasse contains a pretty high percentage of SiO_2 content, which causes incomplete burning in recovery boiler during cooking chemical recovery process and scales trouble in black liquor evaporator.
- iii) That paper made solely out from bagasse is somewhat inferior in tearing strength and is not sufficient in opacity, and that there are problems as to printability. The advantage of bagasse in Peru in another phase is that it is obtainable at seaside districts. Therefore, as far as transportation problems are concerned, this fact is a definite advantage over woodpulp produced at remote forest areas.

How then can bagasse which is burnt as fuel be made available at present? There are no other means than to let the cane sugar mills using it as fuel instead of coal or oil as the source of power, and to organize a thorough system of surplus bagasse collection. Conversion of boiler fuel is not only a means to secure fibrous material, but contributes to the modernization and efficiency of sugar cane mills. As for the capital required for the boiler conversion and the installation of de-pithing process and baling press for packing bagasse, the conceivable

solution is that the Government or paper mills supply the necessary funds, to be recovered by the price of bagasse as it is supplied.

2) Newsprint production will not be profitable

What Peru most urgently desires at the moment is the domestic production of newsprint, which is at present totally dependent on imports. It was said that many discussions had been repeated for many years concerning the establishment of newsprint mill using Cetico at Iquitos and Pucallpa, and that mill experiments had been completed of such pulpwood.

However, there remains several questions as to making establishment of newsprint mill as the starting point of the development of Peruvian forest resources.

At present, newsprint is traded all over the world as an international commodity, the northern Hemisphere, Canada, Finland and Sweden in particular, being the main suppliers.

Those countries are rich in softwood resources of high quality and are making it efficiently in large scale mills using extremely low cost power. The minimum economical production scale of newsprint in those countries is said to be 200,000 tons per year. According to FAO estimates, the newsprint requirements in Peru is expected to be only 30,000 tons in 1965. Even if a newsprint mill is established in Peru to supply domestic requirements, the scale would be far too small to be able to compete on the international markets.

It should not be forgotten, too, that, for the production of newsprint, power consumption will amount to 1,800 to 2,200 KWH per ton, which makes it uneconomical for a mill unless it is located at a place where power can be supplied cheaply.

Thirdly, newsprint is a product which takes least manufacturing processes among papers and its production is influenced mostly by the suitability of pulpwood. It is true that, because of the recent progress in paper making technology, softwood species other than those growing in Northern districts or part of hardwoods growing in warm areas are increasingly used for making newsprint, but there is no question as to the superiority of newsprint made of softwood.

From the above considerations, we have to point out that it is an extremely dangerous attempt to give the first priority to newsprint as the product of a paper mill to be established in the forest areas.

- 3) Pulpwood problems: attention should not be paid to Cetico alone. Of the many species of wood, which are said to be as many as 200, so far the only species considered in Peru as pulpwood is Cetico. It is true that Cetico forests grow relatively unmixed, that it is the only species that can easily be felled and collected, and that the experiments carried out so far seem to show that it is suitable for pulpwood in general. However, it is not considered from its properties that it is the only species of wood that can be used pulp wood. It is natural that pulp and paper mills will be established

using Cetico as the main pulpwood, but, at the same time, it would become necessary to take up other species in order to improve the quality of products.

Pucallpa districts are rich in Cetico, but are not good as regarding its location. Tingo Maria districts are poor in Cetico, but these High Jungle districts are relatively easy to develop in contrast to Amazon districts.

There are miscellaneous species found there, but those suitable as pulpwood are rather abundant there. Transportation to Lima is nearer and more convenient for those districts than for Pucallpa.

Iquitos is insufficient in transportation facilities and the development of this area is a matter to be solved in future.

4) Water and drainage system

Pulp and paper is one of the typical industries which consumes very large quantity of water. Water necessary for the production of various grades of pulp is as follows:

Ground woodpulp 40 - 50 m³ per ton of pulp,

Unbleached sulphate pulp 75 - 150 m³ per ton of pulp,

Bleached sulphate pulp 330 - 400 m³ per ton of pulp,

At integrated mills:

Newsprint 160 m³ per ton of pulp,

Unbleached sulphate paper 170 m³ per ton of pulp,

Bleached sulphate paper 350 - 450 m³ per ton of pulp.

Water is required to be soft water of high purity.

From the above considerations, capital investments for the treatment of paper and chemical consumption will have to come to a big sum if the brownish water of the Amazon or Ukayari Rivers is to be used at Iquitos or Pucallpa. More desirable is to use the relatively pure water at Tingo Maria.

Furthermore, water pollution by pulp and paper mills has caused many problems in various countries. If mills are to be established in forest areas of Peru, it is absolutely necessary to have both equipments to burn spent liquor and chemical recovery system. The treatment system for the drainage from pulp washing and bleaching processes will be also necessary.

- 5) Paper mills to be established at seaside districts and pulp mills at forest districts.

One idea of possible pulp and paper mills to be established in Peru in the future is as follows.

A paper mill and a sulphate pulp mill using bagasse as raw material are to be established at seaside districts first, and then an unbleached sulphate pulp mill using broad leaved wood forest districts (the best site is Tingo Maria). A semi-chemical pulp plant may be built in the latter mill. The entire pulp produced at the latter mill is to be sent to the paper mill at seaside, where fine papers such as printing and writing, as well as kraft wrapping paper, various boards and corrugated paper are to be produced, using sulphate pulp sent from the mill at forest districts after bleaching part of it,

mixed with bagasse pulp and some imported pulp.

The important thing is that the pulp mill to be established at forest districts should be solely devoted to making pulp with minimum power, chemicals, materials and labor and supplying it to the favorably located mill near seaside.

Sulphate process has a wide adaptability in the way of utilizing versatile species of wood. Pulp obtained by this process is good in its strength. Recovery of spent liquor is also most highly developed for this process. When the production of semi-chemical pulp is one-third or one-fourth of that of sulphate pulp, the spent liquor may well be mixed at the recovery process of sulphate pulp. It's product may be used for making corrugated medium or as a mixture after bleaching for making medium grade printing paper.

The probable scale of the mills would roughly be as follows:

Pulp mill at forest

Unbleached sulphate pulp	100 - 120	ton per day,
Semi-chemical pulp	30 - 40	" ,
Bagasse pulp mill at seaside	50 - 100	" ,
Paper mill at seaside	200 - 250	"

D. Quality of paper products

The quality of printing, writing and packaging papers produced in Peru is at pretty low level. Particularly notable is the un-uniformity of quality even in the same grade. There is still much left to be improved in sheet formation, opacity, strength and brightness. At the Paramonga mill which we visited, efforts were being made for installing modern equipments and the existing equipments were not at all obsolete. However, if we would be allowed to make a few comments, we noted that the equipments at the stock preparation room were rather poor and that instrumentation at various processes were not quite fully up-to-date. The mill, which had a capacity of producing 150 tons per day, was considered to be large enough to take up the problem of chemical recovery.

The matter which especially attracted our attention was that a thorough quality control system had to be introduced for the improvement of the quality of its products and that sorting had to be strictly carried out at the finishing room.

