FEASIBILITY STUDY ON THE ESTABLISHMENT OF THE POWDERED ACTIVATED CARBON PLANTS IN THE REPUBLIC OF THE PHILIPPINES

JUNE, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a Feasibility Study on the Powdered Activated Carbon Plants Establishment Project and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to the Philippines a survey team headed by Mr. Shigeo Ueki seven times starting in January 1984.

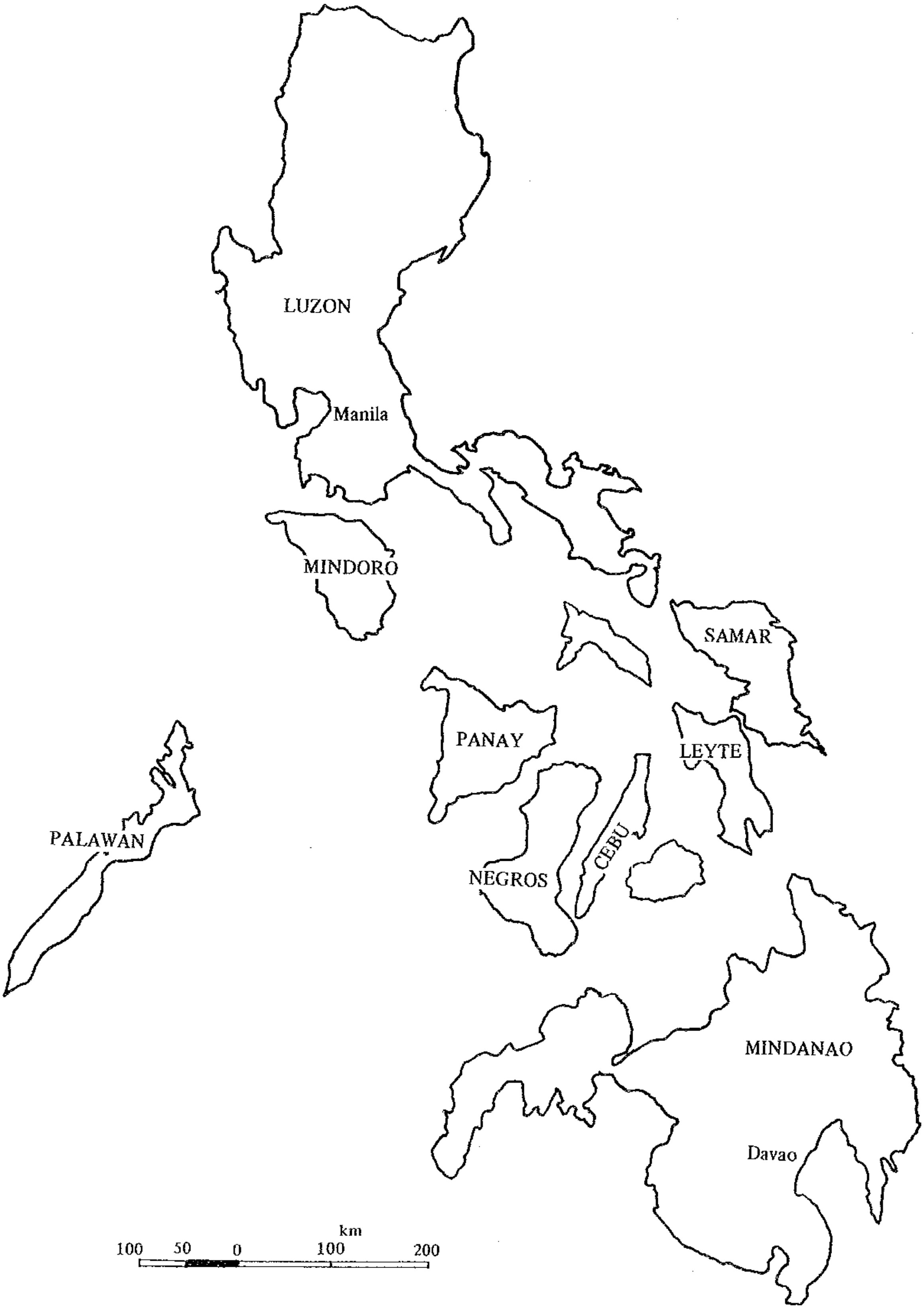
The team exchanged views on the Project with the officials concerned of the Government of the Philippines and conducted a field survey in Manila, Davao and other related areas. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

Tokyo, June, 1985

Keisuke Arita
President
Japan International Cooperation Agency


LUZON
Manila
MINDORO
SAMAR
PANAY
LEYTE
PALAWAN
CEBU
NEGROS
MINDANAO
Davao
km
100 50 0 100 200

In this report the following currency exchange rates are used:

US$ 1 = ¥245 = ₱18

ABBREVIATIONS

(1) Unit and Conversion

b.d.	Bone Dry
BFD	Board Feet per Day
°C	Degree Centigrade
D, d	Day
DCF	Discounted Cash Flow
FOB	Free on Board
CIF	Cost, Insurance and Freight
g	Gram
kg	Kilogram
H, Hr, h	Hour
ha	Hectare
Hz	Hertz
IRR	Internal Rate of Return
IRROE	Internal Rate of Return on Equity
IRROI	Internal Rate of Return on Investment
EIRR	Economic Internal Rate of Return
km	Kilometer
kV	Kilovolt
kVA	Kilovolt Ampere
kW	Kilowatt
kWh	Kilowatt Hour
m	Meter
m^2	Square Meter
m^3	Cubic Meter
M.M.	Man Month
t, T	Metric Ton
V	Volt
Y, y	Year
¥	Yen
$	United States Dollar
₱	Peso
ℓ	Liter

Kcal	Kilocalorie
%	Percent
ppm	Parts per Million
kg/cm^2	Kilogram per Square Centimeter

(2) **Organization, Company and Others**

NSTA	National Science and Technology Authority
NIST	National Institute of Science and Technology
JICA	Japan International Cooperation Agency
GIDLH	Government Industrial Development Laboratory, Hokkaido
BOI	Board of Investments
BFD	Bureau of Forest Development
NEDA	National Economic Development Authority
PHILSUCOM	Philippine Sugar Commission
PCA	Philippine Coconut Authority
MWSS	Manila Waterworks & Sewage System
LWUA	Local Water Utilities Administration
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
TRC	Technology Resource Center
NPCC	National Pollution Control Commission
SPDA	Southern Phils. Development Authority
UM	University of Mindanao
IDC	Industries Development Corp.
UA	Union Ajinomoto Inc.
MCCI	Maria Cristina Chemical Industries Inc.
MVC	Mabuhay Vinyl Corporation
PAC	Pacific Activated Carbon Co., Inc.
PJAC	Philippine Japan Activated Carbon Co.
UCAP	United Coconut Association of the Philippines, Inc.
PRC	Philippine Refinery Company
ITIT	International Transfer of Industrial Technology

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SUMMARY AND RECOMMENDATIONS

SUMMARY AND RECOMMENDATIONS

1. Regarding the plan to manufacture powdered activated carbon by using sawdust that is presently being disposed of in huge quantities in the Philippines, joint research has been conducted between GIDLH, a research institute belonging to the Japanese government, and NIST, a research institute belonging to the Philippine government. Also, in 1984, with the cooperation between the two research institutes, tests were conducted by means of a small scale plant constructed in NIST.

2. This project involves the construction of a powdered activated carbon manufacturing plant based on the results of these research activities.

3. The objective of this study is to sound out the feasibility of constructing the plant described above.

4. A huge volume of coconut shell activated carbon is being manufactured in the Philippines and exported. However, since no wood-based powdered activated carbon is being manufactured, its entire required volume is being imported.

5. If the project is implemented, then the product manufactured through this project will replace the wood-based powdered activated carbon presently being imported by the Philippines. In addition, the product can also be exported. Therefore, the manufacture of powdered activated carbon from sawdust as raw material is conceived to be highly significant for the Philippines.

6. Sawdust that is the raw material for this project is generated in many regions in the Philippines, and presently being disposed of without being utilized. The larger portion of the sawdust consists of lauan sawdust and is available free of charge. Wood species other than lauan as well as waste wood were also studied for use as the raw material, but these sources are not dependable as the raw material as observed from the aspects of available volume and procurement prices.

7. Tests done using the small scale plant confirmed that powdered activated carbon of good quality is obtained by using sawdust as the raw material. Accordingly, when the yield of product from char produced from sawdust was 25%, the product's methylene blue adsorption strength was 180–200 ml/g. This performance gave confirmation that the product

manufactured through this project can be put to various applications.

8. Approximately 1,300 T/Y of activated carbon are being consumed in the Philippines, about 300 tons of which consist of powdered activated carbon and about 1,000 tons consist of granular activated carbon. Powdered activated carbon is being used primarily in food processing industries such as sugar refining, edible oil refining, and refining of sodium glutamate.

9. Powdered coconut shell activated carbon has come to replace a portion of imported powdered activated carbon recently, but there are fields in which powdered coconut shell activated carbon cannot be used as alternative. Since the product produced through this project is favorably comparable with imported powdered activated carbon, it is capable of replacing imported powdered activated carbon.
In addition, its high quality level enables the product to be exported to neighboring countries.

10. The domestic activated carbon market for the product manufactured through this project is conceived to run up to about 160 T/Y.
Among neighboring countries, Japan has the largest activated carbon market. In Japan, the price of powdered activated carbon is high owing to the soaring of sawdust price in recent years, so the product manufactured through this project can be exported to Japan.

11. Seven regions in the Philippines were surveyed in the first stage survey in order to confirm the volume, quality, etc. of sawdust that will be available. As a result, since the Davao region was confirmed to provide sufficient volume of sawdust at low cost, the Davao region was recommended as the optimum site for plant construction from the aspect of raw material procurement.

12. The processes to be adopted for this project should preferably be the same as those adopted in both basic research and tests. Accordingly, in the cost estimation for the financial analysis of the project, the adoption of the open hearth furnace process for sawdust carbonization and the circular fluidized bed type furnace process for char activation was assumed.

13. The production capacity was decided at 40 T/month taking into consideration the procurement of sawdust, product market and minimum production capacity of the plant.

14. One-fourth of the product is assumed to be sold on the domestic market, and three-fourths

exported to foreign market.

15. Considering the market situation and profitability, the construction of a product refining plant is not included within the scope of this project.

16. According to results of tests it was found that 16 tons of sawdust (bone dry), 500 kWh of electricity and 20 m^3 of water are necessary for producing one ton of product through this project.

17. It was finally concluded that Davao City is the best plant site according to the results of the second stage survey which was made to study conditions for raw material procurement, availability of utilities, meteorological conditions, land procurement and product transportation costs, etc.

18. Plant equipment and the some structural materials of plant buildings are to be imported from Japan.

19. A total land area of about 10,000 m^2 is necessary for this project, and the building floor area is expected to run up to about 2,900 m^2.

20. The time required for plant construction is one year, including the time required for test run.

21. The plant is assumed to be completed by March 1987, and plant operation commenced in April 1987.

22. All prices and costs are estimated in U.S. dollar as of September 1984. These prices and costs are escalated on an assumption that they will be escalated with an annual escalation rate of 5% up to the time of completion of plant construction.

23. The following currency exchange rates are used in this study.

US$1 = ¥245 = ₱18

24. The total funds necessary up to the completion of plant construction in March 1987 are estimated to be US$1,823,548, of which foreign currency portion is US$1,316,481 and local portion US$507,067.

TOTAL INVESTMENT COST REQUIRED (By Apr., 1987)

(US$)

	FC	LC	Total
Land		67,376	67,376
Machinery & Equipment	591,316	108,335	699,651
Building	548,791	217,098	765,889
Vehicle	117,498		117,498
Test Run	7,456	11,276	18,732
Pre-operation Cost	51,420	12,516	63,936
Initial Working Capital		90,466	90,466
Total	1,316,481	507,067	1,823,548

25. The foreign currency portion of funds is to be met by a long-term loan, and the local currency portion by equity. The conditions for borrowing long-term loan were assumed to be uniform repayment in ten years, and the interest rate 8% (Case A) or 12% (Case B). Short-term fund deficiency is assumed to be met by a short-term loan at an interest rate of 30% per annum.

26. The number of days of plant operation is 300 days annually. The plant's operation rate in the initial year is 70%, and 100% in subsequent years.

27. The product will have to be competitive on the domestic market with the imported powdered activated carbon, and on the Japanese market with the powdered activated carbon of same kind which is presently being imported.
For this reason, it will be necessary to set the product's ex-factory price at US$1,600/T for the domestic market, and at US$1,200/T for the export market (average US$1,300/T), as of prices of September 1984.
Therefore, the product's average ex-factory sales price at the time of commencement of sale in April 1987 is calculated at US$1,470/T.

28. *The corporate income tax rate is as follows:*

0 – ₱100,000	25%
Over ₱100,000	35%

29. The following tax credits are offered to this project:

a) Tax credit on Net Value Earned.

b) Tax credit on Net Local Content of Exports.

30. After commencement of plant operation, funds will be deficient for a period of 1 year in Case A and for 2 years in Case B, with the result that short-term fund will have to be borrowed. But after that time the necessary cash can be obtained through the sales of the product.

31. Internal rates of return are as follows:

	Case A	Case B
IRR on investment (before tax)	15.27%	14.91%
IRR on investment (after tax)	13.58%	13.33%
IRR on equity (after tax)	21.26%	15.03%

32. As observed from the aspects of production cost, debt service coverage ratio, pay-out period, rate of return on investment, rate of return on equity, etc., this project is judged to be financially feasible.

33. The economic internal rate of return is as follows:

EIRR 20.85% (Case A)
EIRR 20.68% (Case B)

34. The amount of foreign currency acquired through this project (import payments plus export revenues), after subtracting the interest and capital repaid on the long-term loan, will be as follows:

US$5,012,871 (Case A) (Value in 1987)
US$4,772,932 (Case B) (Value in 1987)

35. Carrying out this project will provide various kinds of indirect benefits in addition to direct benefits.

36. No technical problem is encountered in carrying out this project. As observed from the results of financial and economic analyses, the project is concluded to be feasible.

(RECOMMENDATIONS)

1. In order for the product manufactured through this project to compete favorably with foreign products on export markets, it would be desirable for the product to be given further special promotional incentives from the aspects of taxation.

2. Since this project provides foreign currency by a small amount of investment and within a short period of time after commencement of plant operation, it will be desirable for the project to be carried out as early as possible.

3. More than half of the product manufactured through this project is to be exported. In order to expedite the sale of the product on the foreign market, a business tie-up with a foreign activated carbon manufacturer will be necessary. This will also have the effect of stabilizing the foundation of this project.

4. In order to operate the plant with stability, training of employees and guidance in plant operation will naturally be necessary. However, these operations will be very costly, and the expenses for long-term guidance may oppress the plant's financial conditions. Even when taking this factor into consideration, a tie-up with a foreign activated carbon manufacturer is considered to be advantageous.

5. The corporate body carrying out this project may be an official organization, a private corporation or its joint concern. However, as observed from the standpoint of early project execution and brisk corporate activity, the selection of a sawmill as the enforcing entity will be a desirable form. In this case, as it will be possible to utilize the various conveniences possessed by the sawmill, highly advantageous conditions can be obtained in connection with plant construction and operation including raw material procurement.

6. It is recommended that, in the comercial implementation of the project, NIST gives its assistance to the enterprise/investor/s as requested.

7. It will be necessary for the plant management to constantly strive to acquire an ever wider scope of knowledge relating to the activated carbon industry as well as industries utilizing activated carbon as a means of expanding the sales market for the product.

Chapter 1

INTRODUCTION

Chapter 1. INTRODUCTION

1.1 Background of This Project

Various measures are being adopted in the Philippines today for the preservation and effective utilization of its forest reserves.

In consonance with these measures, forestation is being advanced actively and regulations relating to felling of trees are being enacted. In addition, exports of timber as felled is controlled in order to promote exports of processed timber.

Under the existing situation of active enforcement of these measures, it has become vitally important for the Philippines, in order to promote development of the domestic forestry industry, to encourage efficient utilization of sawdust that is being thrown away by sawmills without being utilized, and of logging waste and residues that are being left to rot in the mountains.

From the standpoint of effective utilization of these untapped timber resources, joint basic research has been advanced these several years between the Government Industrial Development Laboratory, Hokkaido a governmental research institute of the Japanesent Government and the National Institute of Science and Technology a research institute of the Philippine Government, with the aim of developing technologies for producing powdered activated carbon from tropical woods Findings of the basic research have shown that several kinds of tropical woods are promising for use as the raw materials for manufacturing powdered activated carbon.

Pursuant to this, the Philippine Government requested the Japanese Government to extend technical cooperation for determining the feasibility of commercializing the manufacture of powdered activated carbon on the basis of the results of these basic research activities.

In response to this request, the Japanese Government entrusted the work of extending technical cooperation to Japan International Cooperation Agency.

The Japan International Cooperation Agency dispatched a preliminary survey team to the Philippines in March 1983, where deliberations were held to define the scope of work to be conducted in connection with basic items for carrying out the feasibility study. Based on *these deliberations, an agreement was reached between the Agency and NIST on* "*Implementing* Arrangement for Technical Cooperation between Japan International Cooperation Agency and National Institute of Science andTechnology for Feasibility Study on the Establishment of the Powdered Activated Carbon Plants (hereinafter referred to as I/A), and both parties affixed their signatures to this agreement.

1.2 Objective of Feasibility Study

The objective of this feasibility study is to make a feasibility study (hereinafter referred to as F/S) on the establishment of powdered activated carbon plants using tropical wood and waste available in the Philippines as the raw materials, based on the aforementioned I/A and Minutes of Meeeting on I/A (refer to Appendix 1A-1).

1.3 Scope of the Study

The scope of the study is described in detail in the I/A and Minutes of Meeting, and the principal items are summarized as follows:

a) Review and analysis of the background of the project
b) Market study
c) Study on raw materials
d) Study on the plant site
e) Drafting the conceptual design of the plant
f) Financial analysis
g) Economic and social evaluation

Since this project is essentially based on research relating to technologies for the manufacture of powdered activated carbon by using tropical wood, it will have a deep relationship with the forestry industry and sawing industry of the Philippines regardless of whether tropical wood itself or its logging waste and residues are utilized. Accordingly, it will be necessary to include in item a) analysis of the existing situation of the forestry industry and sawing industry of the Philippines.

Also, regarding the tests on the manufacture of powdered activated carbon which are conducted in the compounds of NIST in parallel with the feasibility study, close liaison is to be maintained with the Test Team and the performances of the activated carbon product evaluated in order to feed back these results on the selection of raw material and plant site.

1.4 Study Method and Schedule

In field surveys, detailed deliberations were held with the counterpart team headed by Dr. Filemon A. Uriarte, Jr., Director of NIST and necessary data were obtained through joint operations as by visiting many organizations and corporations. Also, detailed deliberations were held on the basic methods for data analysis.

Site surveys were conducted on two occasions - - the 1st Stage Study, followed with the 2nd Stage Study. Appendix 1A-2 shows the members of the F/S Team, Test Team and Counterpart Team, Appendix 1A-3 and 1A-4 the schedules of surveys by F/S Team and Test Team respectively, and Appendix 1A-5 the principal places visited.

Acknowledgement

In carrying out this feasibility study, valuable opinions and suggestions were received from His Excellency Dr. Emil Q. Javier, Minister of the National Science and Technology Authority and Dr. Quintin L. Kintanar, Deputy Minister of the same Authority, while the greatest cooperation was received from Dr. Filemon A. Uriarte, Jr., Director, National Institute of Science and Technology and other members of the counterpart team. Also, great convenience was provided by many public organizations and private corporations through which valuable data were obtained. The sincerest gratitude is extended to all these personages.

Additional Remarks

The following method was adopted for reporting the various data and information collected.

The study teams strove to collect as much data as possible in field surveys, for which numerous governmental organizations, related organizations and private corporations were visited. These organizations and corporations were invariably very cooperative and supplied diverse data by way of documents and conversation. During the field survey many powdered activated carbon consuming companies were visited.

Detailed statistics relating to the consumption of activated carbon by industries are difficult to obtain in any country since the number of consumers runs up to an enormous quantity including consumers on small scales, making it very difficult to grasp any detailed situation on the product's consumption.

Also, divulging information relating to the specific kinds and volumes of activated carbon being used by a company in its manufacturing processes may disclose the methods adopted by the company for refining its products, thus making companies in general reluctant of revealing these information, with the result that obtaining detailed statistics on activated carbon consumption is very difficult.

Despite these circumstances, activated carbon consumers in the Philippines were generally very cooperative and offered the study team much valuable data most kindly.

The team analyzed the activated carbon market in the Philippines by utilizing a huge volume of data acquired in this manner. However, it will be necessary from the standpoint of ethics of a technical consultant to prevent leakage of information pertaining to the contents and method of operation of these companies when giving a report on the results of analysis of the market situation. Therefore, the method of employing total figures was adopted instead of reporting on individual cases and of using generic expressions as a means of refraining from divulging information relating to individual companies.

Chapter 2

ACTIVATED CARBON INDUSTRY

Chapter 2. ACTIVATED CARBON INDUSTRY

The history of activated carbon dates as far back to the years before Christ (B.C.). During this long period of history, great changes have been brought about in human society, and today huge volumes of activated carbon have come to be employed even for preventing environmental pollution. And in the process of such transition in the utilization of activated carbon, demands have been raised persistently for activated carbon of ever higher quality levels, triggering a series of significant technological progress in the manufacture of activated carbon.

The state of utilization of activated carbon differs widely between industrially advanced countries and developing countries. However, it cannot be denied that even with developing countries, the situation of utilization of activated carbon is bound to undergo a transition from the existing situation, stimulated by population increases and industrial progress, and to gradually approach the situation characterizing industrially advanced countries today.

Meanwhile, several major changes have occurred even as observed from the aspects of the raw materials used for producing activated carbon. Specifically, even mineral-based raw materials have come to be employed in addition to wood-based and animal-based raw materials. Not only coal but oil-based raw materials are usable. Furthermore, petrochemical products produced by using oil as the raw material are also usable.

In the Philippines, the activated carbon market lies as yet in its infant stage. But from the viewpoint of raw materials resources, the Philippines is one of the most blessed coutries in the world. Coconut shell is a raw material that is produced every year, and most of waste timber as well as sawdust are being left to rot without being put to any useful application, with the result that there is even anxieties of environmental pollution, and in some regions this has become a reality.

Against this background, the venture to manufacture powdered activated carbon by utilizing waste sawdust must be regarded as a highly significant undertaking indeed.

Before venturing into the commercial manufacture of powdered activated carbon, it will be necessary to acquire a broad scope of knowledge relating to activated carbon, as pointed out in Chapter 18. The knowledge to be acquired will primarily consist of the following items:

1) Items Relating to Manufacture

i) Plant operation conditions.

ii) Method of analysis of product and semi-finished product.

iii) Relationship between operating conditions and product quality.

iv) Relationship between raw material and product quality.

v) Equipment maintenance methods

2) Items Relating to Product Sale

i) Kinds of Product

(a) Kinds of product by raw materials.
(b) Kinds of product by shape.
(c) Applications by kind of product.
(d) Market prices by kind of product.
(e) Characteristics of powdered activated carbon.

ii) State of Activated Carbon Industries in Other Activated Carbon Producing Countries.

iii) State of Activated Carbon Consumption Industries in the Philippines

(a) Refined sugar industry.
(b) Sodium glutamate industry.
(c) Edible oil industry.
(d) Glucose industry.
(e) Glycerine industry.
(f) Medical drug industry.

iv) State of Activated Carbon Consumption Industries in Neighboring Countries.

The acquisition of knowledge relating to the items listed above will be beneficial not only when negotiating with product purchasers, especially when setting product selling prices, but will also enable the manufacturer to produce products meeting the specific needs of purchasers, and to pave the way for developing new markets.

Refer to Appendix 2A-1 for details on the kinds of activated carbon, manufacturing methods and way of applications in the world.

Chapter 3

PRODUCTION AND TRADE OF ACTIVATED CARBON IN THE PHILIPPINES

Chapter 3. PRODUCTION AND TRADE OF ACTIVATED CARBON IN THE PHILIPPINES

3.1 Background and Present Status of Activated Carbon Manufacturing Industry

As pointed out in Chapter 2, activated carbon raw materials are available in the form of coal-based, oil-based and wood-based raw materials as well as coconut shell.

In this respect, the Philippines is blessed with abundant raw materials such as coconut shell, timber and sawdust, which provide advantageous conditions for the activated carbon industry. However, the existing situation is that only coconut shell is being utilized as the raw material for manufacturing coconut shell activated carbon, which belongs to the category of granular activated carbon. Timber and sawdust, which are also usable for producing powdered activated carbon, have not been utilized so far for the manufacture of activated carbon.

In the Philippines coconut shell activated carbon is being manufactured as described above and the larger portion of it is being exported, while a considerable volume of coconut shell charcoal is also being exported.

Excepting for coconut shell activated carbon, no other form of activated carbon is being manufactured in the Philippines, so the entire volume of coal-based granular activated carbon as well as wood-based powdered activated carbon necessary for industries in the country is being imported.

3.2 Coconut Industry

The Philippines is foremost in the world in coconut cultivation, with the output exceeding five times that of runner-up Sri Lanka and decisively outpacing other countries by a wide margin. The present situation of the coconut industry is shown in Appendix 3A-1.

Active promotion of coconut cultivation in the Philippines raised the 1981 output to about four times that of thirty years ago, and to nearly double that of 1972. However, drought has had the effect of decreasing the output during the last few years.

The land area for coconut cultivation runs up to roughly 4 million hectares, accounting for the largest area diverted for the cultivation of a single crop. Cultivation is the most brisk in the descending order of South Mindanao, South Tagalog, West Mindanao, North Mindanao and West Visayas. Therefore, the coconut products industry has achieved rapid development in these five regions.

The principal products of the coconut industry are the following:

a) Copra.
b) Desiccated coconut.
c) Coconut oil.
d) Coconut coir.
e) Coco-chemicals.
f) Coconut shell charcoal.
g) Coconut shell activated carbon.

These products are being exported in large quantities and, together with other export products such as minerals, sugar and forestry products, are playing a vital role for acquiring foreign currencies.

In the past, coconut used to be exported primarily in the form of copra, but the export volume has decreased steadily during the last decade owing to the low unit selling price, in favor of the exporting products of higher added values such as coconut oil and desiccated coconut. As observed from the aspects of export value, coconut oil leads other coconut products, followed in descending order with copra meal/cake, desiccated coconut, copra, coconut shell activated carbon and coconut shell charcoal.

Coconut being the principal agricultural product in the Philippines, the various kinds of products derived from the coconut are expected to assume leading positions among the country's export commodities.

These products should be exported not as products of low added values but rather as products of higher added values. For this, it will be necessary to produce these products not in the form of raw materials or processed raw materials but rather as final products. And efforts should be made not to export products of low qualities but to export products refined to high quality levels.

3.3 Manufacture of Coconut Shell Activated Carbon

The Philippines is the world's leading cultivator of coconut trees, also world leading producer of coconut shells, as described earlier. Coconut shell activated carbon came to be manufactured in the Philippines in the early 1970s with the cooperation of Japanese activated carbon manufacturers, and today four plants are in operation.

Table 3-1 shows a general description of coconut shell activated carbon plants in the Philippines, which shows that the aggregate registered production capacity of these plants runs up to 12,480 tons/yr. The operation rate of these plants is 80–90%. Incidentally, a new plant has been constructed recently in Atimonan (Quezon Province).

Table 3-1 COCONUT SHELL ACTIVATED CARBON PLANTS

	Names	Registered Capacity	Plant Location	Foreign Investors
A. *	Registered Firm			
1.	Pacific Activated Carbon	2,370 MTPY	Misamis Oriental	Calgon Corp./USA C. Itoh & Co., Ltd./Japan
2.	Phil-Japan Activated Carbon	3,600 MTPY	Davao	Kowa Co., Ltd./Japan Futamura Industries/Japan
3.	Davao Central Chemical	1,920 MTPY	Davao	Takeda Chemical Ind., Ltd./Japan Mitsubishi Corp./Japan
4.	Cenapro Chemical	4,590 MTPY	Cebu	Kuraray Chemical Co., Ltd./Japan Marubeni Corp./Japan
	Total	12,480 MTPY		
B.	Additional			
5.	Interland Chemical Inc.	11,567 MTPY	Quezon Province	None

* Source: Philippine Coconut Authority

Coconut shell activated carbon used to be applied mostly for gas adsorption, solvent recovery and gas refining in gaseous phase, but more recently it has come to be utilized for liquid-state adsorption as water purification. In the Philippines, a case was observed in which a soft drink manufacturer was using coconut shell activated carbon, in place of coal-based granular activated carbon, for carbon dioxide gas refining and water purification.

It was also observed that powdered coconut shell activated carbon was being used for bleaching in the process of refining edible oils.

However, since this powdered coconut shell activated carbon inherently possesses identical properties as coconut shell activated carbon, its adsorption property will be identical to that of granular coconut shell activated carbon, as pointed out in Chapter 2, with the result that its property of adsorbing macromolecular impurities will be inferior compared with wood-based powdered activated carbon.

Table 3-2 shows the specifications of powdered coconut shell activated carbon produced by Davao Central Chemical Corp.

Table 3-2 DAPHILCAR COCONUT SHELL ACTIVATED CARBON

Specifications/Grade	Granular		Powder	
	40 x 80	10 x 32	80 x 350	100 x 350
Apparent Density (g/cc) Min.	0.505	0.550	–	–
Aceton Adsorption (%) Min.	26.5	26.0	–	–
Ash (%) Max.	5.0	5.0	–	–
Moisture (%) Max.	5.0	5.0	6.0	10.0
Caramel Decolorizing Power (%) Min.	–	–	75.0	75.0
Grain Size Distribution				
40 x 80 mesh (%) Min.	82	–	–	–
40 x 32 mesh (%) Min.	–	85	–	–
80 x 350 mesh (%) Min.	–	–	90	–
100 x 350 mesh (%) Min.				
thru 100 mesh				80
thru 200 mesh				60
thru 350 mesh				20

Source: Philippine Coconut Shell (Brochure)

3.4 Trade of Activated Carbon

As described earlier, the Philippines is exporting the larger portion of the coconut shell activated carbon produced domestically, and importing necessary granular activated carbon and powdered activated carbon other than coconut shell activated carbon.

3.4.1 Export of Coconut Shell Activated Carbon

The situation of export of coconut shell activated carbon is as shown in Table 3-3, Table 3-4 and Table 3-5.

As shown in Table 3-3, the volume of export of coconut shell activated carbon is increasing steadily and ran up to about 9,800 tons in 1982 according to Table 3-4, and roughly 73% of which was exported to Japan and about 19% to the United States. Neighboring export destinations for the product were countries such as Taiwan, the Republic of Korea, Indonesia, Thailand and Singapore.

Table 3-3 RP ACTIVATED CARBON : MONTHLY EXPORT VOLUME, 1977–1982

(In MT)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1977	510	487	297	332	481	206	369	607	310	783	480	573	5,435
1978	389	477	410	379	680	419	598	522	458	537	734	690	6,293
1979	459	541	599	529	929	271	698	801	635	588	646	648	7,334
1980	754	769	743	725	1,008	550	716	890	682	496	717	739	8,789
1981	809	848	741	893	663	678	710	963	695	535	654	864	9,043
1982	605	870	838	574	974	913	603	599	509	563	971	957	8,976

Source of Basic Data: Trade and Markets Department
Philippine Coconut Authority

Table 3-4 QUANTITY AND VALUE OF PHILIPPINE EXPORTS ACTIVATED CARBON AND COUNTRY OF DESTINATION: 1982 & 1981

Country	1982			1981		
	Quantity MT	FOB Value Dollars	CIF Value Dollars	Quantity MT	FOB Value	
					Dollars	Pesos
United States	1,843.913	2,478,649	2,802,704	2,687.552	3,720,223	29,067,916
Chile	9.100	10,633	14,383	–	–	–
Sweden	26.980	29,346	35,039	54.000	21,982	172,781
United Kingdom and North Ireland	88.740	93,311	108,119	109.140	111,772	897,139
Belgium	–	–	–	23.520	29,987	232,447
France	285.600	219,509	269,655	107.760	80,691	642,498
Italy	97.760	83,346	98,919	154.320	143,174	1,128,567
Thailand	19.840	16,588	18,035	9.970	9,057	68,927
Singapore	16.680	23,468	24,133	21.800	26,838	210,075
Indonesia	23.880	18,664	20,926	30.000	24,110	188,100
Korea	67.320	51,659	56,348	94.930	90,086	706,259
Hong Kong	–	–	–	1.960	2,566	19,442
Taiwan	87.340	70,256	75,742	97.240	80,074	624,234
Japan	7,145.450	7,051,832	7,601,723	5,750.721	6,998,029	54,853,006
Australia	41.245	45,841	50,769	42.150	50,441	396,542
Fiji Island	24.000	20,655	24,458	32.780	30,017	240,257
Mozanbique	13.230	11,158	13,635	57.210	56,318	439,332
Total	9,791.078	10,204,915	11,214,588	9,273.093	11,475,365	89,869,522

Source: 1982 Foreign Trade Statistics of the Philippines

Table 3-5 COMPANY-WISE EXPORT OF ACTIVATED CARBON

	1981 January – December			1982 January – December		
	Volume (MT)	Value (US$)	Unit Price ($/MT FOB)	Volume (MT)	Value (US$)	Unit Price ($/MT FOB)
ACTIVATED CARBON						
Cenapro Chemical	3,264	3,710,787	1,136.88	3,583	3,532,170	985.81
Davao Central Chem.	2,318	3,447,429	1,487.24	1,941	2,582,236	1,330.36
Pacific Activated	1,768	2,736,688	1,547.90	1,313	2,036,790	1,551.25
Phil-Japan Active	1,432	1,295,382	904.67	2,094	1,668,936	797.01
Others	261	364,170	1,395.29	45	58,620	1,302.67
Total	9,043	11,554,556	1,277.73	8,976	9,878,752	1,100.57
COCOSHELL CHARCOAL						
Durano Trading	6,400	1,066,720	166.67	3,874	554,050	143.02
Dilag Enterprises	5,890	941,105	159.78	4,819	666,930	138.40
Cenapro, Inc.	5,845	1,121,342	191.85	4,717	680,263	144.22
Sharon Commercial	5,215	984,587	188.80	835	172,938	207.11
Phil-Japan Active	2,734	427,770	156.46	2,027	268,255	132.34
Francis Ed. Wilson	2,196	379,046	172.61	1,400	189,700	135.50
H.M. Montenegro	1,312	262,088	199.76	453	54,965	121.34
Asian Carbon	1,010	221,450	219.26	2,100	343,050	163.36
Others	1,754	311,116	177.38	1,736	262,645	151.29
Total	32,356	5,715,224	176.64	21,961	3,192,796	145.33

Source: Philippine Coconut Authority
Diliman, Quezon City

Incidentally, the export volume during the first half of 1984 ran up to 1,424 tons, of which 1,103 tons were shipped to the Japanese market.

In addition to exporting coconut shell activated carbon, the Philippines exports several tens of thousands tons of coconut shell charcoal annually. The export volume of coconut shell charcoal is shown in Table 3-6. In 1982, roughly 89% of this export volume made its way to the Japanese market.

Table 3-6 COCONUT SHELL CHARCOAL EXPORT VOLUME, 1969–1982

(in MT of 1,000 kgs)

Year	Total
1969	3,800
1970	7,232
1971	15,486
1972	17,159
1973	23,466
1974	31,798
1975	16,896
1976	20,059
1977	25,607
1978	25,090
1979	30,342
1980	46,812
1981	32,356
1982	21,961

Source of Basic Data: Trade and Markets Department
Philippine Coconut Authority

3.4.2 Export Price of Coconut Shell Activated Carbon

Fig. 3-1 shows the export prices (FOB) of coconut shell activated carbon produced in the Philippines, indicating that the FOB price per ton of product fluctuated within the range of US$900–1,400 during the period of 1979–1982, and that the price was low in 1982.

According to Table 3-5, the mean FOB price per ton in 1981 and 1982 fell to US$1,278 and US$1,101, respectively.

Meanwhile, the export price (FOB) of coconut shell charcoal per ton fluctuated within the range of US$120–210 during 1979–1982 as shown in Fig. 3-2.

3.4.3 Import Volume of Activated Carbon

As shown in Appendix 3A-4, annual import of activated carbon ranges from about 1,000 tons upto 1,600 tons. Table 3-7 shows the situation of import of activated carbon by the Philippines in 1981 and 1982. Main exporting countries are Japan, the Netherlands, Belgium, the United States and Taiwan. American activated carbon consists almost entirely of coal-based granular activated carbon, while that imported from Europe and Japan consists of coal-based granular activated carbon and wood-based powdered activated carbon.

Table 3-8 shows the state of activated carbon trading between Japan and the Philippines in recent years.

(Note) Since the Philippine economic situation in 1981 and 1982 was stable, the data shown in Table 3-7 seem to reflect the correct market of activated carbon in the Philippines. Because of this reason, for the study of the activated carbon market, the data shown in Table 3-7 are used.

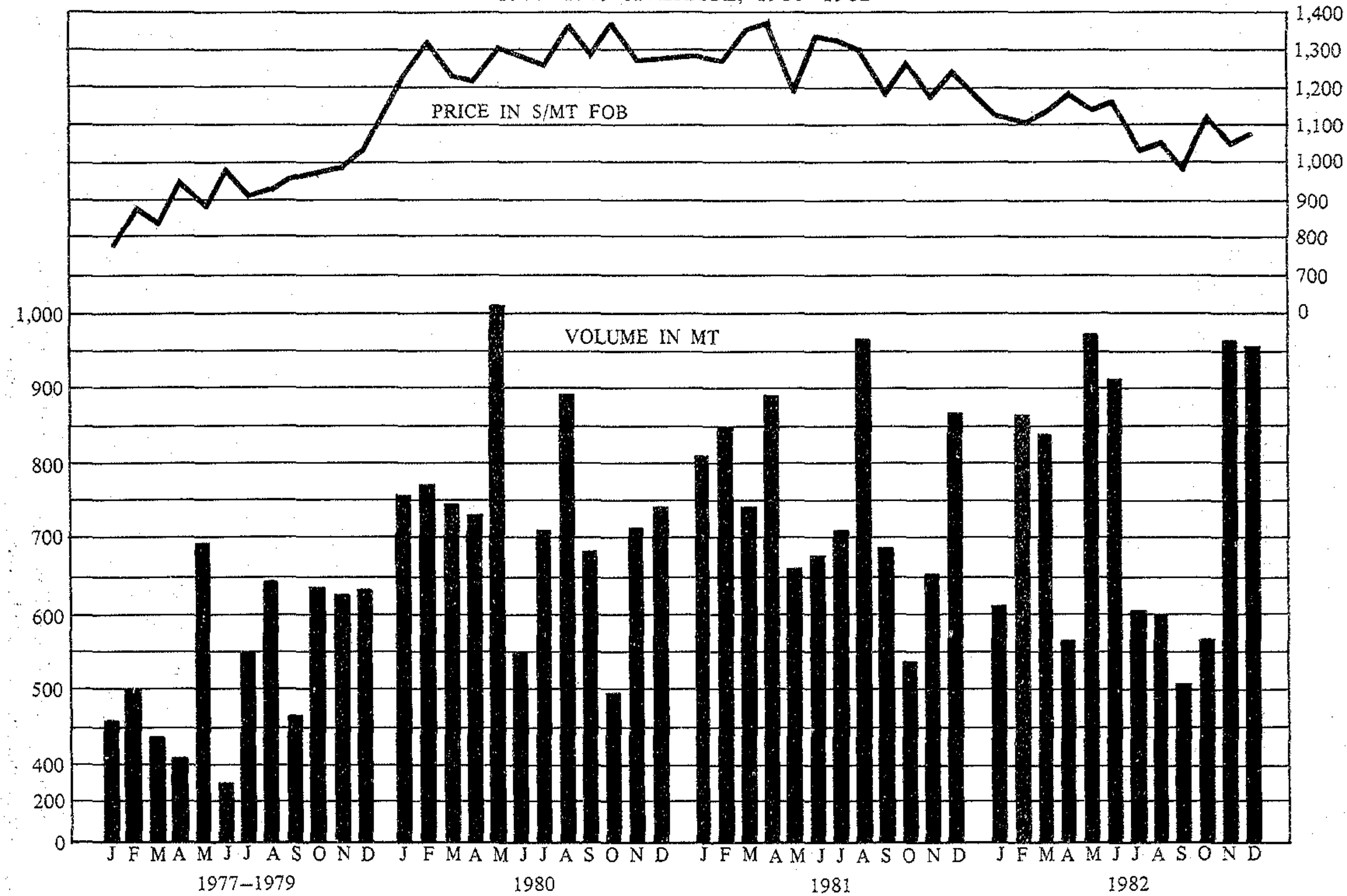
3.4.4 Prices of Imported Activated Carbon

Table 3-7 indicates that the mean import price per ton of activated carbon in 1981 was US$1,661 (FOB), and that in 1982 it was US$1,520 (FOB) and US$1,661 (CIF).

In the Philippines, imported activated carbon is levied an import duty of 30% with respect to the dutiable value (refer to Appendix 3A-2). The amount of tax to be levied is calculated on the basis of the home consumption value (HCV) (refer to Appendix 3A-3).

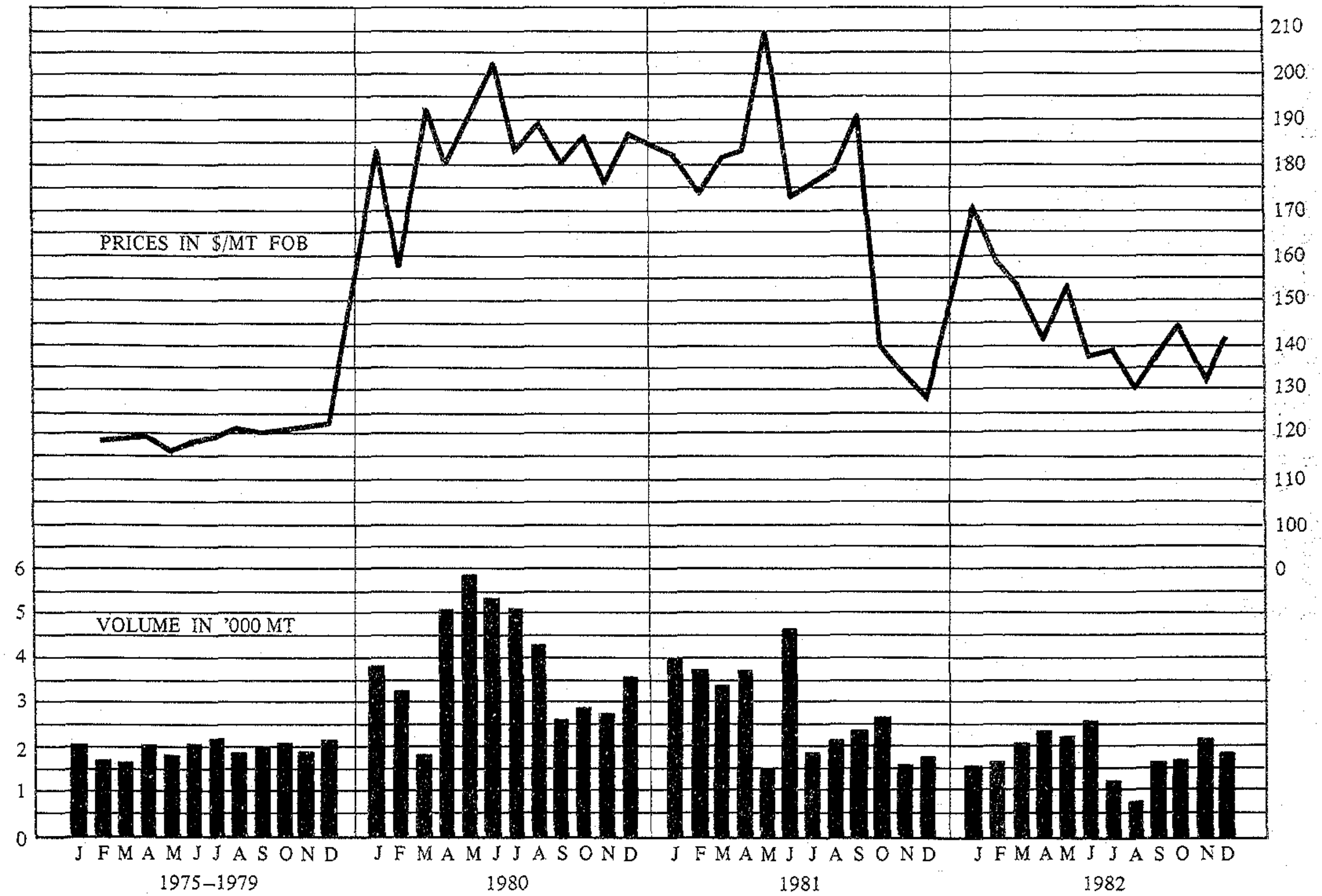
Incidentally, the additional duty was raised to 10% on July 6, 1984, with the result that the price of imported activated carbon is higher than before.

Fig. 3-1 MONTHLY VOLUME AND WEIGHTED TRADED PRICE OF RP ACTIVATED CARBON EXPORTS
1977–1979 AVERAGE, 1980–1982



Source: Trade and Markets Department
Philippine Coconut Authority

Fig. 3-2 MONTHLY VOLUME AND WEIGHTED TRADED PRICE OF RP COCONUT SHELL CHARCOAL EXPORTS 1975–1979 AVERAGE, 1980–1982



Source: Trade and Markets Department; Philippine Coconut Authority

Prepared by: UCAP Research, CS '62/pmg

Table 3-7 QUANTITY AND VALUE OF PHILIPPINE IMPORTS OF ACTIVATED CARBON AND COUNTRY OF ORIGIN : 1982 & 1981

Country	1982			1981		
	Quantity MT	FOB Value Dollars	CIF Value Dollars	Quantity MT	FOB Value	
					Dollars	Pesos
United States	129.096	224,108	248,268	189.852	338,774	2,722,680
United Kingdom and North Ireland	–	–	–	1,475	2,379	18,911
Netherlands	192.619	353,218	372,275	94.128	116,658	933,613
Belgium	244.805	505,577	540,486	352.462	699,703	5,456,744
Germany	38.500	44,416	49,365	13.063	12,799	58,389
Switzerland	70	195	247	–	–	–
Singapore	15	30	40	–	–	–
China	–	–	–	50.000	28,878	218,664
Taiwan	245.000	245,696	259,420	118.500	117,045	917,237
Japan	466.827	628,162	717,326	483.092	847,514	6,597,430
Total	1,316.932	2,001,400	2,187,427	1,302.572	2,163,750	16,963,668

Source: 1982 Foreign Trade Statistics of the Philippines

Table 3-8 JAPANESE EXPORT AND IMPORT OF ACTIVATED CARBON AND COCONUT SHELL CHARCOAL

Fiscal Year	Export to Philippines		Import from Philippines			
	Activated Carbon		Activated Carbon (from Coconut Shell)		Coconut Shell Charcoal	
	Quantity Ton	Unit Price Yen/Kg	Quantity Ton	Unit Price Yen/Kg	Quantity Ton	Unit Price Yen/Kg
1976	189	310	5,200	117	16,954	39
1977	324	396	6,182	187	22,320	41
1978	333	318	7,040	168	20,399	35
1979	381	339	7,622	250	24,480	50
1980	549	389	5,280	307	33,649	53
1981	414	492	6,186	297	20,901	51
1982	304	462	5,723	285	20,470	49
1983	101	458	6,193	228	14,058	44
1984*	152	369	4,772	287	12,527	54
	Philippine Port		Japanese Warehouse			

* Cumulative year to September.

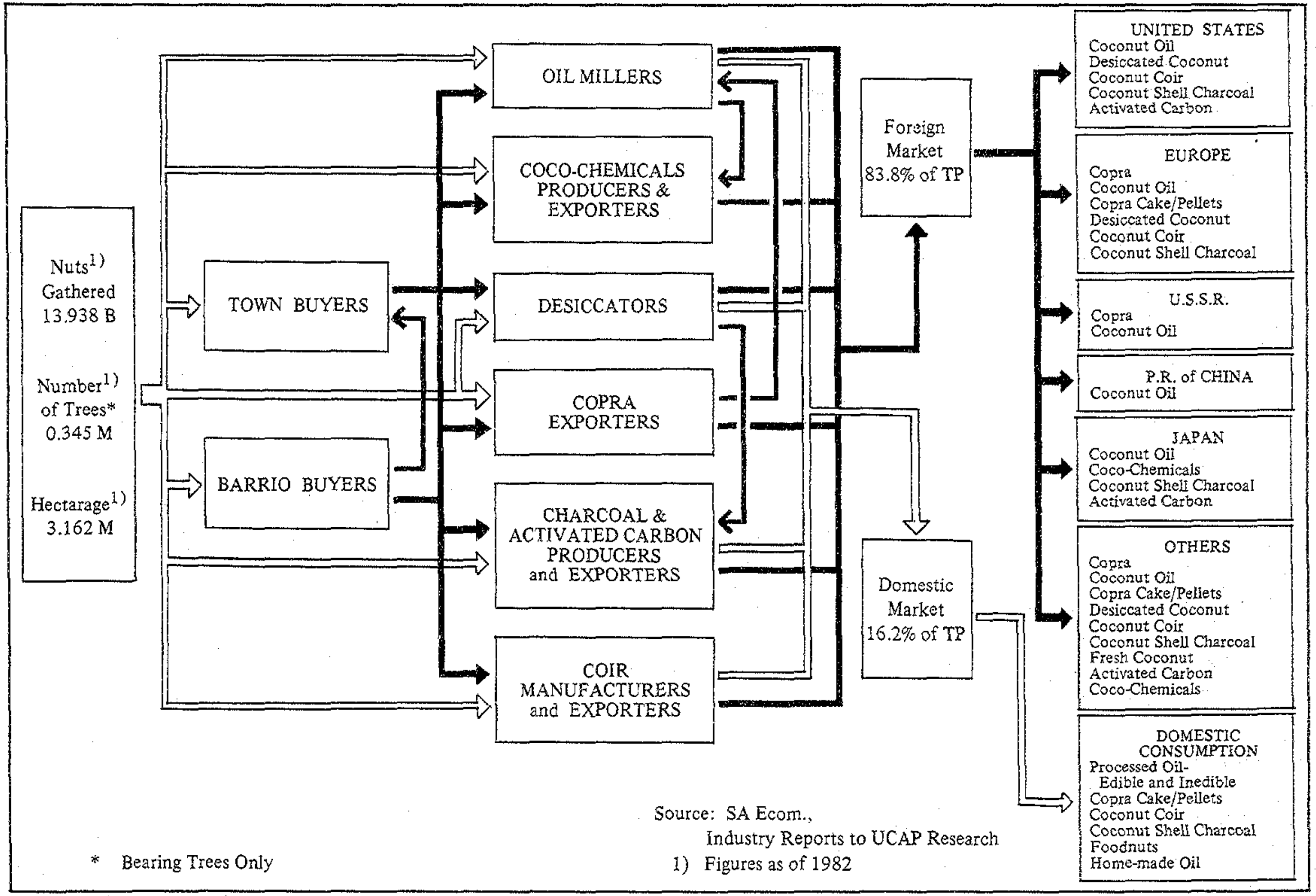
3.5 Activated Carbon Marketing Channels

Table 3-5 and Fig. 3-3 show the marketing channels for coconut shell activated carbon and coconut shell charcoal respectively. As is evident from Table 3-5, almost the entire volume of coconut shell activated carbon is being exported directly by the manufacturers themselves, and only a very slight volume is being exported through channels other than the manufacturers.

On the other hand, coconut shell charcoal is being marketed by traders.

As for the importation of activated carbon, it may be imported by traders, or imported by consumers through negotiation with overseas activated carbon manufacturers. The latter case is predominant in case of large consumers.

Fig. 3-3 MARKETING CHANNELS OF COCONUT PRODUCTS



* Bearing Trees Only

Source: SA Ecom.,
Industry Reports to UCAP Research

1) Figures as of 1982

Chapter 4

FORESTRY IN THE PHILIPPINES

Chapter 4. FORESTRY IN THE PHILIPPINES

4.1 Forestry Administration and Policy

As is mentioned in Chapters 1 and 7, the major raw material of the powdered activated carbon project under contemplation is sawdust, which is generated in the sawmill. Therefore, it is necessary to survey the present situation and the future trend of the forestry and sawing industries in the Republic of the Philippines.

The forests in the Philippines are state-owned, and the forestry administration is conducted by the Bureau of Forest Development under the Ministry of Natural Resources.

The future trend of the forestry and sawing industries will be influenced by the forestry administration and policy to be followed by the government. Therefore, Chapter 4 will report the survey results of the forestry administration and policy in the Philippines.

4.1.1 Forestry Administration

The Bureau of Forest Development under the Ministry of Natural Resources administers all the affairs concerning the forest, involving forestry, forestry industry, national parks, protection of natural environment.

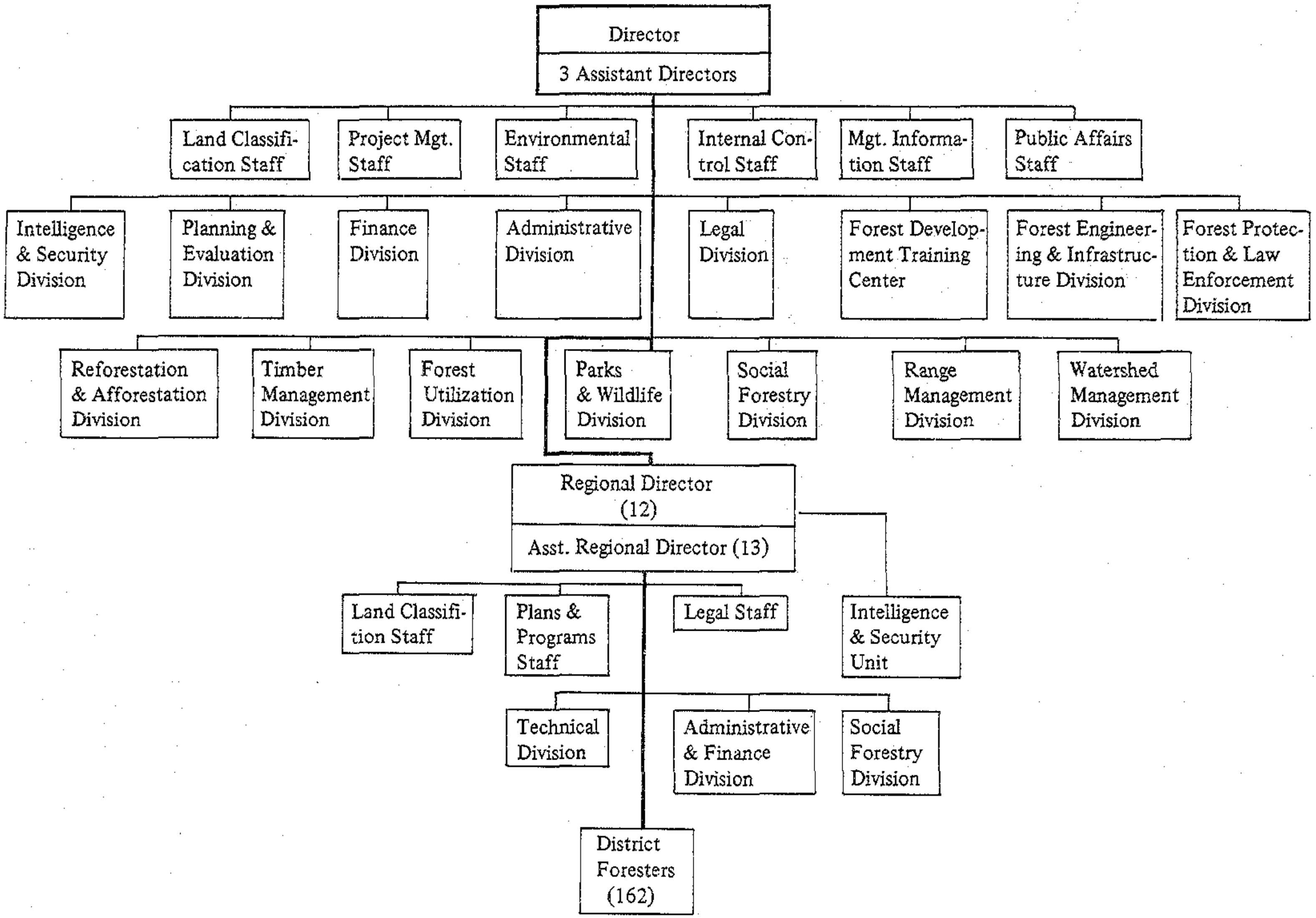
The Bureau of Forest Development, as is indicated in Fig. 4-1, is composed of 15 divisions and 6 staffs as well as of 12 regional offices under the director and 3 assistant directors.

The tests and researches on forestry and forests as well as the tests and researches on forest products are conducted by other national organizations in concert with other national and private bodies respectively.

4.1.2 Forestry Policy

The new Constitution of the Republic of the Philippines was established in 1973, in which Chapter 14, Article 8 specifies that all the natural resources including forests belong to the state and that the trees in the forests are all state-owned.

Fig. 4-1. ORGANIZATION CHART – BUREAU OF FOREST DEVELOPMENT



The forestry administration in the Philippines is based on the Forestry Code, which was enacted under the name of the Forestry Reform Code by Presidential Decree No. 389 of 1974, which was replaced with the Revised Forestry Code by Presidential Decree No. 705 of 1975. The Code was again amended by Presidential Decree No. 1559 of 1978, and 1775 of 1981.

The Revised Forest Code defines the land classification, and at the same time, aims to prevent forest denudation, preserve land and water, promote forestry industry, encourage reforestation so that the forest resources can positively be maintained and developed.

The Code cites the following four items as the policy:

1. The multiple uses of forest lands shall be oriented to the development and progress requirements of the country, the advancement of science and technology, and the public welfare;
2. Land classification and survey shall be systematized and hastened;
3. The establishment of wood-processing plants shall be encouraged and rationalized; and
4. The protection, development and rehabilitation of forest lands shall be emphasized so as to ensure their continuity in productive production.

In order to implement these policies, the Code expressly prescribes the following objects:

a) Reorganization of the forestry administration and establishment of the Bureau of Forest Development.
b) Acceleration of land classification of the public domain.
c) Fixing of the standards for the area and volume of annual allowable cut to maintain the production of forest resources.
d) Encouragement for the establishment of wood-processing plants and restrictions on log exports.
e) Measures for aiding the forest occupant.
f) Promotion of reforestation, especially assistance for the promotion of industrial tree plantation and tree farms.

Presidential Decree No. 1559 clearly indicates that the forest products harvested from industrial tree plantation belong to the ITP lessees. Later, Executive Order No. 725 of 1981 and Ministry Administrative Order No. 5 Series of 1981 augumented the said stipulation, whereby the structure for reforestation by industries was firmly set up.

Regarding logs, Presidential Decree No. 389 of 1974 had prohibited the export entirely in and after 1976. However, Presidential Decree No. 865 of 1975 allowed, as an alleviating measure, the export of log so long as it does not exceed 25% of the annual allowable volume of cut.

4.1.3 Reforestation System

According to the reforestation system in the Philippines, the reforestation is being done by the following 5 types when seen from the point of land utilization:

1) T.L.A. (Timber License Area)
2) I.T.P. (Industrial Tree Plantation)
3) A & D (Alienable or Disposable Land)
4) Agro-Forestry Farms
5) Tree Farms

1) Timber License Area

This is the production forests in the national forest lands, where kinds of trees and annual allowable cut are determined based on climatic types. The tenure of license agreement is 25 years, renewable for like period.

2) Industrial Tree Plantation

The minimum 100 hectares of openlands in the state-owned forests will be leased. In cutting trees, it needs to submit a cutting and reforestation plans to the government for approval. The period of the lease is 25 years, which can be extended for another 25 years.
The object of this reforestation is to restore the fertility of soil, preserve land, maintain and develop the forest resources as well as to replant trees of rapid growth systematically and economically so as to supply timber to various industries. The ownership of the replanted trees belongs to the tenants concerned.

3) Alienable or Disposable Land

This is the national land intended for agriculture. The tenant has merely the possessory title to land but has no claim for the timber. Timber cutting requires the approval of the Minister of Natural Resources. A tax is levied on the utilization of timber.

The transfer of land is restricted during a period of 25 years, but after that, the transfer becomes possible.
The land being intended for agriculture, the tenant has no obligation to replant trees. The ownership of replanted trees belongs to the land occupant.

4) Agro-Forestry Farms

The minimum 100 hectares of national land is leased. The term of lease is 25 years, renewable for like period. A multiple management system is adopted, performing simultaneously reforestation, agriculture and stockraising.
The reforested trees belong to the tenants concerned.

5) Tree Farms

The minimum 10 hectares of national land is leased with the term of 25 years, renewable for another 25 years. Reforestation is done to harvest forest products. The ownership of replanted trees belongs to the tenants concerned.
Tree Farms is a system adopted mainly as a measure against Kaingin as is the case with Agro-Forestry Farms.

4.2 Outline of the Forestry Industry

4.2.1 Use of Forest Lands

Of a total of 30,000,000 hectares of the whole land of the Philippines, the forest lands occupy 16,629,000 hectares. The forest lands specified by land classification total 11,076,000 hectares (66.6%) and the unspecified forest lands are 5,553,000 hectares (33.4%).

The forest lands are classified as are cited in Table 4-1.

Agro-Forest Lands:	4,301,000 hectares
Pasture/Range Lands:	535,000 hectares
Production Forests:	8,314,000 hectares
Protection Forests:	3,480,000 hectares

(Source: 1982 Philippine Forestry Statistics.
The remaining Tables are all based on this statistics.)

Table 4-1. FOREST LAND USE STATUS OF THE PHILIPPINES: 1982

(In Hectares)

Category		Area	%
	Total	16,629,450	
1.	Agro-Forest Lands	4,300,750	25.86
	a. Agro-Forestry Lease Areas	28,240	
	b. Land Occupied by Settlers – Agri-Plantation and Croplands	4,272,510	
2.	Pasture/Range Lands	535,000	3.22
	a. Pasture Lease and Permit Areas	535,000	
3.	Production Forests	8,313,895 1)	50.0
	a. Timber License Areas	7,539,000	
	b. Industrial Tree Plantations and Tree Farms	232,500	
	c. Others (cancelled timber license areas, open lands, etc.)	565,395	
4.	Protection Forests	3,479,805	20.92
	a. Wilderness	23,000	
	b. National Parks	381,550	
	c. Game Refuge & Wildife Sanctuaries	1,667,710	
	d. Watershed Forest Reserves	342,160	
	e. Reforestation Projects	1,065,385	

1) Area of wildeness was deducted as these are within timber licenses.

Note: Some entries are rough estimates only and may be overlapping.

The Agro-Forest Lands consist of the lands possessed under the Agro-Forestry Leases, and the Forest Occupancy Permits and by the settlers. The lands are used for the cultivation of farm products and for afforestation.

The Production Forests are the forest lands where permits are given by means of the Timber Licenses and License Agreements, the Industrial Tree Plantations, and by the Tree Farms.

The Protection Forests consist of wilderness, game and wildlife sanctuaries, watershed reservations and national parks.

The following shows the breakdown of the classified forest lands:

Established forest reservation:	3,431,000 hectares
Established timberland:	5,553,000 hectares
National parks (GRBS/WA):	1,648,000 hectares
Military and naval reservation:	130,000 hectares
Civil reservation:	313,000 hectares

4.2.2 Forest Resources

The forest lands classified in the Philippines comprise the following tree types as are shown in Table 4-2. Namely: Dipterocarp forests: 8,600,000 hectares, mangrove forests: 200,000 hectares, pine forests: 200,000 hectares, mossy forests: 1,700,000 hectares, and man-made plantations: 500,000 hectares.

41% of these forests exist in Mindanao Island, 37% in Luzon Island, and 22% in Visayas Islands.

Table 4-2. FOREST OF THE PHILIPPINES: 1982

(In '000 hectares)

Forest Type		Total	Luzon	Visayas	Mindanao
	Total	11,204	4,178	2,476	4,550
Dipterocarp forests		8,610	2,805	1,799	4,006
Rep-brush		2,262	1,266	688	308
Young growth		3,722	847	410	2,465
Old growth		2,626	692	701	1,233
Mangrove forests		211	17	87	107
Rep-brush		99	4	73	22
Young growth		102	13	9	80
Old growth		10	–	5	5
Pine forests		189	189	–	–
Young growth		38	38		
Old growth		151	151		
Mossy forests		1,726	910	471	345
Man-made plantations		468	257	119	92

The timber volume of these forests totals 796,000,000 m^3, the breakdown of which is shown in Table 4-3. That is: Dipterocarp forests: 662,000,000 m^3 (83.2%), mangrove forests: 4,000,000 m^3 (0.5%), pine forests: 13,000,000 m^3 (1.6%), mossy forests: 71,000,000 m^3 (9%), and man-made plantations: 46,000,000 m^3 (5.7%). Of the stock of forests, Mindanao posseses as much as 49.7%, Luzon 29.9%, and Visayas 20.4%.

Table 4-3. **VOLUME OF TIMBER IN FOREST LANDS OF THE PHILIPPINES: 1982**

(In thousand m^3)

Forest Type/Stand Size	Philippines	Luzon	Visayas	Mindanao
Total	796,011	238,243	162,031	395,737
1. Natural Forest	750,460	211,286	149,744	389,430
1.1 Dipterocarp	662,095	173,478	119,416	369,201
1.1.1 Rep. brush	61,477	30,388	16,940	14,149
1.1.2 Young growth	284,855	60,132	32,450	192,273
1.1.3 Old growth	315,763	82,958	70,026	162,779
1.2 Mangrove	3,944	308	1,374	2,262
1.2.1 Rep. brush	993	40	731	222
1.2.2 Young growth	2,088	268	192	1,628
1.2.3 Old growth	863	–	451	412
1.3 Pine	12,939	12,939	–	–
1.3.1 Young growth	1,438	1,438	–	–
1.3.2 Old growth	11,501	11,501	–	–
1.4 Mossy	71,482	24,561	28,944	17,967
2. Man-made	45,551	26,957	12,287	6,307

4.2.3 Production of Forest Products

Trees in the Philippines were increasingly cut to support the economy after the independence, and most of which has been exported to Japan where demand for wood expanded enormously. This rapid cutting has sharply decreased the natural forests. In spite of the government's efforts, reforestation is not going smoothly, which has resulted in bringing about non-productive forests.

The production and export of the forest products in 1982 are as follows:

Production		Export	
m^3		Volume m^3	Price 1,000 pesos
Log:	4,514,319	725,408	78,477
Lumber:	1,199,974	590,674	123,695
Plywood:	421,866	241,802	67,435
Veneer:	428,453	98,009	20,247
Pulpwood:	541,270		

The changes in the production of those forest products in the past (1960 to 1982) are shown in Table 4-4.

Table 4-4. PRODUCTION OF FOREST PRODUCTS

(In '000 m^3)

	Year	Sawlogs/ Veneer Logs	Pulpwood	Lumber	Plywood	Veneer
CY	1982	4,514	541	1,200	422	428
	1981	5,400	496	1,219	457	553
	1980	6,352	390	1,529	553	660
	1979	6,578	443	1,626	503	634
	1978	7,169	395	1,780	490	546
	1977	7,873	152	1,567	489	496
	1976	8,646	–	1,609	416	403
FY	1974–1975	11,156	–	2,274	465	207
	1973–1974	10,190	–	1,114	705	172
	1972–1973	10,446	–	1,060	732	211
	1971–1972	8,416	–	1,411	642	234
	1970–1971	10,680	–	860	653	242
	1965–1970	49,592	–	5,473	1,684	1,108
	1960–1965	33,748	–	5,568	1,207	805

As this Table indicates, the general trend of the production of those forest products is on the decrease; and especially, the production has drastically been reduced due to the world recession in recent years.

This trend has naturally reflected on the export. As Table 4-5 shows, the reduction in export has particularly been remarkable in logs, being affected by the forestry policy. The actual export of logs registered only about 10% of that of ten years ago.

Table 4-5. **EXPORT OF PROCESSED MAJOR WOOD PRODUCTS: 1960 TO 1982**

(Volume in '000 m^3, Value in '000 US Dollars, FOB)

Year	Lumber		Plywood		Veneer		Sawlogs/Veneer/Logs	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
CY 1982	591	123,695	242	67,435	98	20,247	752	78,477
1981	547	125,725	370	110,741	138	31,336	706	76,287
1980	742	181,210	322	103,843	62	15,410	715	91,997
1979	915	198,345	324	85,203	186	34,590	1,248	144,407
1978	573	85,197	362	70,613	154	22,278	2,211	144,869
1977	455	66,681	221	40,589	155	20,071	2,047	133,848
1976	493	68,144	261	43,165	166	17,882	2,331	135,222
FY 1974–75	458	45,572	249	32,571	135	12,310	6,840	283,164
1973–74	275	21,868	353	47,281	178	3,065	5,434	240,343
1972–73	179	10,950	692	54,344	107	6,180	6,949	201,985
1971–72	152	9,096	564	36,365	127	5,418	7,018	173,253
1970–71	202	11,693	590	38,913	127	5,975	8,443	223,617
1965–70	552	39,438	886	72,932	654	39,320	36,959	906,271
1960–65	460	23,042	694	55,556	528	30,838	19,460	442,230

4.2.4 Species of Forest Products

Of the species of forest products harvested in 1982, lauan (relatively light ones such as Shorea, Parashorea and Pentacme) has overwhelmingly surpassed the other species as Table 4-6 indicates. The R in "R-1" in Table 4-6 shows Region in the Philippines, under which comes Province. The details are shown in Table 4-7.

Table 4-6. SPECIES OF TIMBER HARVESTED BY REGION: 1982

(In thousand m^3)

Species	Philippines	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10	R-11	R-12
Total	4,514	66	844	32	221	36	112	–	169	476	1,007	1,065	487
Almaciga *(Agathis philippinensis)*	33	13	–	–	–	–	–	–	–	1	17	2	–
Almon *(Shorea almon)*	430	–	–	–	–	–	–	–	19	23	97	205	52
Amugis *(Koordersiodendron pinnatum)*	1	–	–	–	1	–	–	–	–	–	–	–	–
Apitong *(Dipterocarpus grandiflorus)*	439	–	27	6	201	4	4	–	–	34	94	55	14
Bagtikan *(Parashorea plicata)*	743	–	39	1	–	–	11	–	15	119	257	204	97
Balete *(Ficus balete)*	4	–	–	–	–	–	–	–	–	–	4	–	–
Benguet Pine *(Pinus kesiya)*	52	46	6	–	–	–	–	–	–	–	–	–	–
Binuang *(Octomeles sumatrana)*	31	–	1	–	–	–	–	–	–	–	9	3	18
Dao *(Dracontomelon dao)*	2	–	2	–	–	–	–	–	–	–	–	–	–
Guijo *(Shorea guiso)*	13	–	2	1	–	–	–	–	–	–	–	8	2
Kalantas *(Toona calantas)*	3	–	–	2	1	–	–	–	–	2	3	4	–
Kalumpit *(Terminalia micro-carpa)*	5	–	–	–	–	–	–	–	–	–	–	–	–
Kalunti *(Shorea kalunti)*	4	–	–	–	–	–	–	–	–			–	–
Lauan, Red *(Shorea negrosensis)*	721	–	325	10	–	15	30	–	45	–	118	122	56
Lauan, White *(Pentacme contorta)*	696	6	92	1	2	7	4	–	9	192	125	137	121
Loktob *(Duabanga moluccana)*	3	–	–	–	–	–	–	–	–	–	–	–	3
Malugai *(Pometria pinnata)*	4	–	–	–	4	–	–	–	–	–	–	–	–
Manggasinoro *(Shorea philippinensis)*	4	–	4	–	–	–	–	–	–	–	–	–	–
Mayapis *(Shorea squamata)*	529	–	146	1	1	2	–	–	28	26	130	139	56
Moluccan sau *(Albizzia falcata)*	11	–	–	–	–	–	–	–	–	–	–	10	–
Narra *(Pterocarpus indicus)*	2	–	2	–	–	–	–	–	–	–	–	–	–
Nato *(Palaquium luzoniense)*	41	–	–	1	1	–	–	–	–	–	15	16	8
Palosapis *(Anisoptera thurifera)*	8	–	3	1	1	2	1	–	–	–	–	–	–
Tanguile *(Shorea polysperma)*	600	–	163	4	3	3	25	–	46	66	112	133	45
Tiaong *(Shorea agsaboensis)*	7	–	7	–	–	–	–	–	–	–	–	–	–
Toog *(Combretodendron quadrialatum)*	1	–	–	–	–	–	–	–	–	–	1	–	–
Yakal *(Shorea astylosa)*	11	–	–	–	–	–	–	–	–	1	6	–	4
Miscellaneous	116	1	25	4	5	2	3	–	7	12	19	27	11

Table 4-7. LIST OF REGION

Region	Province	Remark
1	Abra Benguet Bontoc Ilocos Norte Ilocos Sur La Union Pangasinan	Northwest Luzon
2	Batanes Cagayan Ifugao Isabela Kalinga-Apayao Nueva Vizcaya Quirino	Northeast Luzon
3	Bataan Bulacan Nueva Ecija Pampanga Tarlac Zambales Aurora	Mid Luzon
4	Batangas Cavite Laguna Manila Marinduque Quezon Rizal Mindoro Occ. Mindoro Or. Romblon Palawan	Midsouth Luzon Mindoro Romblon Palawan
5	Albay Camarines Norte Camarines Sur Masbate Sorsogon Cajanduanes	South Luzon
6	Aklan Antique Capiz Iloilo Negros Occ.	Visayas
7	Bohol Cebu Negros Or.	Visayas
8	Leyte del Norte Leyte del Sur Northern Samar Western Samar Eastern Samar	Leyte Samar
9	Basilan Sulu Zamboanga del Norte Zamboanga del Sur	West Mindanao
10	Agusan del Norte Agusan del Sur Bukidnon Misamis Occ. Misamis Or. Surigao del Norte	Mideast Mindanao
11	Southern Cotabato Davao del Norte Davao del Sur Davao Oriental Surigao del Sur	Southeast Mindanao
12	Lanao del Norte Lanao del Sur Northern Cotabato Maguindanao Sultan Kudarat	Midsouth Mindanao

4.3 Forest Resources

4.3.1 Forest Types

The forests in the Philippines can be classified into the following five types:

(a) Dipterocarp Forests
(b) Mangrove Forests
(c) Pine Forests
(d) Mossy Forests
(e) Man-made Plantations

Dipterocarp type cited in (a) grows thick at the swampy bottom of a valley and on a hill or in a mountainous district up to 1,000 meters above sea level.

Mangrove type cited in (b) grows abundantly in the lagoon at an estuary and along a seashore.

Pine type cited in (c) grows in mountain regions of high altitude.

Mossy type cited in (d) grows in areas with steep topography.

When these forest types are arranged in the order of height, (d) comes first, followed by (c), (a) and (b).

4.3.2 Timber Volume by Forest Type

As was mentioned earlier, the timber volume of the entire forests in the Philippines is 796,000,000 m^3 according to Table 4-3.

1) Dipterocarp forest type

Dipterocarp forest predominates the other forest types in terms of area and timber volume; it is not too much to say that the forestry industry in the Philippines is being conducted centering around the wood produced from the Dipterocarp forests. The composition of Dipterocarp forests is shown by old growth and young growth in Tables 4-8 and 4-9.

Table 4-8. VOLUME OF TIMBER IN THE OLD GROWTH FOREST STANDS: 1982

(In thousand m^3)

Geographical Region	DBH (cm)	Grand Total	Dipterocarp					Other Species
			Total	Guisok-Guisok Yakal, Guijo Narig	Apitong	Mayapis Red Lauan Tanguile	Almon Bagtikan White Lauan	
Philippines		315,763	202,866	12,223	23,421	98,232	68,990	112,897
	15–34	57,974	17,954	3,029	3,623	6,554	4,748	39,520
	35–54	84,914	41,697	4,264	6,043	19,045	12,345	43,217
	55–64	45,894	32,289	1,750	4,896	15,461	10,182	14,105
	65–74	35,112	29,584	1,030	3,142	14,187	11,225	5,528
	75+	91,869	81,342	2,150	5,717	42,985	30,490	10,527
Luzon		82,958	62,922	4,771	9,720	37,607	10,824	20,036
	15–34	16,592	8,733	1,569	1,568	3,750	1,846	7,359
	35–54	21,569	13,011	1,423	2,899	6,571	2,118	8,558
	55–64	12,444	11,220	845	2,083	6,880	1,412	1,724
	65–74	9,125	8,347	267	1,177	5,188	1,715	778
	75+	23,228	21,611	667	1,993	15,218	3,733	1,617
Visayas		70,026	24,814	1,164	6,497	9,422	7,731	45,212
	15–34	16,965	2,321	140	1,047	754	380	14,644
	35–54	22,650	6,587	325	1,343	3,770	1,149	16,063
	55–64	10,661	4,149	88	1,444	1,413	1,204	6,512
	65–74	6,455	3,769	197	812	1,319	1,441	2,686
	75+	13,295	7,988	414	1,851	2,166	3,557	5,307
Mindanao		162,779	115,130	6,288	7,204	51,203	50,435	47,649
	15–34	24,417	6,900	1,320	1,008	2,050	2,522	17,517
	35–54	40,695	22,099	2,516	1,801	8,704	9,078	18,596
	55–64	22,789	16,920	817	1,369	7,168	7,566	5,869
	65–74	19,533	17,468	566	1,153	7,680	8,069	2,065
	75+	55,314	51,743	1,069	1,873	25,601	23,200	3,602

Table 4-9. **VOLUME OF TIMBER IN YOUNG GROWTH FOREST: 1982**

(In thousand m^3)

Stand Size/Species	DBH	Philippines	Luzon	Visayas	Mindanao
Total		284,855	60,132	32,450	192,273
	15–34	98,830	22,310	13,070	63,450
	35–54	84,894	17,979	11,156	55,759
	55–74	57,564	8,418	4,923	44,223
	75+up	43,567	11,425	3,301	28,841
Dipterocarp		127,931	27,661	9,902	90,368
	15–34	24,075	5,513	2,396	16,166
	35–54	37,841	7,995	3,639	26,207
	55–74	36,917	5,565	2,415	28,937
	75+up	29,098	8,588	1,452	19,058
Other Species		156,924	32,471	22,548	101,905
	15–34	74,755	16,797	10,674	47,284
	35–54	47,053	9,984	7,517	29,552
	55–74	20,647	2,853	2,508	15,286
	75+up	14,469	2,837	1,849	9,783

Of the timber volume of the old growth of Dipterocarp forests, 64.2% consists of the trees of Dipterocarp species, and the majority of which exists in Mindanao.
Of the timber volume of the young growth of Dipterocarp forests, 44.9% consists of the trees of Dipterocarp species, and the greater part of which is in Mindanao.

The composition of the timber volume in mangrove forest and pine forest types is as follows respectively.

2) Mangrove forest type

Unit: 1,000 m^3

Total		Luzon	Visayas	Mindanao
Old growth	863	–	451	412
Young growth	2,088	268	192	1,628
Rep. brush	993	40	731	222
Total	3,944	308	1,374	2,262

3) Pine forest type

Unit: 1,000 m^3

Total		Luzon	Visayas	Mindanao
Old growth	11,501	11,501	–	–
Young growth	1,438	1,438	–	–
Total	12,939	12,939		

Pine forests are seldom seen in other places than Luzon.

4.4 Timber Licenses and Actual Results

In the Philippines there are several kinds of timber licenses. These licenses are issued respectively according to the nature and kind of a tree to be cut and to the ownership of land.

In 1982 a total of 217 licenses were granted covering 7,500,000 hectares of cutting permitted areas, where 14,000,000 m^3 are allowed to be cut.

Almost all of these licenses are of the Timber License Agreements and Ordinary Timber License, and the rest are the cutting permits mainly for pulpwood.

The leases given for the use of forest lands were 1,242, covering 790,192 hectares.

Mindanao Island possesses most of the wood resources of the Philippines, and the largest number of licenses was granted to that island. Of the 186 Timber License Agreements, 105 were given to Mindanao, and of the 18 Ordinary Timber Licenses, 10 were granted to the island.

As was mentioned in 4.2.3, 4,500,000 m^3 of log, 1,200,000 m^3 of lumber, 420,000 m^3 of plywood, and 430,000 m^3 of veneer were produced in 1982 in the Philippines in accordance with the timber licenses issued.

The production of those products registered a decrease of from 10 to 20% compared with the previous year owing to the worldwide business slump.

The logging waste and residues generated during that year is estimated to be 3,600,000 m³.

4.4.1 Log

As was cited above, the production of log during 1982 was 4,500,000 m³. The following Table shows the production by region.

Unit: m³

Region	Production	Region	Production
1	65,896	7	–
2	844,175	8	168,895
3	32,396	9	475,723
4	221,241	10	1,006,635
5	35,048	11	1,065,419
6	111,999	12	486,892

The Table shows that Mindanao Island (Regions 9, 10, 11, 12) produced 3,000,000 m³ of log, which corresponds to 67.2% of the entire production of the Philippines.

Species of the cut timber are shown in Table 4-6, which indicates that lauan enjoyed an overwhelmingly largest volume.

4.4.2 Lumber

Table 4-10 shows the number of active sawmills and the production capacity of each mill from 1969 to 1981.

The number of active sawmills has decreased due to the recent economic recession and by the protection of forest resources.

In 1982, 190 sawmills were operated, which are shown by region in Table 4-11. A total of Regions 2, 4, 10 and 11 occupies 70% of all the daily rated capacities, and their annual log requirement is 3,200,000 m³.

Table 4-10. ACTIVE SAWMILLS: FY 1969–70 TO CY 1981

	Year	Number	Daily Rated Capacity (1,000 cubic meters)	Annual Log Requirement (1,000 cubic meters)	Capital Investment (million pesos)
FY	1969–70	374	17	7,699	116
	1970–71	352	17	7,683	117
	1971–72	355	17	7,746	180
	1972–73	370	17	7,994	150
	1973–74	355	16	6,292	362
	1974–75	408	17	6,323	402
CY	1976	325	18	7,868	312
	1977	341	18	8,164	312
	1978	357	17	7,893	881
	1979	227	11	4,674	–
	1980	209	11	4,715	–
	1981	182	10	4,253	–

A total lumber production during 1982 was 1,200,000 m^3 as is shown in Table 4-12. The following shows the production by region.

Unit: m^3

Region	Production	Region	Production
1	33,952	7	270
2	315,493	8	24,300
3	91,846	9	46,971
4	137,117	10	143,179
5	2,497	11	264,452
6	67,475	12	72,422

Luzon having the largest number of active sawmills put out 48% of lumber as is shown in the above Table. Mindanao produced 44% and Visayas 8%.

Table 4-11. ACTIVE SAWMILLS BY REGION AND PROVINCE: 1982

(Daily Rated Capacity & Annual Log Requirement in m^3)

Region	Total			With Timber Concession			Without Timber Concession		
	Number	Daily Rated Capacity	Annual Log Requirement	Number	Daily Rated Capacity	Annual Log Requirement	Number	Daily Rated Capacity	Annual Log Requirement
Philippines	190	10,038	4,409,789	107	6,469	2,956,766	83	3,569	1,453,023
Region 1	6	330	132,075	5	259	103,773	1	71	28,302
Benguet	3	177	70,754	3	177	70,754	–	–	–
Mt. Province	2	82	33,019	2	82	33,019	–	–	–
Pangasinan	1	71	28,302	–	–	–	1	71	28,302
Region 2	43	2,033	657,710	25	1,330	445,485	18	703	212,225
Cagayan	9	637	236,448	9	637	236,448	–	–	–
Isabela	21	838	250,485	13	538	164,210	8	300	86,275
Nueva Vizcaya	9	389	121,877	2	113	32,602	7	276	89,275
Quirino	4	169	48,900	1	42	12,225	3	127	36,675
Region 3	21	896	341,053	4	165	56,526	17	731	284,527
Aurora	4	156	44,825	2	85	24,450	2	71	20,375
Bataan	1	35	14,151	–	–	–	1	35	14,151
Bulacan	9	472	188,680	1	71	28,302	8	401	160,378
Nueva Ecija	4	189	75,472	–	–	–	4	189	75,472
Zambales	3	44	17,925	1	9	3,774	2	35	14,151
Region 4	25	1,407	729,931	5	365	312,948	20	1,042	416,983
Batangas	1	35	14,151	–	–	–	1	35	14,151
Metro Manila	14	837	334,907	–	–	–	14	837	334,907
Palawan	3	259	270,495	3	259	270,495	–	–	–
Quezon	7	276	110,378	2	106	42,453	5	170	67,925
Region 5	3	117	47,170	1	35	14,151	2	82	33,019
Camarines Norte	2	82	33,019	1	35	14,151	1	47	18,868
Camarines Sur	1	35	14,151	–	–	–	1	35	14,151
Region 6	5	413	165,093	5	413	165,093	–	–	–
Negros Occidental	5	413	165,093	5	413	165,093	–	–	–
Region 7	1	24	9,434	–	–	–	1	24	9,434
Cebu City	1	24	9,434	–	–	–	1	24	9,434
Region 8	4	260	103,774	4	260	103,774	–	–	–
Eastern Samar	1	47	18,868	1	47	18,868	–	–	–
Northern Samar	1	71	28,302	1	71	28,302	–	–	–
Western Samar	2	142	56,604	2	142	56,604	–	–	–
Region 9	12	571	273,818	8	413	198,113	4	158	75,705
Zamboanga del Norte	3	177	84,905	3	177	84,905	–	–	–
Zamboanga del Sur	9	394	188,913	5	236	113,208	4	158	75,705
Region 10	27	1,734	849,096	22	1,522	752,869	5	212	86,227
Agusan del Norte	19	1,262	622,681	16	1,132	566,077	3	130	56,604
Bukidnon	4	248	118,868	4	248	118,868	–	–	–
Misamis Occidental	1	35	16,981	–	–	–	1	35	16,981
Misamis Oriental	3	189	90,566	2	142	67,924	1	47	22,642
Region 11	35	1,890	926,295	22	1,412	662,524	13	478	263,771
Davao del Norte	6	387	149,432	5	352	132,451	1	35	16,981
Davao del Sur	15	721	369,054	5	330	158,490	10	391	210,564
Davao Oriental	6	354	181,131	6	354	181,131	–	–	–
South Cotabato	3	189	101,886	2	142	67,924	1	47	33,962
Surigao del Sur	5	239	124,792	4	234	122,528	1	5	2,264
Region 12	8	363	174,340	6	295	141,510	2	68	32,830
Lanao del Norte	2	80	38,490	1	71	33,962	1	9	4,528
Maguindanao	4	212	101,887	3	153	73,585	1	59	28,302
Sultan Kudarat	2	71	33,963	2	71	33,963	–	–	–

Source: PCWID

Table 4-12. LUMBER PRODUCTION BY REGION AND PROVINCE: 1982

(In m^3)

Region	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jui.	Aug.	Sep.	Oct.	Nov.	Dec.
Philippines	1,199,974	77,814	88,764	107,105	103,505	114,731	116,461	118,941	96,248	108,114	101,558	96,194	70,539
Region 1	33,952	4,744	3,485	4,836	2,588	3,779	2,445	2,849	1,850	1,865	2,030	1,653	1,828
Benguet	29,807	3,843	2,906	4,462	2,077	3,131	2,256	2,657	1,627	1,673	1,795	1,643	1,727
Mt. Province	2,226	–	–	374	511	310	189	192	223	192	235	–	–
Pangasinan	1,919	901	579	–	–	338	–	–	–	–	–	–	101
Region 2	315,493	14,282	19,359	35,739	30,943	37,571	41,643	32,869	24,601	23,903	22,193	22,259	10,671
Cagayan	70,584	5,311	2,665	7,508	6,821	8,315	8,083	8,163	6,301	4,945	5,143	4,838	2,491
Isabela	181,051	8,209	10,759	17,973	18,002	20,217	25,501	18,939	11,711	13,274	13,986	15,248	7,232
Nueva Vizcaya	44,289	306	4,192	6,651	4,645	5,430	6,623	4,531	3,815	3,775	2,059	1,314	948
Quirino	19,569	456	1,743	3,607	1,475	3,609	1,436	1,236	2,234	1,909	1,005	859	–
Region 3	91,846	4,129	4,681	5,241	6,428	10,078	8,589	13,864	10,009	9,579	7,418	7,683	4,147
Aurora	11,908	1,276	1,584	736	664	1,664	1,465	2,060	1,391	267	563	206	32
Bataan	8,065	–	–	–	–	–	–	471	1,336	1,837	2,585	1,227	609
Bulacan	48,930	2,059	2,378	3,113	3,972	5,379	5,357	8,804	4,751	3,375	2,995	4,475	2,272
Nueva Ecija	8,557	86	–	758	314	1,414	416	862	979	2,709	259	312	448
Pampanga	6,654	708	719	634	664	813	538	1,151	504	195	–	541	187
Zambales	7,732	–	–	–	814	808	813	516	1,048	1,196	1,016	922	599
Region 4	137,117	13,719	10,924	14,177	13,104	12,526	16,310	14,054	11,229	10,471	9,047	7,640	3,916
Batangas	2,531	1,071	911	549	–	–	–	–	–	–	–	–	–
Metro Manila	97,826	10,814	8,374	9,502	9,038	9,061	9,704	9,320	7,696	6,382	7,713	6,816	3,406
Palawan	27,133	1,476	963	3,286	2,955	2,289	5,427	3,568	2,689	3,181	838	144	317
Quezon	9,627	358	676	840	1,111	1,176	1,179	1,166	844	908	496	680	193
Region 5	2,497	62	163	173	137	170	236	–	792	477	287	–	–
Albay	1,556	–	–	–	–	–	–	–	792	477	287	–	–
Camarines Norte	941	62	163	173	137	170	236	–	–	–	–	–	–
Region 6	67,475	5,778	8,363	9,362	2,604	8,664	1,256	5,282	4,484	4,208	5,538	5,599	6,337
Negros Occidental	67,475	5,778	8,363	9,362	2,604	8,664	1,256	5,282	4,484	4,208	5,538	5,599	6,337
Region 7	270	69	–	–	–	–	–	–	6	85	110	–	–
Negros Oriental	270	69	–	–	–	–	–	–	6	85	110	–	–
Region 8	24,300	2,237	1,550	2,245	4,485	920	3,209	2,663	–	779	2,998	2,427	787
Eastern Samar	13,203	1,264	555	1,204	1,571	418	2,434	1,845	–	–	1,959	1,953	–
Western Samar	2,892	380	291	532	1,689	–	–	–	–	–	–	–	–
Northern Samar	8,205	593	704	509	1,225	502	775	818	–	779	1,039	474	787
Region 9	46,971	4,211	4,312	3,966	4,969	4,614	3,098	5,467	6,648	2,727	3,122	2,697	1,140
Zamboanga del Norte	28,330	3,297	3,256	2,154	2,641	2,882	2,137	2,558	5,129	785	1,942	1,549	–
Zamboanga del Sur	18,641	914	1,056	1,812	2,328	1,732	961	2,909	1,519	1,942	1,180	1,148	1,140
Region 10	143,179	5,818	6,508	9,664	15,356	11,325	11,187	16,352	11,409	14,724	14,145	12,586	14,105
Agusan del Norte	117,688	3,571	5,818	8,837	13,040	9,106	9,525	13,219	8,328	12,237	12,227	10,833	10,947
Agusan del Sur	14,519	1,086	293	441	1,186	1,695	1,094	2,105	1,624	1,762	1,469	381	1,383
Bukidnon	10,838	1,086	293	386	1,130	524	568	1,028	1,323	725	449	1,372	1,775
Misamis Oriental	134	–	–	–	–	–	–	–	134	–	–	–	–
Region 11	264,452	16,642	24,794	16,354	18,351	17,290	25,035	19,967	22,333	33,661	25,436	23,922	20,667
Davao del Norte	43,664	2,514	1,318	1,854	1,174	1,658	4,453	4,933	4,886	6,571	5,262	3,917	5,124
Davao Oriental	43,132	2,473	3,910	2,641	2,833	3,767	3,829	2,248	4,402	4,156	5,217	3,451	4,205
Davao del Sur	104,876	8,222	10,478	6,571	10,809	8,019	8,667	8,388	8,808	16,744	6,384	7,230	4,556
South Cotabato	10,008	1,503	252	680	135	347	1,348	1,298	671	485	429	1,718	1,142
Surigao del Sur	62,772	1,930	8,836	4,608	3,400	3,499	6,738	3,100	3,566	5,705	8,144	7,606	5,640
Region 12	72,422	6,123	4,625	5,348	4,540	7,794	3,453	5,5741	3,427	5,635	9,234	9,728	6,941
Lanao del Norte	45,979	3,430	1,789	3,431	2,882	4,222	1,947	4,583	1,895	4,345	6,259	6,574	4,622
Maguindanao	17,861	1,424	1,763	1,073	1,170	2,269	1,506	991	1,532	1,290	1,560	2,074	1,209
North Cotabato	8,582	1,269	1,073	844	488	1,303	–	–	–	–	1,415	1,080	1,110

4.4.3 Plywood

422,000 m³ of plywood were produced in 1982, of which 370,000 m³ were put out in Mindanao and 52,000 m³ in Luzon.

4.4.4 Veneer

428,000 m³ of veneer were produced in 1982, of which 369,000 m³ were put out in Mindanao and 59,000 m³ in Luzon.

4.4.5 Demand for Each Product

The following Table shows the projected output of forest products in the five-year plan from 1983 to 1987 in the Philippines.

Unit: 1,000 m³

	Actual production		Planned production		
	1980	1981	1982	1983	1987
Log	6,352	4,570	5,500	5,600	6,000
Lumber	1,529	830	1,500	1,600	1,800
Plywood	553	322	500	520	560
Veneer	660	230	500	520	560

In Table 4-4 cited earlier, are shown the changes in the production during the past 10 years or so; and description was made that each product was on the decrease.

According to the five-year plan it is expected that demand will fairly be restored in the future, but in 1981 and 1982 it still continued to decrease; from which it is considered that demand may not necessarily be restored as is anticipated in the plan.

Accordingly, it is considered that sawdust, the main raw material of the activated carbon project, will not be generated more significantly than the quantity being generated at present.

4.5 Kind of Wood as Raw Material

As a part of the ITIT project that Ministry of International Trade and Industry of Japanese Government has been conducting with the purpose of cooperation with developing countries, the Government Industrial Development Laboratory, Hokkaido and Philippine National Institute of Science and Technology (NIST) jointly launched a five year basic research on the powdered activated carbon production technique using tropical wood from 1976. Experiments were conducted on various wood species including lauan, principal species, in the Philippines. Besides lauan, the following five species were selected and studied to determine if they are useful or not as raw materials for manufacturing powdered activated carbon.

Ipil-Ipil (Leucaena leucocephala)
Coir Dust (Cocus nucifera)
Kakauate (Gliricida sepium)
Apitong (Dipterocarpus grandiflores blanco)
Falcata (Albizzia falcataria)

Description will be made below on the characteristics of these five species.

4.5.1 Ipil-Ipil

Ipil-Ipil consists of two kinds, the native one is a small tree grown in the Philippines, and the other is giant one originally grown in Latin America.

Both grow rapidly. The former is low in height, and consequently is convenient to harvest its leaves which are rich in protein. The leaves are processed as stock feed. Approximately 9,000 tons of this feed were exported to Japan in 1981.

Giant Ipil-Ipil grows tall, and is planted chiefly for firewood and charcoal. It is this giant Ipil-Ipil that was selected for the present project. However, it is not long since the tree was brought to the Philippines. At first, giant Ipil-Ipil was thought to be a tree that would grow anyplace. As it grows rapidly, it was called a miracle tree.

As a matter of fact, however, the tree highly requires a location suitable for its growth, and it is becoming clear that the tree particularly dislikes acid soil and soil of high density.

Furthermore, the shape of giant Ipil-Ipil is not suitable for lumber. Hence, the generation of sawdust from this tree cannot be expected. The raw material of the project under consideration being sawdust coming from the sawmill, the material cost will rise very high if giant Ipil-Ipil should be used as material wood. Therefore, giant Ipil-Ipil is unsuitable as the raw material for powdered activated carbon.

Giant Ipil-Ipil has been planted on a large scale in the vicinity of Iligan, Mindanao by Mabuhay Agro-Forestry Corporation (MAFCO), a joint venture between Japan's Kawasaki Steel Corporation and Philippine Mabuhay Vinyl Corporation, to produce a substitute of coke for iron manufacture.

MAFCO started tree planting in 1978, and finished planting over approximately 1,200 hectares in the industrial tree plantation by 1982, but it is not yet in the stage of being able to evaluate this tree planting.

4.5.2 Coir Dust

Coconut shell is being used in the Philippines to manufacture granular activated carbon for export.

Coir dust is dust which is generated when coir fiber is produced from the fibrous part called husk, the outer covering of coconut shell. Coir dust is being discarded as unusable.

Coir fiber is used to make the seat cushion of automobiles and airplanes or to make a rope.

4.5.3 Kakauate

Kakauate is a small tree belonging to the leguminous plant, which is being used as fuel in the Philippines. The tree is fairly abundant in Ilocos, North Luzon.

Kakauate is usually planted along the way between fields and by the roadside. Thus the quantity is small, and the tree is also unsuitable for sawing. Hence, no sawdust can be expected from it. Therefore, Kakauate cannot be counted on as raw material of the present project.

4.5.4 Apitong

Apitong is a general term for the Dipterocarp species belonging to the Dipterocarp family, but it does not include particularly heavier and harder species.

Apitong grows widely in Southeast Asia, and it is known that 11 species are growing in the Philippines.

Apitong is seen all over the Philippine islands, especially grows most abundantly in Palawan Island, followed by Mindanao Island.

Apitong has high adaptability to soil and is not so much affected by landform. It generally grows upright and high on the dried area halfway down hill, and is fit for sawing.

Compared with lauan, Apitong has greater specific gravity, and is somewhat heavier and harder or heavier and harder according to species. Its airdried specific gravity ranges widely from 0.6 to 0.7 up to more than 0.88. Apitong contains much resin, which oozes out on the surface, posing a problem when sawed. But the degree of oozing out of resin differs according to species.

Apitong is used as raw material for various purposes. Of the 4,500,000 m^3 of the logs produced in 1982, 440,000 m^3 (about 10%) was occupied by Apitong.

Although Apitong is being sawed in the largest quantity next to lauan, the quantity of its sawdust is not large enough to be solely used as raw material for the manufacture of powdered activated carbon of the present project.

4.5.5 Falcata

Falcata is a species belonging to a silk tree of the leguminous plant. This is a typical species of the silk trees having the lightest specific gravity. It is one of the leading trees in the world that grow rapidly, and is said to be a miracle tree as is the case with Ipil-Ipil.

Flacata comes to stand dead in 14 years, and is needed to be cut before that period. Trees of eight years are suitable for making pulp.

Fully grown Falcata stands more than 30 meters, sometimes reaches 45 meters with the diameter ranging from 60 to 80 centimeters. As it grows rapidly, it is fragile in terms of the quality of wood. And as its roots are shallow, it is very liable to be blown down by wind. Falcata can be processed easily, but has very poor durability.

Falcata being light and soft, it is used for producing pulp as well as for making plywood, core material, and furniture.

The largest Falcata plantation is located in Bislig, Mindanao Island, covering 20,000 hectares which Paper Industries Corporation of the Philippines (PICOP) is using mainly as a tree farm producing pulpwood.

PICOP is using some 400,000 m^3 of Falcata per year in the form of wood for making mechanical pulp and chemical pulp to manufacture newsprint.

Further, an increased supply from industrial tree plantations is expected in the future, enabling the Corporation to use about 600,000 m^3 of Falcata.

Japan's Mitsui & Co., Ltd. set up International Agro-Forestry Development Corporation (AGROFOR) as a joint venture between a local sawmill and others. The Corporation is operating a man-made plantation producing Falcata for lumber. This plantation is situated in Aras Asan, Mindanao Island. Plantations producing Falcata for lumber are seldom seen in other places than Mindanao. Even if there are such man-made plantations in other places that produce wood for lumber, there is no plantation which is being experimented for such a relatively long period of time and on such a large area as is being conducted by AGROFOR.

AGROFOR has planted trees over 500 hectares since it began planting in 1974, and tree cutting is scheduled to start in about 1984, but its forestation evaluation has not yet been made.

On the other hand, Falcata is a natural tree, and it being a sun tree, it grows scatteringly in such places where a forest or trees were divested. In view of this, even if Falcata is thick in diameter, it cannot be supplied quantitatively.

Thus, the supply quantity of Falcata is not large. This is the main cause that has delayed development of the utilizing technique of Falcata so far.

From what has been described above, it is very difficult to use Falcata as raw material for the project under contemplation. Whether or not it is usable depends upon the development of said technique in the future.

4.5.6 Others

As mentioned earlier, the lauan tree is the most forested species in the Philippines, and is being processed in quite large numbers in sawmills all over the country. However, the majority of the sawdust generated through sawmilling is just disposed of or burnt without being put to any specific use.

Therefore, because of the large amounts of sawdust disposed of, the sawdust from the lauan tree processing is thought to be most ideal for this project.

The details will be given in Chapter 7.

Chapter 5

CARBONIZATION AND ACTIVATION TESTS WITH SMALL SCALE PLANT

Chapter 5. CARBONIZATION AND ACTIVATION TESTS WITH SMALL SCALE PLANT

5.1 Background and Purpose

The technical study aspect was conducted on the basis of the results of a joint research project continuously for five years from 1976 between the Government Industrial Development Laboratory, Hokkaido (GIDLH) and the National Institute of Science and Technology of the Philippines (NIST), as a part of the ITIT Program (International Transfer of Industrial Technology) of the Japanese Government.

This joint research project involved basic research relating to technologies for manufacturing powdered activated carbon by using tropical woods as the raw material, wherein highly satisfactory results were obtained. The project was subsequently taken over and advanced as a project of the Japan International Cooperation Agency (JICA).

In this project, a small scale powdered activated carbon manufacturing plant was installed in the compounds of NIST, and tests on carbonization, activation and refining were carried out by means of this plant using sawdust of lauan and five other kinds of trees which had been found to be promising through basic research. Studies were made on optimum activation conditions, and the properties of manufactured powdered activated carbon products were evaluated.

5.2 Raw Materials

The raw materials put to test consisted of the following wood species. They are ipil-ipil, coir dust, kakauate, apitong, falcata, red lauan, white lauan, Davao sawdust, I.D.C. sawdust and E.A. sawdust.

Davao sawdust was derived primarily from white lauan, I.D.C. sawdust from red lauan and white lauan, while E.A. sawdust was a mixed sawdust derived from primarily apitong and red lauan.

5.3 Preparation of Raw Materials

There were some kinds of trees which were selected as the objects of tests and whose sawdust was difficult to obtain. In such cases lumbers were procured, crushed into sawdust form, then tested. For this, a Japanese made cutter type sawdust making machine was used that was capable of crushing lumber into particles of 0.2–0.5 mm in diameter and had a sawdust production capacity of about 0.5 m^3/hr.

5.4 Drying

Some sawdust contained high moisture and were difficult to carbonize, and since it was also necessary to elucidate the influences of moisture on carbonization, samples of these sawdust were dried and put to carbonization tests.

Drying was carried out by two methods – solar drying and hot-gas drying. It was found that in solar drying, the quantity of moisture evaporated was only 3.2 kg/m^2·day, and that a big land area would be required for drying a large quantity of sawdust. For hot-gas drying, the waste heat of carbonization furnace after-burners was utilized. In this case, the heat efficiency was found to be 44.8% when drying sawdust of 36% moisture content to a moisture content of 10%.

5.5 Carbonization

Carbonization was carried out by using an open hearth type carbonization furnace that is being used popularly in Japan.

The furnace is a down-draft type self-combustion furnace having slow carbonization rate, but it provides char of good quality for use as activated carbon raw material since carbonization is accomplished at a low temperature. In addition, it features trouble-free and easy operation owing to its simple structure, making it a furnace that is suitable and adaptable to Philippine conditons.

Regarding carbonization, thermogravimetric analysis of raw materials was first conducted with the purpose of acquiring basic data. The carbonization process of various wood species were evaluated and analyzed. By adopting this method, an analogical inference was made of the relationship between carbonization temperature and char yield from the thermal decomposition characteristics and thermal stability of wood. This relationship was obtained to get a criterion for setting the optimum conditions for operating the carbonization furnace for the manufacture of char.

As for the structure of the carbonization furnace, it has an inner dimension of 1.5 m, length of 2.8 m and height of 0.6 m. Its outer walls are lined with "Oya" stone, while its bottom face is made of castable refractory and equipped with a flue, above which is provided a wire cloth. For carbonization, new sawdust was spread successively on ignited sawdust layer.

The time required for completion of carbonization is normally four days and becomes longer, the greater the sawdust's moisture content, the finer the sawdust's particle size, and the weaker the smokestack's air flow. In some cases seven days were required, but under proper conditions, carbonization was completed in two days.

The standard carbonization rate using the test furnace was 0.5 $kg/m^2 \cdot hr$ of char when Davao sawdust was used. In this case, the sawdust's moisture was 38%, the mean particle diameter 0.45 mm and yield 25% (against bone dry sawdust).

The temperature of the carbonization reaction layer was about 300°C±20°C. A certain extent of fluctuation was observed depending on the strength of draft, but there was not large fluctuation during the test.

Regarding char properties, some differences were observed depending on the wood species, but as a whole the volatile matter content was slightly less, ash content very high and the bulk density rather high, compared with Japanese pine, cedar and cypress.

Data conforming with the above-described tendency were obtained as shown by the technical analysis and elementary analysis of both sawdust and char, which indicated that the fixed carbon content was higher and the calorific value also higher, compared with Japanese char. As a whole, the results indicated that both carbonization conditions and char properties do not differ much from those in Japan.

5.6 Activation

Activation was carried out by the gas activation process. In this process, char is reacted with reactive gases (H_2O, O_2) at a high temperature of approximately 1,000°C in order to expand the inner surface areas of char particles and generate numerous capillary tubes.

The furnace used in this process was a circular fluidized bed type activation furnace. Its cylindrical reaction zone has a diameter of 260 mm, length of 3,200 mm, and into which reactive gas is introduced by means of numerous nozzles. The gas circulates inside the cylindrical furnace while reacting with char. Activated char and fines, carried by the circulating gas flow, is passed through a boiler and collected by means of a cyclone.

Activation tests were conducted by varying the quantity of reactive gas, ratio between H_2O and O_2, feed rate of char into the furnace, interior temperature of the furnace and char retention time in the furnace, and optimum activation reaction conditions were studied.

The quality of activated carbon produced by activation under optimum conditions are broadly classified into three groups.

The group of activated carbon produced from Davao sawdust exhibited the most excellent quality, white lauan and I.D.C. sawdust, which featured methylene blue value of 180 mℓ – 200 mℓ at 25% yield on raw char. This was followed with activated carbon obtained from falcata, ipil-ipil, kakauate and E.A. sawdust, which displayed methylene blue value of 150–170 mℓ at 25% yield. Coir dust being characterized by a high ash content, activated carbon obtained from this raw material also contained much ash even after activation. Therefore it has a low adsorption ability unless ash is removed by refining.

It was found that char of low bulk density was characterized by highly porous particles, good reaction with the activation gas, and provided activated carbon of good quality.

Also, continuous operation of the activation furnace showed that no special problem was involved, and that good activated carbon could be manufactured with stability.

The gas in the activation furnace was analyzed, from which the state of reaction was estimated, and the heat balance of the activation furance was obtained together with measurement of the furnace wall's heat flow quantity.

5.7 Crushing

After activation, activated carbon products were crushed by means of a hammer mill type crusher.

Regarding the particle size distribution after crushing, 1–3% of powdered activated carbon consisted of particles of over 100 mesh, and 4–9% consisted of particles of over 200 mesh, which is comparable with that of powdered activated carbon products available on the market.

5.8 Refining

Crushed powdered activated carbon may be used as it is, but since the powdered activated carbon deriving from tropical wood has an ash content of 5–11%, nearly three times that of its ounterparts produced from Japanese pine, cedar or cypress, its use after refining may be preferable. However, activated carbon for decoloring of oils, sodium glutamate production, etc. does not require refining.

Refining was accomplished by adding unrefined powdered activated carbon with 1 N HCl solution by 5–10 times the weight of equivalent activated carbon. The mixture was agitated for 24 hrs, then water-washed with a centrifugal dehydrator/separator, followed by drying.

By virtue of this process, it was found, with lauan-based refined activated carbon, that the ash content was reduced to less than 1%, the methylene blue value improved by about 10%, and the iodine adsorbability was also improved. Meanwhile, ipil-ipil-based refined activated carbon displayed a unique characteristic of its methylene blue decolorizing power being improved as much as 25% and its iodine adsorbability being increased by 10%.

From the results of measurement of surface area by the BET method, it was found that virtually all kinds of activated carbon displayed good quality of 1,076–1,473 m^2/g. Residual heavy metals in refined activated carbon was also analyzed by atomic absorption analysis, but with all kinds of activated carbon, no heavy metal of problematical proportions was detected.

Refining by the method described above provided refined activated carbon conforming to the standards of the 10th revised Pharmacopoeia Japonica whose standards are at present the most rigid among the standards applicable for activated carbon in Japan. By this, it was corroborated that powdered activated carbon can be manufactured that possesses adsorbability and purity which fully conform to the Japanese Standards for Food Additives as well as the Standards of Japan Water Works Association which is applicable to powdered activated carbon for city water.

That is, it has been fully confirmed that virtually all kinds of activated carbon for principal applications can be manufactured, including activated carbon for decoloring of sugar, decoloring of amino acids, water purification and for refining of medical drugs, industrial chemicals and liquors such as sake.

Chapter 6

MARKETS FOR ACTIVATED CARBON

Chapter 6. MARKETS FOR ACTIVATED CARBON

6.1 Industries Using Activated Carbon

As described earlier in Chapter 2, activated carbon has various uses. The principal purposes for which activated carbon is used are the following:

- Manufacture of industrial chemicals
- Recovery of solvents
- Adsorption of gases (including cigarette filters)
- Manufacture of foods
    - Monosodium glutamate refining
    - Refining of oils
    - Sugar refining
    - Manufacture of glucose
    - Liquor refining
- Manufacture of medicine
- Refining of city water
- Treatment of sewerage and waste water

Table 6-1 shows the purposes for which powdered and granular activated carbon products are being used in principal industries.

As described in Chapter 2, there are various kinds of granular activated carbon and powdered activated carbon.

Generally speaking, granular activated carbon can be regenerated after its use. Since it excels in gas and liquid permeability, it can be utilized in either gaseous phase or in liquid phase. When using it for large-scale refinining in the process of mass production of a single product, it more frequently proves highly economical although installation of granular activated carbon-packed columns and regeneration facilities are necessary.

On the other hand, powdered activated carbon consists of very fine particles and is characterized by poor gas permeability, so it is hardly used in gaseous phase. However, since its particles have fine pores of comparatively large sizes, it has a large capacity of adsorbing coloring and other molecules, making it highly effective for removing impurities by adding it into liquids

Table 6-1 PRINCIPAL APPLICATIONS OF ACTIVATED CARBON

Industry		Purpose
Powdered Activated Carbon	Industrial Chemicals	Refining of Dyestuff Intermediate Products, Refining of Organic and Inorganic Industrial Chemicals, Photographic Chemicals and Liquids for Drycleaning
	Water Purification	Removal of Impurities from City Water, Treatment of Sewerage Water, Treatment of Waste Water
	Brewing	Decoloration of Sake and Other Alcoholic Beverages, Adjustment of Color and Odor for Beer Production
	Monosodium Gultamate	Decoloration
	Starch Sugar	Decoloration of Glucose and Starch Syrup
	Sugar Refining	Decoloration
	Medicated Drugs	Refining of Antibiotic Agents and Various Kinds of Other Medicated Drugs
	Edible Oils and Fats	Decoloration
Granular Activated Carbon	Water Purification	Refining of City Water, Sewerage Water and Industrial Effluent
	Gas Adsorption	Air Purification in Industrial Plants, etc.
	Solvent Recovery	Recovery of Carbon Disulfide, Acetone, Alcohol, Benzol, etc.
	Industrial Chemicals	Refining of Organic and Inorganic Industrial Chemicals
	Foodstuff	Refining in Food Processing Industry
	Catalysts	Use as Catalytic Carrier in Vinyl Chloride, Vinyl Acetate and Other Manufacturing Industries

containing impurities, followed by stirring the mixture and filtration.

When using activated carbon on a small scale, installing a spent activated carbon regeneration facility will be uneconomical, so in such a case the use of powdered activated carbon which needs no regeneration facility will be more economical. The use of powdered activated carbon will be mandatory especially when manufacturing quality products by decoloration.

Therefore, powdered activated carbon displays its full adsorption capacity when it is used for the principal purpose of decoloration.

6.2 Markets for Activated Carbon in the Philippines

The market demands for activated carbon in the Philippines are being met by local coconut shell activated carbon, imported powdered activated carbon and imported coal-based granular activated carbon, and the annual volume of consumption of activated carbon runs up to about 1,300 tons.

Table 6-2 shows the markets for activated carbon in the Philippines by industry. It is obvious that the activated carbon market consists primarily of the food processing industry, especially the sugar refining, monosodium glutamate manufacturing industry and edible oil industry, and that these industries consume nearly 90% of the total volume. Other industries consuming activated carbon are the glucose manufacturing industry, glycerine manufacturing industry and water treatment for soft drink making.

Also shown is a description on the markets using for granular activated carbon and powdered activated carbon in each industry.

6.2.1 Sugar Refining Industry

About one-half of the total volume of activated carbon consumed in the Philippines is being used by the sugar refining industry. Activated carbon is used not in the manufacture of unrefined or raw sugar but only in sugar refining.

The unrefined sugar output in the harvesting year of 1981–1982 ran up to 2,439,963 tons (refer to Table 6-3), and the refined sugar output to 850,660 tons (refer to Table 6-4).

There are 42 unrefined sugar mills and 9 sugar refineries in the Philippines. Eight

Table 6-2 CONSUMPTION BY INDUSTRY OF ACTIVATED CARBON

Industry	Share in Total Consumption (%)
Sugar refining	52.4
Monosodium glutamate	27.9
Vegetable oil refining	9.7
Water purification	3.5
Glucose manufacture	3.2
Glycerine refining	2.4
Chemical purification	0.4
Alcohol refining	0.3
Total	99.8

Source: Export Market Studies Institute of Export Development
Board of Investments (February 1984)

sugar refineries are presently in operation, among which seven are using granular activated carbon and only Davao Sugar Refinery is using powdered activated carbon.

Among the refineries using granular activated carbon, four are using CAL activated carbon produced in the United States, one is using Norit activated carbon produced in Holland, and one is using Diahope activated carbon produced in Japan.

Incidentally, the operation rate of sugar refineries during fiscal 1982 was about 60%. The rate of consumption of granular activated carbon is estimated at 0.07–0.08% of the output of refined sugar, and powdered activated carbon at 0.3–0.4% of the refined sugar output.

6.2.2 Monosodium Glutamate Industry

In the Philippines there is only one monosodium glutamate manufacturing plant. This plant is engaged exclusively in the manufacture of monosodium glutamate, and its monthly output is about 1,300 tons.

Up till about two years ago, the plant used only powdered activated carbon for

Table 6-3 1980–1981 and 1981–1982 FINAL PRODUCTION OF UNREFINED SUGAR

(in Metric Tons)

	1980–1981 Crop		1981–1982 Crop	
	Termination Date	Final Production	Termination Date	Final Production
North, Central & South Luzon:				
Casuco	6-17-81	25,258.147	5-30-82	38,241.524
Hind	2-27-81	2,927.300	3-14-82	3,755.350
Paniqui	4-18-81	15,665.750	4-03-82	17,939.050
Tarlac	4-16-81	104,106.283	4-25-82	91,842.285
Carebi	-0-	-0-	-0-	-0-
Nasudeco	3-15-81	17,948.295	3-21-82	20,859.400
Pasudeco	4-09-81	61,503.500	3-25-82	61,323.300
Canlcubang	5-14-81	101,127.289	5-04-82	90,428.905
DCN Pedro	6-03-81	131,132.228	5-15-82	114,249.440
Batangas	5-21-81	59,670.050	5-03-82	54,870.513
Bisudeco	6-08-81	28,784.058	6-20-82	30,874.511
Total Luzon		548,122.900		532,384.778
Piculs		8,665,974.70		8,417,150.64
North Negros:				
Bacolod-Murcia	4-05-81	34,209.458	4-05-82	35,056.945
Talisay-Silay	4-27-81	28,586.671	5-03-82	39,264.277
First Farmers	5-06-81	91,894.054	5-23-82	96,453.243
Hawaiian-Philippine	4-26-81	114,801.665	5-02-82	99,042.505
Aidsisa	5-10-81	63,258.095	5-03-82	73,827.106
Vicmico	8-31-81	164,128.683	8-31-82	197,594.803
Lopez	8-09-81	100,840.110	8-31-82	126,063.955
Sagay	7-19-81	40,078.712	8-29-82	46,658.236
Danao	6-11-81	16,529.624	7-12-82	20,177.841
San Carlos	6-09-81	55,360.954	6-23-82	53,848.014
South Negros:				
Ma-Ao	5-04-81	62,630.654	4-30-82	56,723.896
La Carlota	4-26-81	160,473.283	5-02-82	127,516.048
Biscom	5-02-81	162,604.671	4-26-82	160,531.362
Sonedco	5-03-81	77,071.379	5-09-82	73,475.050
Dacongcogon	6-16-81	21,436.400	5-15-82	24,145.800
Upsuhco	6-15-81	51,649.489	6-15-82	60,887.369
Bais	5-31-81	47,277.181	6-02-82	58,048.257
Tolong	5-31-81	22,845.310	6-02-82	28,457.081
Total Negros		1,315,624.893		1,377,771.988
Piculs		20,800,393.57		21,782,956.34
Panay:				
Pilar	6-10-81	31,925.117	6-30-82	44,294.544
Asturias	6-02-81	23,853.346	6-14-32	27,322.988
Calinog-Lambunao	5-24-81	35.150.136	5-23-82	38,881.970
Passi	5-11-81	33,286,234	5-31-82	46,011.019
Allied Central	5-11-81	23,550.019	5-09-82	20,809.264
Santos-Lopez	5-21-81	33,762.600	5-29-82	30,432.700
Total Panay		181,527.453		207,752.485
Piculs		2,869,999.24		3,284,624.27
Eastern Visayas:				
Bogo-Medellin	5-22-81	44,170.708	6-19-82	44,816.498
Durano	8-01-81	31,240.817	7-31-82	32,243.467
Hideco	7-18-81	38,691.539	8-29-82	56,138.772
Ormoc-Poasario	5-27-81	24,616.950	7-01-82	26,458.100
Total Eastern Visayas		138,720.014		159,656.837
Piculs		2,193,201.80		2,524,218.77
Mindanao:				
Busco	6-26-81	84,404.624	7-11-82	94,132.044
Dasuceco	6-07-81	20,808.350	6-20-82	28,587.831
Nocosii	5-22-81	23,604.917	6-28-82	39,676.664
Total Mindanao		128,817.891		162,396.539
Piculs		2,036,646.50		2,567,534.21
Grand Total – Philippines		2,312,813.150		2,439,962.627
Piculs		36,566,215.81		38,576,484.23

Prepared by: Sugar Licensing & Control Division, Production Regulation & Control Office

Table 6-4 REFINED SUGAR PRODUCTION

(in Kilos)

Refineries	CY 1982–83	1981–82	1980–81	1979–80	1978–79
Victorias	320,771,555	359,840,450*	355,385,770	355,819,200**	392,136,750
Insurefco	71,855,300	65,371,950	75,130,600	75,583,950	76,014,800
Davao	14,544,300	10,705,500	8,119,350	7,319,550	14,865,150
Luisita	95,892,750	97,463,600	107,014,800	77,847,250	88,079,200
Carebi	0	0	0	0	0
Cal.-Lam.	132,296,190	125,413,400	144,453,250	144,425,350	0
Casuco	16,719,450	24,615,300	23,703,400	18,816,000	13,227,600
Busco	87,671,600	90,268,650	117,308,800	26,668,650	0
Balayan	92,253,700	76,983,650	132,995,000	0	0
Total	832,004,845	850,662,500	964,110,970	701,479,950	584,323,500

* as of July 1982
** as of July 1980
Source: EDP
Prepared by: Sugar Licensing & Control Div., Production Regulation & Control Office

monosodium glutamate production, but at present it adopts two processes – the continuous decoloration process that uses coal-based granualr activated carbon and the batch type decoloration process that is based on the use of powdered activated carbon.

The color of monosodium glutamate raw liquor will differ depending on the quality of raw material molasses, so the quantity of powdered activated carbon to be used for refining will differ according to the degree of coloring of the raw liquor.

At present, the plant is estimated to consume 50 T/Y of coal-based granular activated carbon as make-up and 50 T/Y of powdered activated carbon.

6.2.3 Edible Oil Refining Industry

The Philippines is the world's leading producer of coconuts and is exporting copra, coconut oil and other products deriving from coconuts to all parts of the world.

There are over 50 coconut oil mills and over 20 coconut oil refineries. Table 6-5 offers a general description of these refineries, whose aggregate refined coconut oil manufacturing capacity runs up to 600,000–700,000 T/Y. Table 6-6 indicates the volume of domestic consumption of refined edible coconut oil.

Fuller's earth is used for refining edible oil, and it is employed in combination with powdered activated carbon when refining oil to high levels.

Coconut oil is refined by the process shown in Fig. 6-1. Coconut oil, as with the oil of rape-seed, cotton seed, corn and peanut, does not contain much phosphatides, so the degumming process is not used in coconut oil refining.

Normally, alkali treatment and pretreatment are followed by decolorization in the bleaching process, at which stage activated carbon is used. The deodoration process may follow, if necessary. When using fuller's earth and activated carbon in combination, the volume of activated carbon used runs up to an average of 0.04% with respect to the volume of crude coconut oil.

The operation rate of coconut oil refineries is less than 50%. Now, assuming the operation rate at 40%, the output of refined coconut oil in fiscal 1982 will run up to 275,000 tons/yr. And assuming the ratio of use of powdered activated carbon at 0.04% of the volume of crude coconut oil, then the consumption of powdered activated carbon is calculated at roughly 110 T/Y.

Imported powdered activated carbon was being used before in the Philippines for the decoloration of edible oils, but today domestically produced coconut shell powdered activated carbon has come to be used in increasing volumes.

6.2.4 Water Treatment

Water treatment consists of city water treatment and sewerage/waste water treatment. In the Philippines, city water is not being treated with activated carbon at city water treatment facilities. Nor is there any case of activated carbon being used at public sewerage/waste water treatment facilities.

Activated carbon used in the Philippines for water treatment is for the purification

Table 6-5 CAPACITIES OF RP COCONUT OIL REFINERIES
(As of December 30, 1982)

	Company	Daily (Maximum) Refined Oil M.T.	Annual Maximum M.T.
1.	Central Vegetable Oil Co.	60	19,800
2.	Liberty Oil Factory	65	21,450
3.	Imperial Vegetable Oil Co.	60–70	23,100
4.	Lu Do & Lu Yu Crop.	35	11,550
		100 (Cochin)	33,000
5.	Malabon Soap & Oil Co.	120	39,600
6.	Philippine Refining Co.	35	11,550
7.	Procter & Gamble PMC	100–150	49,500
8.	International Oil Factory	100–150	49,500
9.	Royal Oil Products	106	34,990
10.	San Pablo Manufacturing Corp.	150	49,500
		300 (Cochin)	99,000
11.	Tamuco Enterprises	80	26,400
12.	Coco Chemical Philippines	50	16,500
13.	Pacific Oil Products (Malabon)	60	19,800
14.	Vizayan Manufacturing Corp.	30	9,900
15.	Royal Industrial	50	16,500
16.	Lim Ket Kai	75	24,750
17.	People's Industrial	80–100	33,000
18.	Logaspi Oil (Davao)	143 (Cochin)	33,000
19.	Tayabas Oil	40	13,200
20.	Lucena Oil Factory	85	28,050
21.	Crystal Oil Mill, Inc.	35	11,850
	Total	2,089	689,370

Source: Industry Reports to UCAP
Coconut Oil Refiners Association

Table 6-6 REFINED COCONUT OIL, LAUNDRY SOAP AND OTHER COCONUT-BASED PRODUCTS: VOLUME OF DOMESTIC SALES, MONTHLY 1981–1982

(in Metric Tons)

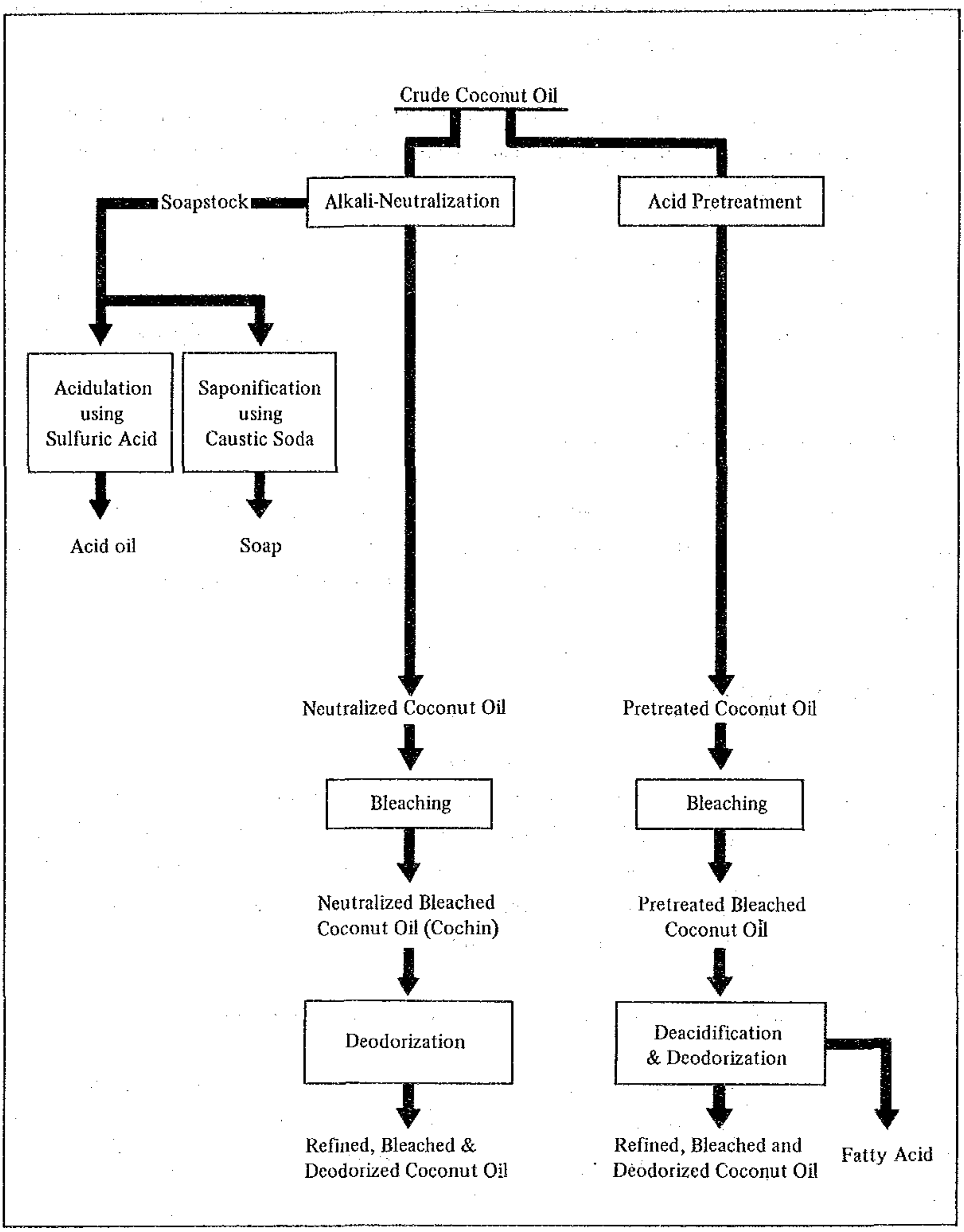
	Edible Oil Sales		Laundry Soap		Other Coco Based Products (Copra Terms)		Total Sales of Edible Oil, Laundry Soap & Coco-Based Products (Copra Terms)[1]	
Month	1981	1982p	1981	1982p	1981	1982p	1981	1982p
January	12,403	10,076	267	961	3,003	3,984	24,142	21,998
February	12,279	7,966	459	943	3,157	4,844	24,304	19,292
March	12,001	12,344	671	1,354	2,404	5,022	23,324	27,290
April	8,497	10,805	205	898	2,740	3,694	17,247	22,861
May	9,256	9,408	847	616	4,392	2,940	20,899	19,442
June	12,415	12,752	927	1,301	4,376	3,948	26,281	26,943
July	7,296	10,793	1,037	1,256	4,586	3,892	18,015	23,443
August	7,955	10,726	1,401	988	3,842	4,614	18,790	23,750
September	8,702	3,283	1,285	684	4,003	4,284	20,074	10,572
October	10,560	3,335	974	1,579	4,837	4,975	23,678	12,446
November	8,963	4,026	1,061	760	3,691	5,425	19,948	13,047
December	8,868	3,527	585	590	2,276	5,835	17,835	12,427
Total	119,195	99,091	9,719	12,020	43,307	53,456	254,537	233,511

1 Conversions used: 1.68 kilos of copra to a kilo of refined coconut oil.
1.13 kilos of copra to a kilo of laundry soap.

r Revised, p Preliminary

Source: Coconut Industry Stabilization Fund
Philippine Coconut Authority

Fig. 6-1 **FLOW DIAGRAM OF ALKALI-REFINING AND PHYSICAL REFINING PROCESSES FOR COCONUT OIL**



Source: Spectrum of Coconut Products
Philippine Coconut Authority

of water used for soft drink making (such as water for Coca Cola). In this case, the granular activated carbon-packed column is adopted, and the same type of facility is also used at the same time for the refining of carbon dioxide gas.

In the past, coal-based granular activated carbon was used, but some facilities were observed using domestically produced granular coconut shell activated carbon in place of the coal-based granular activated carbon.

In this case, the activated carbon, after being used for a fixed period of time, is replaced with new activated carbon without being regenerated. The total volume of granular activated carbon that is being put to this application throughout the Philippines is calculated to be about 45 T/Y.

6.2.5 Glycerine Refining Industry

Crude glycerine generated as byproduct in the process of manufacturing soap is collected, and activated carbon is used in the process of its refining. Refining is being accomplished by companies such as Colgate and Kao, and UNICHEM. The total production is about 10,000 T/Y.

6.2.6 Other Markets

Activated carbon is being used by many small-scale plants, including plants engaged in the manufacture of glucose and industrial chemicals. In an example of a very small consumption, a plant was using activated carbon for waste liquid treatment. In this case, annual consumption was 400 liters of imported granular activated carbon and 12 kg of imported powdered activated carbon. There are numerous plants like this, using activated carbon on small scales, but the aggregate volume of consumption is not so large.

6.2.7 Volume of Activated Carbon Consumption in the Philippines

As described above, coconut shell activated carbon manufactured in the Philippines is almost entirely being exported. Meanwhile, the volumes of other kinds of granular and powdered activated carbon demanded by the domestic market is being imported. Table 3-7 of Chapter 3, shows the volumes of imports in recent years.

According to this table, the import volume in 1981 and 1982 was 1,302 tons and 1,317 tons, respectively. In these years, powdered coconut shell activated carbon was not participating in the domestic activated carbon market yet, so the import volumes mentioned above may be considered as having met virtually the entire needs of the domestic activated carbon market in the Philippines. Incidentally, a part of these import volumes include granular activated carbon used as initial charge for newly fabricated refining columns.

Table 6-7 shows the estimated industrial consumption of activated carbon by kind as of 1982.

Table 6-7 CONSUMPTION BY KIND OF ACTIVATED CARBON (ESTIMATE) (1982)

Industry	Granular Activated Carbon MT/Y	Powdered Activated Carbon MT/Y
Sugar refining	630	40
Monosodium glutamate	50	60
Vegetable oil refining	–	110
Water purification	45	–
Glucose manufacture	–	40
Glycerine refining	–	30
Chemical purification	–	5
Alcohol refining	–	4
Initial charge for new vessel	300	–
Total	1,025	289

According to this table, the activated carbon market in the Philippines in 1982 concisted of about 1,000 tons of granular activated carbon and about 300 tons of powdered activated carbon.

Later, however, this situation underwent a notable change owing to a change in the Philippine economic situation and the introduction of powdered coconut shell activated carbon into the market. As a consequence, the edible oil industry, for example, which had relied on imported powdered activated carbon all along has come to consume large quantities of powdered coconut shell activated carbon, and this trend is expected to continue in the years ahead.

Meanwhile, since decoloring ability of the powdered coconut shell activated carbon is inferior to that of wood-based powdered activated carbon, more volume of powdered coconut shell activated carbon may be required for refining a unit volume of edible oil.

6.3 Price of Activated Carbon in the Philippines

Coconut shell activated carbon being a domestic product, it is available to consumers at a moderate price, and its selling price per ton was US$940–1,200 in 1984. Meanwhile, the prices of imported powdered activated carbon in 1982 was as shown in Table 6-8.

Table 6-8 QUANTITY AND VALUE OF PHILIPPINE IMPORTS ACTIVATED CARBON AND COUNTRY OF ORIGIN (1982)

Country of Origin	Kind of Activated Carbon	Quantity MT	FOB Value $	CIF Value $	CIF Value/MT $
U.S.A.	Granulated	129.096	224,108	248,268	1,923.13
Belgium	Granulated	244.805	505,577	540,486	2,207.82
Netherlands	Granulated Powdered	192.619	353,218	372,275	1,932.70
Germany	Powdered	38.500	44,416	49,365	1,282.20
Taiwan	Powdered	245.000	245,696	259,420	1,058.85
Japan	Granulated Powdered	466.827	628,162	717,326	1,345.60

Source: 1982 Foreign Trade Statistics of the Philippines

According to this table, the CIF price per ton of coal-based granular activated carbon ranges at US$1,900–2,200 and that of powdered activated carbon at US$1,060–1,300. Regarding the import price of activated carbon in 1984, the following prices were confirmed:

Granular activated carbon, US$2,017/T (FOB Europe)
Powdered activated carbon, US$2,571/T (Philippine consumer)

An import duty is levied on imported activated carbon. The method of calculation is shown in Chapter 3, Appendix 3A-2 and Appendix 3A-3. Accordingly, for Philippine consumers, the purchase price of activated carbon is very high.

As described in Appendix 3A-2 and 3A-3, the "Home Consumption Value (HCV)" is adopted for the calculation of import duties. According to information of 1984, the Home Consumption Value per ton of product lies in the range of US$660–1,460. In this case, the import duty per ton of product is calculated at about US$280–530.

With the lowest priced powdered activated carbon (US$1,060 ... probably zinc chloride-based activated carbon) the price is calculated at US$1,340/ton including import tax.

Incidentally, the rate of an additional duty was raised to 10% in July 1984.

6.4 Demand and Supply of Activated Carbon in Japan

Japan being a world's major consumer of activated carbon and an importer of large quantities of Philippine coconut shell activated carbon, a study of the situation of demand and supply of activated carbon in Japan constitutes a matter that is both necessary and vital when planning the manufacture of powdered activated carbon in the Philippines.

6.4.1 Consumption of Activated Carbon in Japan

Tables 6-9 and 6-10 as well as Figs. 6-2, 6-3, 6-4 and 6-5 show the transition in the consumption of powdered activated carbon and granular activated carbon in Japan.

These Tables and Figs. reveal the following situations in connection with the consumption of activated carbon in Japan.

Up till about 1975, the demand for powdered activated carbon had outstripped that for granular activated carbon, but the situation was reversed from 1977 with a conspicuous increase in the manufacture and demand for granular activated carbon, and in 1983 the demand for granular activated carbon is about twice as large as that for powdered activated carbon.

In the background of this situation was the rapid increase of industrial production in the 1970s that accompanied atmospheric and water pollution problems which, in turn, triggered widespread use of granular activated carbon.

Table 6-9 DEMAND OF POWDERED ACTIVATED CARBON IN JAPAN

Dry basis, including import

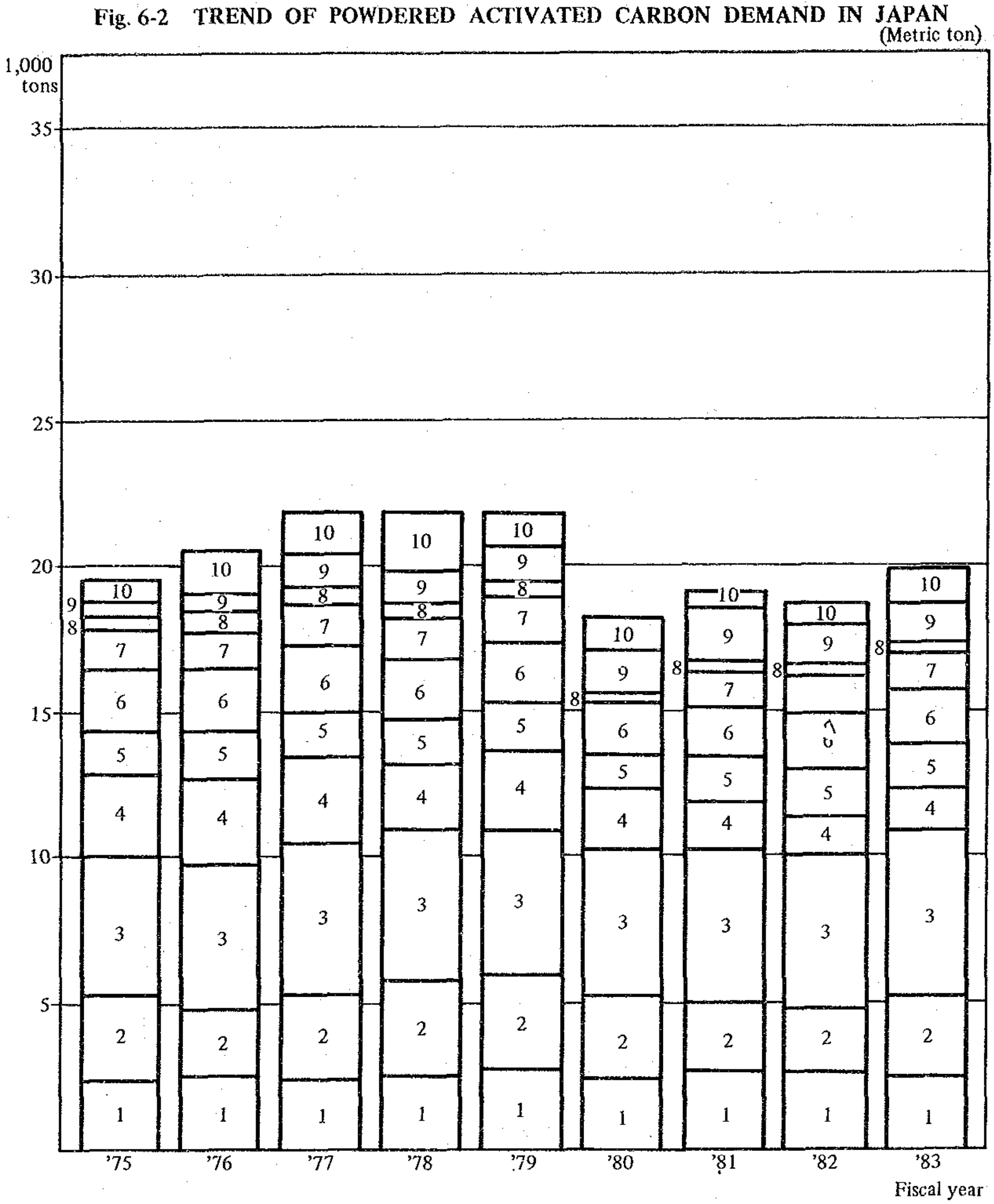
Application \ Year	'75	'76	'77	'78	'79	'80	'81	'82	'83
Sugar	2,844	2,844	2,914	2,276	2,642	2,034	1,563	1,317	1,421
Chemicals	4,576	5,035	5,160	5,206	5,787	4,953	5,228	5,124	5,667
Sodium glutamate	2,092	2,156	2,085	2,335	2,077	1,789	1,638	1,872	1,926
Glucose	1,614	1,605	1,588	1,573	1,472	1,106	1,527	1,653	1,464
Fermented products	2,516	2,492	2,433	2,574	2,848	2,512	2,675	2,729	2,495
Water supplies	2,888	2,232	2,763	2,452	2,666	1,682	2,506	2,340	2,749
Pharmaceuticals	1,279	1,241	1,412	1,480	1,584	1,246	1,184	1,233	1,288
Oil and fats	440	776	601	554	495	311	307	236	268
Others	532	644	1,330	1,120	1,116	1,460	1,727	1,364	1,342
Domestic totals	18,781	19,025	20,286	19,570	20,687	17,093	18,445	13,868	18,620
Export	723	1,444	1,357	2,066	1,084	1,071	560	726	1,183
Total	19,504	20,469	21,643	21,636	21,771	18,164	19,005	18,594	19,803

Table 6-10 DEMAND OF GRANULAR ACTIVATED CARBON IN JAPAN

Dry basis, including import

Application \ Year	'75	'76	'77	'78	'79	'80	'81	'82	'83
Catalyst	753	921	1,088	909	906	918	956	646	691
Gas absorbent	8,025	9,896	11,046	13,242	14,105	13,491	13,662	13,194	14,234
Chemicals	707	772	848	1,270	1,371	1,483	1,215	1,353	1,412
Water supplies and Waste water treatment	7,644	9,332	9,921	11,027	13,327	12,838	14,320	13,881	15,635
Solvent recovery	524	1,019	814	892	1,175	1,451	1,524	1,585	1,542
Food	–	–	–	–	647	1,184	955	1,006	1,143
Others	700	737	1,230	1,472	1,003	1,414	1,422	775	607
Domestic total	18,353	22,677	24,947	28,812	32,444	32,679	34,054	32,440	35,264
Export	154	502	397	431	827	1,126	840	1,042	1,112
Total	18,507	23,179	25,344	27,243	33,271	33,805	34,894	33,482	36,376

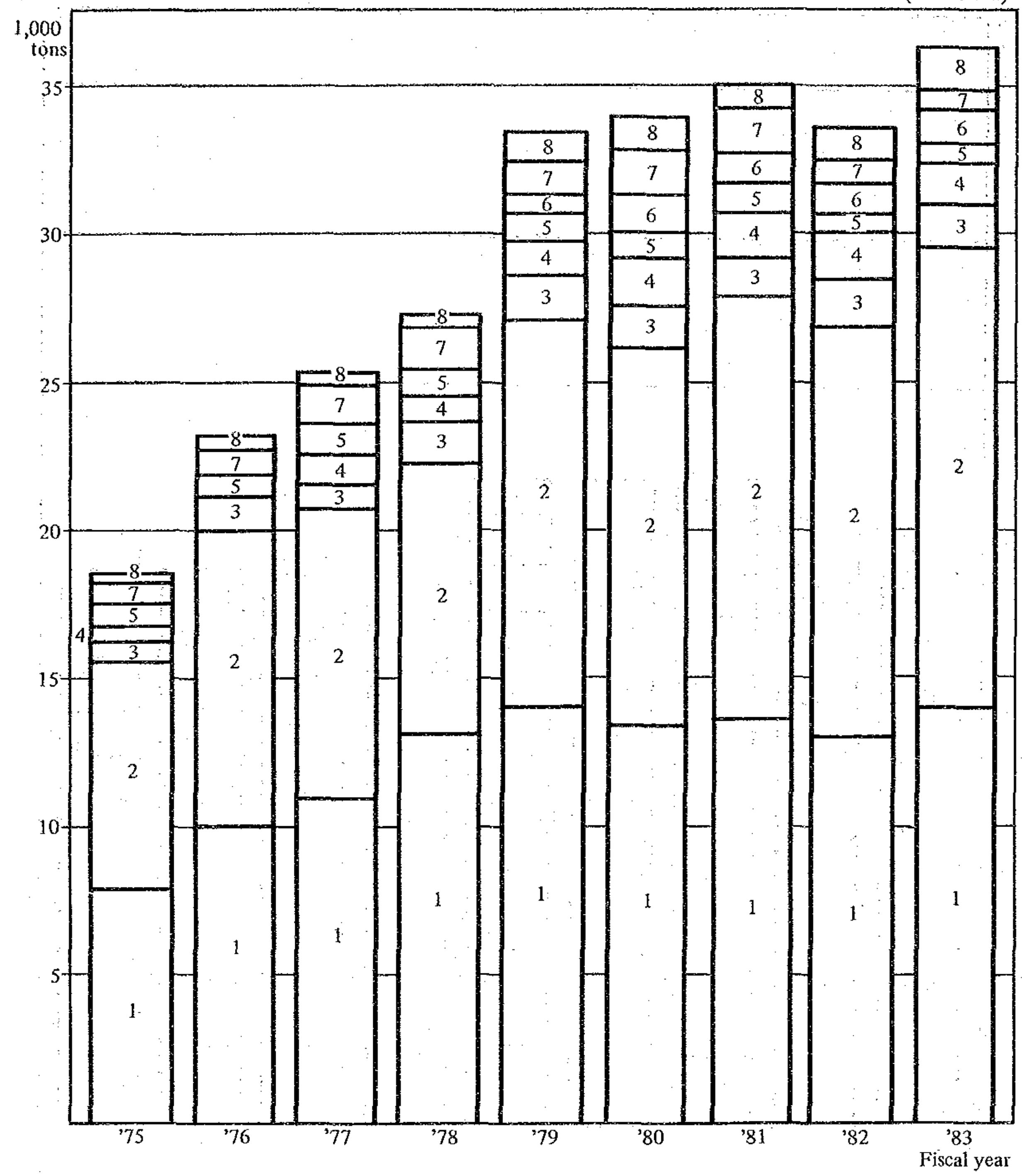
Fig. 6-2 TREND OF POWDERED ACTIVATED CARBON DEMAND IN JAPAN



1. Fermented products
2. Water supplies
3. Chemicals
4. Sugar
5. Glucose
6. Sodium glutamate
7. Pharmaceuticals
8. Oil and fats
9. Others
10. Export

Fig. 6-3 TREND OF GRANULAR ACTIVATED CARBON DEMAND IN JAPAN

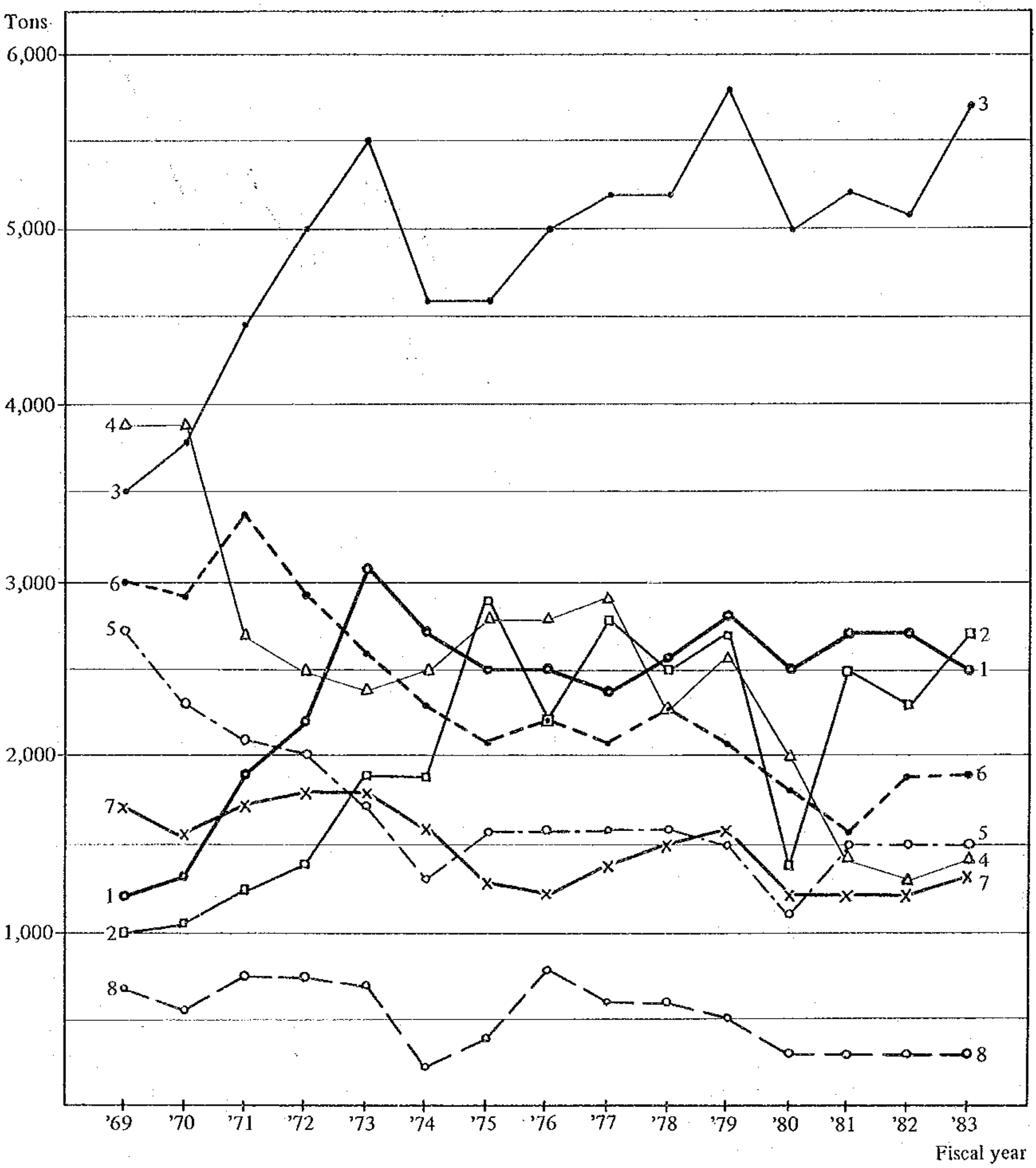
(Metric ton)



1. Gas absorbent
2. Water supplies and Waste water treatment
3. Chemicals
4. Solvent recovery
5. Catalyst
6. Food
7. Others
8. Exports

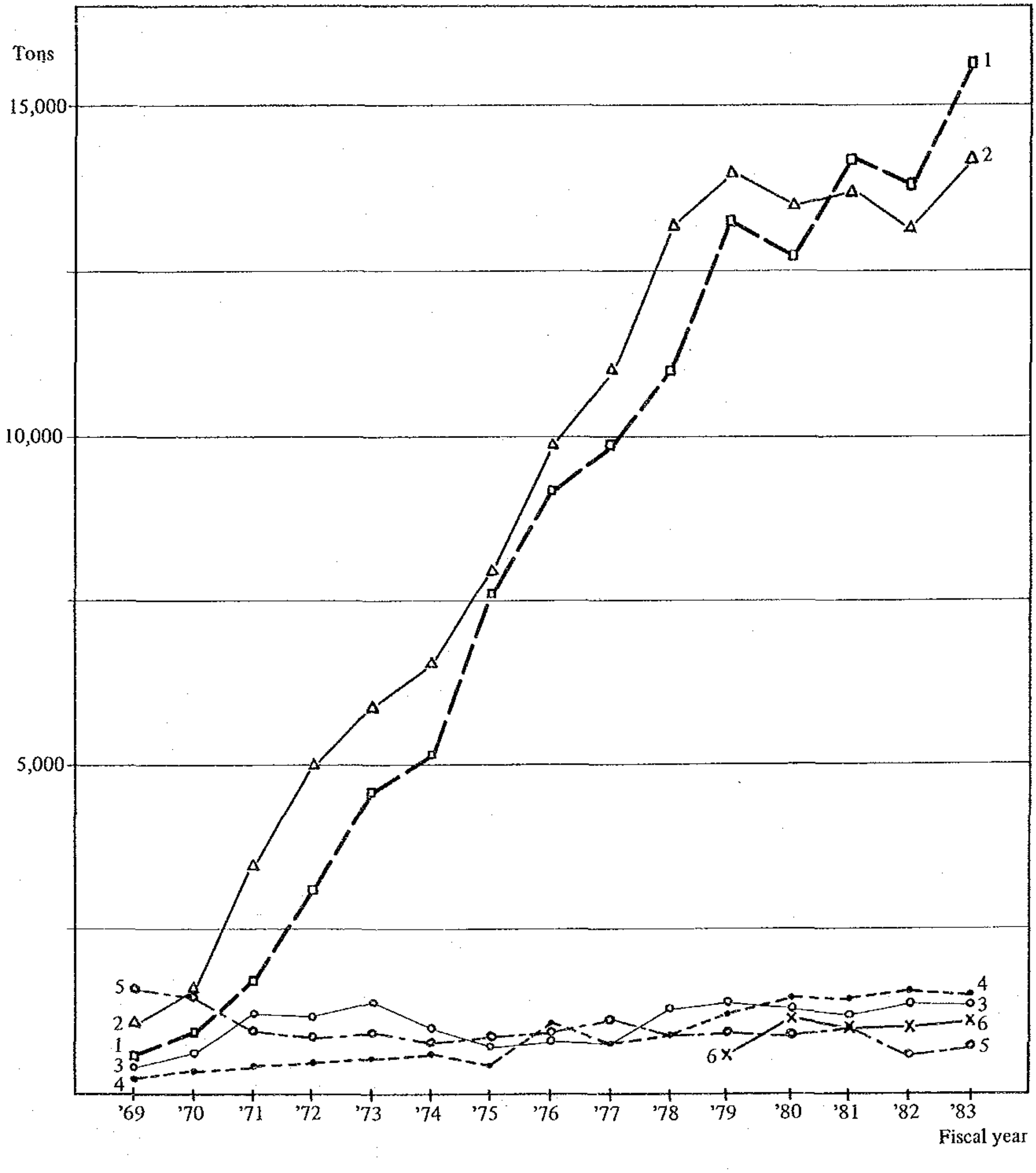
Fig. 6-4 TREND OF POWDERED ACTIVATED CARBON DEMAND IN JAPAN

(Metric ton)



1. Fermented product
2. Water supplies
3. Chemicals
4. Sugar
5. Glucose
6. Sodium glutamate
7. Pharmaceuticals
8. Oil and fats

Fig. 6-5 TREND OF GRANULAR ACTIVATED CARBON DEMAND IN JAPAN
(Metric ton)



1. Gas absorbent
2. Water supplies and Waste water treatment
3. Chemicals
4. Solvent recovery
5. Catalyst
6. Food

Meanwhile, the demand for powdered activated carbon as a whole has hardly changed from 1975 up to the present. The stagnancy in demand in the sector of sugar refining has been conspicuous, and slight demand decreases are evident in the sectors of refining of monosodium glutamate and refining of edible oil. However, demand increases are evident in other sectors of industry, with the result that the consumption volume as a whole has generally remained on the same level.

6.4.2 Production of Activated Carbon in Japan

In postwar Japan, about 100 activated carbon manufacturers competed for viability in the small market, leading to successive bankruptcy of smaller companies which were unable to compete by way of capital, technology and business performance. Only about a dozen manufacturers survived backed up by powerful consumers. Subsequently, supported by the development of new uses, quality improvement, development of new products and manufacture on larger scales against the backdrop of the country's period of high economic growth rate, the industry has come to operate with stability today.

Table 6-11 shows the situation surrounding activated carbon manufacturers in Japan today.

6.4.3 Trade of Activated Carbon of Japan

1) Export of Activated Carbon from Japan

Table 6-12 and Table 6-13 show the volumes and values of exports of activated carbon from Japan to various countries. The following countries were the main importing countries in 1983: Soviet Union (670 tons), the Republic of Korea (402 tons), the United States (309 tons), Australia (224 tons), Hungary (194 tons), China (167 tons) and the Philippines (103 tons), followed by Indonesia, Cuba and Thailand.

2) Import of Activated Carbon into Japan

Table 6-14 shows the volumes of import of activated carbon into Japan in 1983, indicating that the Philippines accounts for the largest share of imports. This is due to the import of coconut shell activated carbon from the coconut shell activated carbon manufacturing plants constructed jointly by Philippine corporations and Japanese manufacturers and trading companies, as described in Chapter 3, Table 3-1.

Table 6-11 Activated Carbon Manufacturer in Japan
(As of August 1984)

(Ton/Month)

	Location	Production Capacity		Process*	Raw materials	
		Powdered	Granular			
Kurare Chemical Co.	Okayama		940	C,D	Coconut shell, Australian Coal	
Sankyo Sangyo	Amagasaki	–	100	B,D	Coconut shell	Amagasaki Coke/ Mitsubishi Chem.
Shinagawa Tanso	Shohgawa	30	10	B,D		
Takeda Chemical Ind. Ltd.	Shimizu	450	400	B,C,D	Wood charcoal, Coconut shell	
Minabe Kako	Wakayama	250	–	A		
Cataler Industrial Co.	Shizuoka	100	300	B,D	Coconut shell, Wood charcoal	
Taihei Chemical Ind.	Kasugai	100	20	B,C,D	Wood charcoal Coconut shell	
Tsurumi Coal Co.	Tsurumi		450	B,C,D	Coconut shell, Australian coal	
Fuji Tanso Ind. Co.	Hiroshima	150	100			
Futamura Chemical Co.	Gifu	850	50	A,B,C,D	Wood charcoal, Coconut shell	
Hokuetsu Carbon Ind. Co.	Kanagawa	100	100	B,C,D	Wood charcoal	
Marubishi Carbon Co.,	Okayama	100	–	B,D		
Mitsubishi Chem. Ind. Co.	Kurosaki	–	200	B,C	Coal	
Kureha Chem. Ind. Co.	Nishiki	–	300	B,C	Petroleum pitch	
Japan Iron Powder Co.	Kashiwa		100	B,C	Australian coal	Mitsui Mining Co.
Hokutan Chemical Co.	Toda	–	300	B,C	Coal	
Total		2,130	3,370			

*Process: A – Zinc chloride,
B – Gas or steam,
C – Granular,
D – Crushed

Table 6-12 EXPORT OF ACTIVATED CARBON FROM JAPAN

(kg)

1976	1977	1978	1979	1980	1981	1982	1983
2,158,903	2,282,494	4,307,765	2,860,756	4,275,037	3,235,817	2,884,221	2,589,125

Table 6-13 EXPORT OF ACTIVATED CARBON FROM JAPAN
(1983 Calendar Year)

Country	Volume (kg)	Value (¥1,000)
R. Korea	402,176	247,316
N. Korea	24,750	11,743
China	167,330	11,743
Taiwan	27,982	20,336
Hong Kong	22,826	11,435
Vietnam	4,100	9,221
Thailand	55,100	25,862
Singapore	35,420	9,468
Malaya	4,000	1,550
Philippine	103,304	47,195
Indonesia	89,746	37,750
India	32,245	20,786
Iran	400	260
Bahrain	359	329
Su Arab	2,250	3,256
United Kingdom	4,684	2,574
Fr. Germeny	17,515	11,125
Germany	2,820	3,057
Italy	13,110	7,195
Finland	1,000	1,836
USSR	670,000	168,100
Czechoslovakia	144	218
Hungary	194,000	73,578
Yugoslovakia	640	1,229
Romania	25,000	20,876
Bulgalia	3,000	1,500
Canada	20,187	12,503
USA	309,239	339,764
Cuba	75,000	24,000
Peru	10,000	4,589
Chile	250	794
Brazil	30	450
Egypt	1,726	2,705
Nigeria	1,080	1,282
Zaire	15,000	5,521
S. Africa	18,990	7,604
Zambia	6	234
Australia	223,716	85,750
New Zealand	9,000	1,868
Fiji	1,000	551
Total	2,589,125	1,332,094

Source: Japan Exports & Imports

Table 6-14 IMPORT OF ACTIVATED CARBON

(kg)

Country \ Year	'76	'77	'78	'79	'80	'81	'82	'83
R. Korea	5,000	–	30,000	119,990	60,000	90,500	–	–
China	–	–	–	2,040	52,000	149,000	121,000	496,505
Taiwan	489,725	955,880	932,600	670,000	378,460	412,280	211,200	207,720
Singapore	79,980	81,980	18,000	18,000	56,000	220,000	160,000	50,000
Malaysia	1,804,024	1,694,949	1,787,641	2,577,688	2,733,698	2,363,756	2,598,019	2,765,826
Philippine	4,863,128	6,200,692	6,202,500	8,011,371	5,593,249	5,798,907	6,243,712	5,631,290
Sri Lanka	–	–	229,900	564,900	–	–	12,000	30,000
United Kingdom	96	75	1,097	6,011	1,162	17,944	32,310	30,204
Denmark	560	–	–	75	–	–	129	–
Netherlands	113	12,494	12,150	15,030	23,898	26,054	35,600	47,035
Hong Kong	–	–	–	–	–	–	–	2,000
Belgium	–	916,603	554,812	1,358,660	741,221	1,101,982	1,511,351	932,860
Thailand	50,000	–	–	1,000	–	–	–	–
France	32	–	–	77	40	1,172	5,513	2,050
Fr. Germany	96,056	115,662	130,447	78,612	115,314	151,287	70,949	120,579
Switzerland	–	–	–	10	–	–	–	–
Italy	–	–	–	–	–	270	–	4,000
USA	2,454,127	947,351	359,472	259,817	452,679	358,235	299,050	271,664
Australia	52,563	31,500	101,195	335,180	313,025	295,795	74,145	–
Total	9,895,364	10,957,186	10,442,814	14,018,461	10,520,691	10,987,182	11,324,976	10,300,733
EC	96,857	1,044,834	698,506	1,458,465	881,585	1,298,709	1,655,852	1,145,728

Powdered activated carbon imported from Malaysia is from a joint-venture plant constructed by a Japanese manufacturer and Malaysian corporation. Meanwhile, Belgian coal-based granular activated carbon is being imported from the Eruopean plant of Calgon Corp. of the United States.

6.5 Situation of Activated Carbon Industries of Neighboring Countries

1) China

Several activated carbon manufacturing plants are in operation. Regarding granular activated carbon, coal-based and coconut shell activated carbon are being manufactured, while in connection with powdered activated carbon, zinc chloride process activated carbon is being produced. It appears that plans are in progress for the manufacture of activated carbon by steam activation process.

2) Taiwan

Activated carbon is being manufactured primarily by the zinc chloride process, but a small quantity is also being produced by steam activation process.

3) The Republic of Korea

Several companies are manufacturing activated carbon by steam activation process.

4) Malaysia

Activated carbon based on steam activation process is being manufactured by a plant constructed jointly by Japanese and Malaysian companies, and exported to Japan. It seems that palm kernel is also used as a raw material.

5) Singapore

Activated carbon based on steam activation process has come to be manufactured under joint venture between Japanese and local interests.

6.6 Estimated Demand for Activated Carbon

6.6.1 Estimated Demand in the Philippines

As shown in Table 6-7, about 1,300 tons of activated carbon are being consumed annually in the Philippines. Before, virtually the entire volume had been relied on imports, but as described earlier, domestically produced coconut shell activated carbon is steadily replacing imported products.

Naturally, refining of high level cannot be expected by using only coconut shell activated carbon, and there are also cases where replacement with coconut shell activated carbon will be impossible owing to the specific types of existing production facilities adopted by activated carbon consumers. For this reason wood-based powdered activated carbon must be imported. However, the tendency for some time will be to use domestic coconut shell activated carbon wherever possible, and to rely on imports for the remaining portion of activated carbon, with the aim of suppressing imports as much as possible.

When the Philippine industry achieves further progress in the years ahead and the existing economic situation is improved, the required volume of activated carbon will necessarily increase, but for the time being, the volume of consumption of activated carbon is expected to remain on about the same level.

That is, the annual volume of consumption of activated carbon is expected to remain at about 1,300 tons.

Of this volume, roughly 1,000 tons will be granular activated carbon, and granular activated carbon for sugar refining and monosodium glutamate refining is expected to be met by imports. Meanwuile, domestic coconut shell activated carbon of granular type will be used for water treatment. Regarding the initial charge for new refining columns other than for water treatment it will be met by imported activated carbon.

On the other hand, the consumption of powdered activated carbon will be about 300 tons, and powdered activated carbon for sugar refining and monosodium glutamate refining will be met by imports. About 50% of activated carbon used for the refining of edible oil will be met by domestic powdered coconut shell activated carbon, while the rest of 50% will be met by imported wood-based powdered activated carbon. Regarding activated carbon for application to other sectors, roughly 70% of the demand is observed to be met by domestic powdered coconut shell activated carbon and the remaining 30% by imported wood-based powdered activated carbon.

Incidentally, when this project is implemented, the product produced thereby will replace a part of this imported wood-based powdered activated carbon.

6.6.2 Estimated Demands in Export Markets

Activated carbon, especially powdered activated carbon, involves high transportation costs in proportion to its weight. Therefore, a study of future demands will be made especially in those countries situated within relatively short distance.

1) Japan

Japan consumes a huge volume of activated carbon. Despite a stagnant mood in industrial activities the volume of consumption of activated carbon is increasing steadily, and since the consumption exceeds domestic output, a substantial volume is being imported.

The demand for granular activated carbon is growing steadily in recent years in the sectors of gas adsorption and water treatment, as shown in Table 6-10 and Fig. 6-3. In 1983, the volume of consumption ran up to roughly 35,000 tons. Since the demand for granular activated carbon for use in water treatment is expected to increase even henceforth, the overall demand for granular activated carbon appears to increase steadily. The increase will be met by imports and production increase of coal-based granular activated carbon.

Meanwhile, the volume of consumption of powdered activated carbon has long remained on about the same level, as shown in Table 6-9 and Fig. 6-2. In 1983, the volume of consumption was about 20,000 tons. It is obvious that there are cases in which the use of granular activated carbon would be more economical, but there are many sectors of application and cases in which powdered activated carbon has to be used by all means. It is for this reason that the consumption of powdered activated carbon has managed to remain on about the same level for a long period of time.

As a recent trend, pollution of city water, especially pollution during the dry seasons, has become conspicuous. Therefore, there is a tendency of the supply of powdered activated carbon for city water treatment running short.

When taking this situation in Japan into consideration, the most logical inference would be to conclude that the consumption of powdered activated carbon will tend to remain on about the same level even henceforth.

Meanwhile, when observed from the aspects of manufacture of powdered activated carbon, raw material sawdust shortage and rising prices are evident. The situation surrounding the demand and supply of raw material sawdust is described in Appendix 6A-1. That is, sawdust has come to be used in large volumes as fuel, for mushroom cultivation and as littering material by the livestock industry, triggering a rapid increase in sawdust prices. The output of sawdust itself also shows signs of decreasing in the years ahead.

Therefore, the outlook is that it will become increasingly difficult henceforth to procure sawdust at moderate price for use as the raw material for manufacturing powdered activated carbon.

The situation of import of powdered activated carbon is shown in Table 6-14. Imports from Malaysia, Taiwan and Singapore are conceived to consist of powdered activated carbon, and the import volumes generally lie on about the same level.

Against the backdrop described above, a balance is being maintained at present between demand and supply. However, the price of powdered activated carbon shows all signs of rising in concert with the price of raw material sawdust. In fact, a substantial price increase was observed this year, and this trend will continue into the future. Accordingly, if a high quality wood-based powdered activated carbon of low price is manufactured in some neighboring countries, it will be imported replacing highly priced Japanese powdered activated carbon.

2) Situation in Other Countries

As described earlier, activated carbon is being manufactured in various countries such as China, Taiwan, the Republic of Korea, Malaysia and Singapore, among which Malaysia, China, Taiwan and Singapore are exporting the product to Japan.

However, Thailand is not manufacturing activated carbon as yet, and is therefore importing the product. Meanwhile, Indonesia may be manufacturing a small quantity of activated carbon, but there is a high probability that its import volume will increase as the country achieves further industrial progress.

Because of the situation described above, there is a possibility that the product of the present project finds its market also in Thailand and Indonesia.

6.7 Sales Markets for the Product of This Project

6.7.1 Sales Markets in the Philippines

Powdered coconut shell activated carbon is available at a moderate price in the Philippines, as described earlier, so it would be inadvisable for the product manufactured by this project to compete with the powdered coconut shell activated carbon in the same markets.

Since the product features excellent properties not possessed by powdered coconut shell activated carbon, it should be sold in sectors where its unique characteristics can be displayed fully. In other words, it should be marketed with the aim of replacing imported powdered activated carbon that is being imported at a high price. The estimated sales volumes by industrial sectors are conceived as follows:

1) Sugar Refining Industry

There is at present one sugar refinery that is using imported powdered activated carbon. This refinery is observed to increase its output and plans to continue to use powdered activated carbon even henceforth. Therefore, the sales potential of the product of this project to the sugar refining industry is estimated at 50 T/Y.

2) Monosodium Glutamate Industry

Assuming that imported powdered activated carbon presently being used in the manufacture of monosodium glutamate can be replaced, the sales potential of the product of this project is estimated at 80% of the volume being consumed, or at 40 T/Y.

3) Edible Oil Industry

Powdered coconut shell activated carbon has come to be used in this sector. However, since there is a possibility that the high quality products cannot be obtained if only powdered coconut shell activated carbon is used in the refining process, wood-based powdered activated carbon should also be used. Assuming that 50% of the required volume of activated carbon is met by wood-based powdered activated carbon, then the sales potential of the product manufactured through this project will run up to roughly 50 T/Y.

4) Other Sectors

Powdered coconut shell activated carbon has come to be used even in other sectors. Assuming that 30% of the total volume of required activated carbon is met by wood-based powdered acrivated carbon, the sales potential of this product will run up to about 20 T/Y.

By adding up the sales potentials described above, the total sales potential of the product manufactured through this project will be up to about 160 T/Y.

6.7.2 Export Markets

The largest export market for the product of this project will be the Japanese market. As pointed out earlier, a balance is presently being maintained between demand and supply in the Japanese powdered activated carbon market. However, the existing situation suggests a rise in the price of powdered activated carbon. Therefore, the size of the Japanese market will be amply large as long as the product of this project is exported at a price that is competitive with those of its Japanese counterparts.

Other markets exist in neighboring countries such as Thailand and Indonesia, as pointed out earlier, but they are very much smaller in scale compared with the Japanese market.

6.8 Sales Plan and Selling Price of the Product of This Project

1) Sales Plan

As described in Paragraph 6.7.1, the domestic sales market is expected to be about 160 T/Y. However, in the sales plan, the domstic sales volume is assumed at 120 T/Y (25% of annual output). Meanwhile, the annual export sales volume is assumed to be 360 T/Y (75% of annual output).

2) Selling Price

(a) Selling Price for Domestic Market

On the domestic market, the product will have to compete with imported powdered activated carbon. The market price of steam activated powdered activated carbon is about US$2,000/ton or over. In order to compete with this price, the product's ex-factory price of US$1,600/ton is judged appropriate taking its sales tax of 10% and the transportation cost of $35/T between Davao and Manila into account.

With this ex-factory price, the product's selling price in Manila will be US$1,795, and since the product features excellent quality, it is fully capable of competing with the imported powdered activated carbon.

Incidentally, when comparing the product's price with that of imported zinc chloride-based activated carbon, the latter's moisture content of roughly 30% should be taken into account.

(b) Selling Price for Export Market

When exporting the product to Japan that constitutes a large export market, its selling price should be competitive with the powdered activated carbon currently being imported by Japan.

The current powdered activated carbon import price is conceived to be about ¥360,000/ton. The product's transportation cost between Davao and Yokohama, including various miscellaneous expenses, is calculated at about ¥62,000/ton. And by taking the sales tax of 10% into account, the product's ex-factory price is calculated at US$1,106/T.

However, since the product manufactured through this project is of good quality featuring M.B. value of 190–200 at char yield of 25%, its ex-factory price is set at US$1,200/ton. With this selling price, the product is considered to be competitive in Japanese market.

The domestic sales amount and export sales amount will be as follows, and the mean ex-factory price will be US$1,300/ton as of September 1984:

Domestic sales amount:	US$1,600 x 120 =	US$192,000
Export sales amount:	US$1,200 x 360 =	US$432,000
Total		US$624,000

Chapter 7

AVAILABILITY OF RAW MATERIALS

Chapter 7 AVAILABILITY OF RAW MATERIALS

7.1 Raw Materials

Raw material for the present project are various tropical woods, their logging waste and residues. In industrializing the manufacture of powdered activated carbon, it is desirable that raw materials meet the following conditions:

(a) They are available abundantly, and can be supplied steadily.
(b) Price is low.
(c) They are available within a short distance from the plant.
(d) Their properties are suitable for the production of good quality powdered activated carbon.

7.1.1 Quantity

As was mentioned in Chapter 4, Lauan is a primary wood of the forestry industry in the Philippines, surpassing by far the other wood species. Of the five species besides Lauan, Giant Ipil-Ipil and Falcata were planted because of their rapid growth. However, their quantity is less than that of Lauan at present.

The quantity of the other species is less than that of the above two species and are not promissing as raw material of the present project.

7.1.2 Price

A large quantity of sawdust is generated in the sawmills of the Philippines, of which a very small quantity is being used as fuel, and a great portion is left as it is without being utilized or is burned away with difficulties in disposing it. Therefore, sawdust can be obtained free of charge at present.

Most of the slabs generated in the sawmills is used as fuel within the mill and the rest is often sold. The selling price is about $\$4/m^3$.

Giant Ipil-Ipil is being used as fuel, the selling price of which is about $20/ton.

Logging waste and residues are generated in large quantities when trees are felled, but they cost much when carried off the forest, and moreover the residues are with bark. Accordingly, they are not fit for raw material for the present project.

In case slabs and logs generated in the sawmill are used as raw material, the cost which is needed for crushing them into the shape of sawdust will be added. The cost becomes much higher than the selling price above described.

7.1.3 Distance from the Plant

As will be described later, the raw material of powdered activated carbon weighs approximately 16 times as much as the product. Therefore, it ought to be considered that the transportation cost of raw material exerts an effect upon the production cost.

Accordingly, it is desirable that the raw material generating places are concentrated and are located near the plant.

A result of survey shows that the transportation cost is about $0.15/$m^3$/km.

7.1.4 Properties

The test team found that the powdered activated carbon made from Lauan and five other wood species has no great defect in its quality.

However, when viewed from the properties of raw material, coir dust and the sawdust generated in the sawmills of Northern Luzon contain considerably much water and must be dried, by way of a preliminary treatment, before they are utilized for making powdered activated carbon. Hence they are economically disadvantageous.

7.1.5 Conclusion

From what has so far been studied, it is concluded that the sawdust coming from the sawmill is the most economical raw material.

Description will be made below as to the availability of raw materials centering on sawdust.

7.2 Precondition

When the minimum monthly production capacity of a powdered activated carbon manufacturing plant is assumed to be 20 tons, the plant will put out 240 tons of powdered activated carbon a year. To produce one ton of powdered activated carbon from sawdust, it will require 16 tons (bone dry) of sawdust.

Accordingly, to manufacture 240 tons of activated carbon a year, the following quantity of sawdust is needed:

$$240 \text{ tons/year} \times 16 \text{ tons/ton} = 3{,}840 \text{ tons (bone dry)/year}$$

In case the sawdust is obtained from the sawmill, the following quantity of logs must be processed in the mill assuming that 10% sawdust is obtained from the processed log:

$$3{,}840 \text{ tons/year} \div 0.1 = 38{,}400 \text{ tons (bone dry)/year}$$

In terms of volume, this will become as below when the bulk density of log is assumed to be 500 kg/m^3:

$$38{,}400 \text{ tons/year} \div 0.5 \text{ tons/m}^3 = 76{,}800 \text{ m}^3\text{/year}$$

According to 1982 Philippine Forestry Statistics, the sawmills operated during that year were 190, which had put out 1,200,000 m^3 of lumber.

If the yield of the lumber is supposed to be 60%, an average wood processing per sawmill will become:

$$1{,}200{,}000 \text{ m}^3 \div 0.6 \div 190 \doteqdot 10{,}500 \text{ m}^3\text{/sawmill/year.}$$

Therefore, the number of sawmills that can generate the above quantity of sawdust, which is necessary for manufacturing powdered activated carbon, will be as follows:

$$76{,}800 \text{ m}^3\text{/year} \div 10{,}500 \text{ m}^3\text{/sawmill/year} = 7 \text{ sawmills}$$

The provinces having this number of sawmills are shown in the following table, which is based on Table 4-11 cited earlier.

Region	Province	Number of sawmills
Region 2	* Cagayan	9
	* Isabela	21
	Nueva Vicaya	9
3	Bulacan	9
4	* Metro Manila	14
9	Zamboanga del Sur	9
10	* Agusan del Norte	19
11	* Davao del Sur	15

According to Table 4-12 cited earlier, the provinces, that actually processed more than 80,000 m^3 of wood, in other words, that produced over 50,000 m^3 of lumber, are the five provinces marked with *.

7.3 Availability of Kind of Wood as Raw Material

In case the minimum production capacity of a powdered activated carbon manufacturing plant is 20 ton a month as was described in 7.2 and the plant uses surplus sawdust in the sawmill, approximately 80,000 m^3 of wood must be processed to meet the requirement.

In 1982 some 1,200,000 m^3 of lumber were produced in the Philippines, which is about 2,000,000 m^3 in terms of the quantity of wood.

According to Table 4-6 cited in 4.2.4 of Chapter 4, the majority of produced logs consisted predominantly of Lauan. Of the five wood species used as raw material beside Lauan, only 439,000 m^3 of Apitong and 11,000 m^3 of Falcata were put out.

Therefore, from the standpoint of supply, Lauan can be the most suitable raw material for the present project, but as to the five wood species other than Lauan, it can be considered as follows: As was described in 4.5 of Chapter 4, Giant Ipil-Ipil and Falcata have recently attracted attention as being the species that grow fast, and have thus been planted. However, Giant Ipil-Ipil is not suitable for sawing; and Falcata being still very small in quantity for lumber, it is difficult to adopt Falcata alone as a kind of wood for the raw material of the present project.

7.4 Survey of Raw Material

The Government of the Philippines proposed the candidates areas for plant sites at the time of concluding the I.A. The study team investigated them taking into account the forest situation and sawing activities, and then selected the following seven places where a survey was conducted on the generation of surplus sawdust, the main raw material of the project under contemplation.

In surveying these places, availability of other raw materials was also investigated.

(a) Cagayan de Oro and Butuan (Northern Mindanao)
(b) Davao (Southern Mindanao)
(c) Negros Island
(d) Isabela Province (Northern Luzon)
(e) Metro Manila
(f) Camarines Norte Province (Southern Luzon)
(g) Laguna Province (Central Luzon)

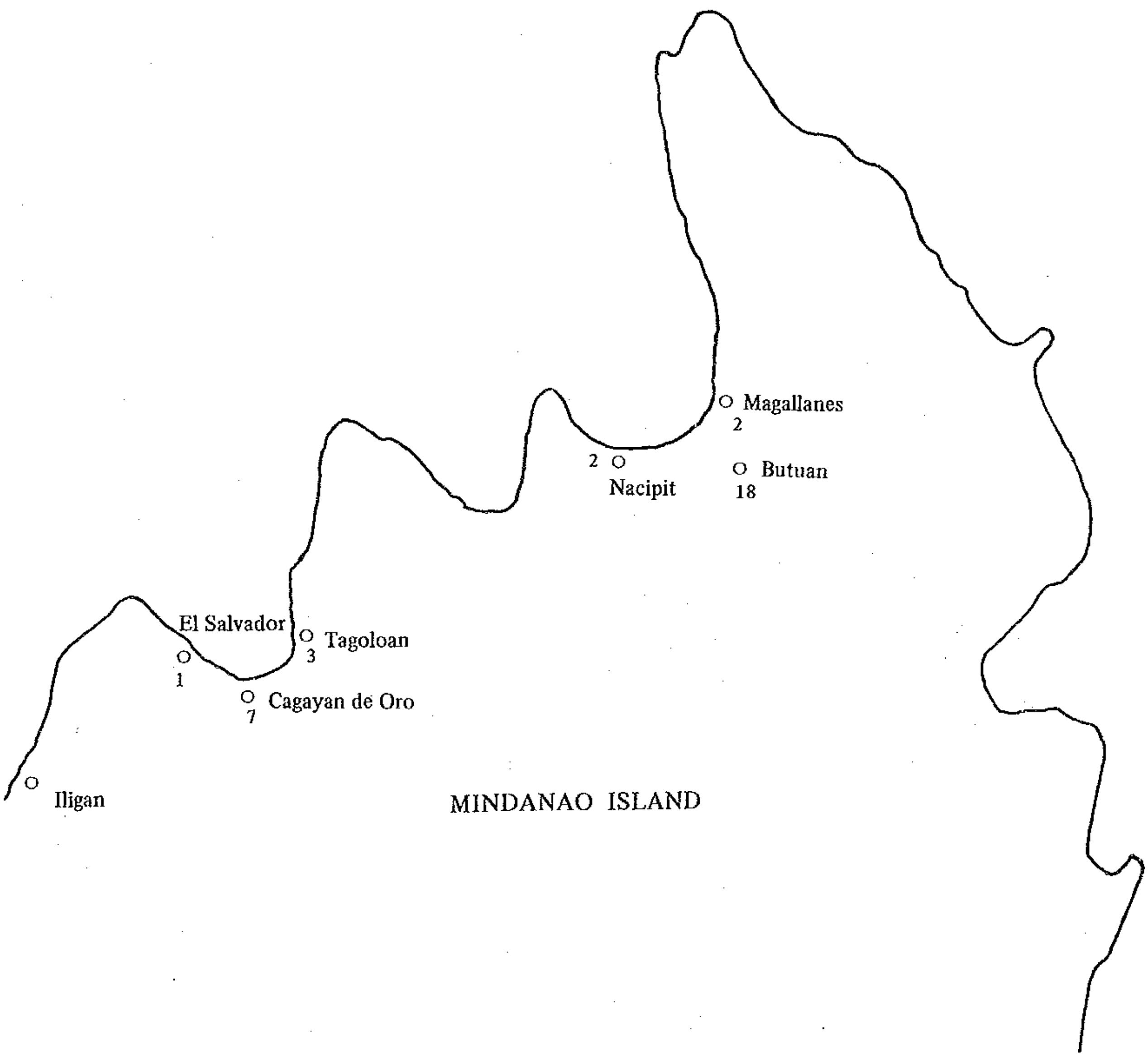
7.4.1 Cagayan de Oro and Butuan Region

The situation of sawmills in this region in 1981 and 1982 was as follows:

		Existing Sawmills	Daily Rated Capacity (1,000 BDF/D)	Annual Log Requirement (1,000 m^3)	Active Sawmills	Lumber Production (1,000 m^3)
Cagayan de Oro	1981				1	2
	1982	11	262	296	1	0.1
Butuan	1981				14	77
	1982	24	652	766	19	118

Fig. 7-1 shows the distribution of sawmills in this region.

Fig. 7-1. NORTHERN MINDANAO



As the above table indicates, the number of active sawmills in Cagayan de Oro was only one, and the lumber production was very small as well. In Butuan the active sawmills numbered 19, which have produced 118,000 m^3 of lumber. However, compared with their rated capacity, the rate of operation was low.

The wood species sawed in this region is mainly Red Lauan, followed by White Lauan.

In Butuan sawmills are relatively concentrated, generating sawdust which is equivalent to about 15% of the wood processed. But the public peace in this region is not well maintained. Moreover, Nasipit Lumber Co., Inc., the largest sawmill here, is making processed goods from sawdust, and consequently, sawdust is rather running short. Hence, it is difficult to have high expectation of Butuan as a source of raw material.

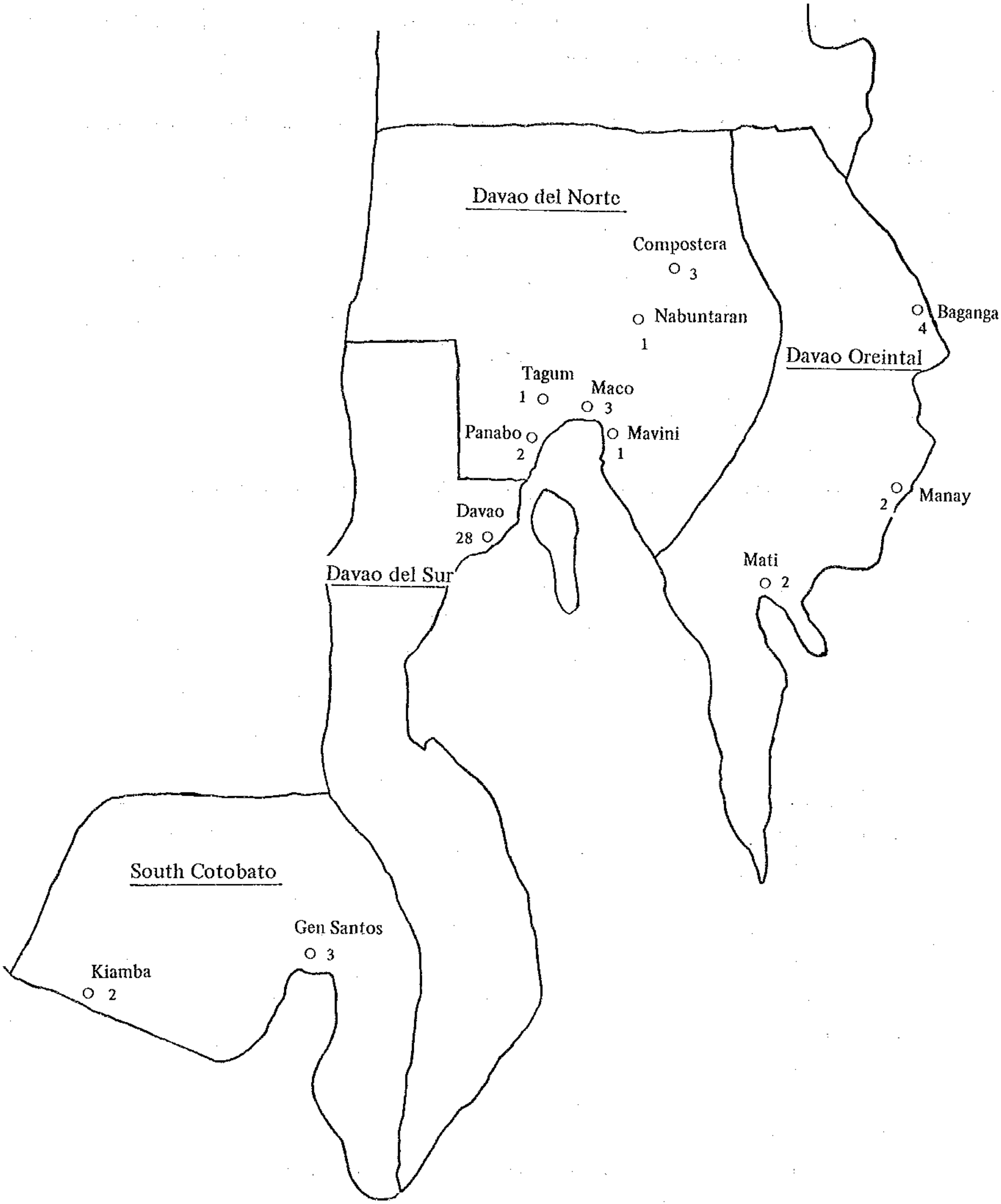
7.4.2 Davao region

The situation of sawmills in this region in 1981 and 1982 was as follows:

		Existing Sawmills	Daily Rated Capacity (1,000 BDF/D)	Annual Log Requirement (1,000 m^3)	Active Sawmills	Lumber Production (1,000 m^3)
Davao del Norte	1981				5	163
	1982	12	251	280	6	44
Davao del Sur	1981				19	117
	1982	28	558	632	15	105
Davao Oriental	1981				8	65
	1982	10	244	272	6	43
South Cotabato	1981				2	15
	1982	5	145	168	3	10

The distribution of sawmills in the Davao region is shown in Fig. 7-2.

Fig. 7-2. SOUTHERN MINDANAO



The Davao region is a leading place in the Philippines, where sawing is being conducted actively. Especially, 28 sawmills in Davao del Sur are all located in Davao City, forming a sawing center in this region.

Compared with other regions, Davao has a greater ratio of active sawmills and its mills are sawing large quantities of wood. According to a discussion meeting at the Davao Branch of the Bureau of Forest Development and a result of surveys conducted at sawmills there, the wood species being used in this region is Lauan, primarily White Lauan. Besides, some quantities of Apitong, Yakal and Guijo are being sawn.

The sawdust generated in the sawmills in this region is almost left as it is inside and outside of the sawmills or is being burned away without being utilized.

The quantity of sawdust being generated differs according to each sawmill, but generally speaking, from 10 to 15% sawdust is generated from procssed log.

The quantity of sawdust being generated in major sawmils in Davao City totals about 8,000 m^3/month. In addition, small sawmills, which were not surveyed, are expected to generate some 4,000 m^3/month. Hence, the total sawdust being generated in Davao City is estimated at approximately 12,000 m^3/month.

However, the operation of sawmills is affected by the existence of timber licenses, and of well-maintained logging roads as well as by the rainy season and dry season. For instance, C. Alcantara & Sons, Inc., a principal sawmill in this area, is working on a three-shift system, while the other sawmills are on one- or two-shift operation or are suspending their work awaiting the arrival of wood.

When the actual procurement of sawdust is assumed to be about 50% of the generated sawdust, with the method of its collection is taken into account, the quantity of sawdust obtainable will be some 6,000 m^3 a month.

In case 16 tons (bone dry) of sawdust is needed to produce 1 ton of powdered activated carbon and the bulk density of sawdust, which is generated in Davao City, is assumed to be 0.2 ton/m^3, the bone dry quantity of the above sawdust will be

$$6{,}000\ m^3/\text{month} \times 0.2\ \text{ton}/m^3 = 1{,}200\ \text{tons/month}.$$

The quantity of powdered activated carbon to be produced from that will be

1,200 tons/month ÷ 16 tons/ton = 75 tons/month.

In the Mindanao region, sawing is being performed either by the European method or by the Japanese method. When logs are sawed axially with a band saw, using these methods, the band saw is cooled with oil without using water. The sawdust thus generated contains almost the same moisture as the log has. Accordingly, the sawdust is fit for manufacturing powdered activated carbon.

As was just mentioned, sawmills are concentrated in Davao City, producing plenty of lumber. It is convenient to gather sawdust. Therefore, Davao City and its vicinity are the most suitable place to set up a powdered activated carbon manufacturing plant.

7.4.3 Negros Island

		Existing Sawmills	Daily Rated Capacity (1,000 BDF/D)	Annual Log Requirement (1,000 m^3)	Active Sawmills	Lumber Production (1,000 m^3)
Negros Oriental	1981				1	0.24
	1982	6	121	114	1	0.2
Negros Occidental	1981				5	105
	1982	10	290	274	5	67

The operation of sawmills in 1981 and 1982 in Negros Island is as per the above table. In 1982 Negros Occidental Province had produced lumber, but recently the cutting of trees in this island was prohibited in order to reserve the timber resources, which caused Insular Lumber Co., the largest sawmill in the area, to suspend its operation.

Therefore, it is impossible to collect sawdust in the island.

In Negros Island Giant Ipil-Ipil has been planted, and there is an Ipil-Ipil cultivators' association which is supplying the products from its forest of several thousand hectares to a sugar refining factory and others as fuel.

The unit price is \$18 to 21/ton.

7.4.4 Isabela Province

		Existing sawmills	Daily Rated Capacity (1,000 BDF/D)	Annual Log Requirement (1,000 m³)	Active sawmills	Lumber Production (1,000 m³)
Isabela	1981				22	172
	1982	33	547	381	21	181

Isabela Province is the greatest lumber producing place in Northern Luzon. There are many sawmills, which form a hub of the sawing industry in the Philippines.

Fig. 7-3 shows the distribution of sawmills in this region.

The operation of sawmills in 1981 and 1982 is indicated in the above table, which shows that sawing was done fairly briskly.

The wood species being sawed in Isabela Province is Lauan, chiefly red one. In addition to sawing in the province itself, logs are being transported to Manila. Sawdust of about 10% of wood is being generated in the sawmills, but is seldom utilized and is left as it is inside and outside of the sawmill, and is burned away, which causes problems as is the case with other regions.

Sawing in Isabela Province is being done by the American method, and unlike in the Davao region water is used to cool the band saw, and consequently, the sawdust thus generated contains much water. It is therefore disadvantageous to manufacture powdered activated carbon from such sawdust because it must be dried before being used.

As Fig. 7-3 indicates, the sawmills in Isabela Province exist in a wide area, and it is inconvenient to gather sawdust.

Isabela Province is situated 300 to 500 kilometers away from Manila, and if a powdered activated carbon manufacturing plant is established in this area, the product must