ORIENTATION STUDY REPORT
FOR
THE DEVELOPMENT OF PETROCHEMICAL
INDUSTRY IN THE PHILIPPINES

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JAPAN INTERNATIONAL COOPERATION AGENCY

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March 31st 1975

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1. Introduction

1.1 This Orientation Study Report has been prepared by the Consultants by appointment by the Japan International Cooperation Agency in accordance with an agreement made between the Japanese Government and the Philippine Government. This report has been compiled as part of STUDY ON DEVELOPMENT OF PETROCHEMICAL INDUSTRIES IN REPUBLIC OF THE PHILIPPINES.

The studies by the Consultants started on 1st February, 1975, and field survey mission composed of eight (8) members headed by Mr. T. Chino (UNICO International Corporation, Tokyo) was sent to the Philippines.

During the field survey in the Philippines, a back-stopping group of the Consultants in Japan prepared this Orientation Study on the basis of assumed conditions.

1.2 In accordance with the major objectives of this Orientation Study which is to clarify the global prospects on the establishment of a petrochemical complex in the Philippines, the widest possible range of relative factors and alternatives have been taken into account. Further, in view of future prospects of the related chemical industries which operate on similar petroleum feeds, the establishment of an olefin complex is not the only subject of this successive studies. An aromatics complex and/or synthetic fiber raw materials complex, as well as a nitrogenous fertilizer plant, have also been studied in certain depth in this report.

In this connection, a preliminary study on a plan for allocation of hydrocarbon feeds to the related industries has been made on the basis of Filoil Refinery in Cavite which is tentatively nominated as a candidate project site.

1.3 Therefore, in this Orientation Study, major subjects of study are Olefin, Aromatics and Synthetic Fiber Raw Materials, Nitrogenous Fertilizers and Allocation of Hydrocarbons. However, in regard to the related industries (i.e., aromatics, synthetic fiber raw materials and nitrogenous fertilizers), comments and recommendations by the Consultants on the results of the Orientation Study are provided herein for further elaborated studies to be conducted separately.

1.4 Due to constraints of the allowed amount of time, assumed conditions employed in this Orientation Study may not be fully appropriate for this particular project study. However, in further extended studies to be conducted later, conditions specified in the "BASIC CONDITIONS FOR STUDY" attached hereto will be used. These basic conditions shall be established through mutual discussions between the parties concerned on the parts of the Philippine Government and the survey team sent by JICA to the Philippines. Therefore, it should be understood that conceptual figures and/or comparative results brought about by this Orientation Study are the essential factors for the further studies.

2. Summary and Comments

2.1 Feedstock for Petrochemical Industries

2.1.1 Allocation of Local Hydrocarbon Raw Materials

<u>SUMMARY</u>

(1) The expected total amount of naphtha, kerosene, and light gas oil available from the expanded Filoil Refinery (50,000 BPSD) is sufficient for covering approximately 260,000 tons per year of ethylene production.

(2) Available naphtha for the aromatic complex from the expanded Filoil Refinery is sufficient for approximately 40,000 tons per year of p-TPA production which will be still below the expected local demand in the year 1980 (i.e., approx. 50,000 t/y as p-TPA).

(3) Any fraction except LPG from the expanded Filoil Refinery is available in sufficient amounts as the feed for the 1,000 t/d of ammonia production.

<u>COMMENTS</u>

(1) In view of the expected scope of the domestic market and the production scale of both olefins and aromatics, it seems recommendable that the supply of the feeds from the expanded Filoil Refinery be allocated with preference to olefins production.

(2) In the case of establishing both complexes for olefin and aromatics production, a naphtha shortage will have to be covered by imported naphtha or by locally produced naphtha to be supplied by other refineries.

(3) In order to enable the utilization of light fractions of the raw materials for olefin and/or aromatics complex, production of ammonia and urea should be planned on the basis of fuel oil as a feed which will be made available in a large surplus.

2.1.2 Raw Material Price

<u>SUMMARY</u>

(1) The project may not be viable economically if the import duty and tax in force were to be imposed on raw materials, as the raw material cost vitally affects the production cost.

(2) Specifically prepared pricing systems for feeds for petrochemical industries, as practiced in all the advanced countries, have not been established as yet in the Philippines.

(3) The pricing policies adopted in the advanced countries are mostly practiced by previlege on tax and duties on such a feed.

(4) The international price level of naphtha as a feed for petrochemical industries is approximately US$80 to US$90/kl.

COMMENTS

(1) The prices of raw materials for petrochemical industries should be properly established in the Philippines at a level similar to that prevailing in advanced countries.

(2) Import duty on crude oil and Specific Tax on refinery products should, therefore, be adjusted by exemption or by credit for the respective proportions to be fed into petrochemical industries, so as to realize an appropriate price level of such feeds.

2.2 Olefins

SUMMARY

(1) Demand Forecast and Prospect of Domestic Market

Although it is not as serious as in the other countries in Southeast Asia, the Philippines market consumption of olefin resins fell sharply due to the price increase of olefin products caused by oil crisis in the late 1973. The demand forecast made by BOI before the oil crisis must, therefore, be re-examined. The results of a preliminary examination by means of the price and GDP elasticity method indicated that, in order to maintain an economic scale of olefin complex at a high operational rate the price level of olefins should be kept at level lower than the import price level at present.

(2) International Tendency of Petrochemical Products Demand/Supply

The plastic resin demands in 1974 are generally estimated to be 60% to 70% of 1973 level in Asian countries. The price of plastic resins in the Asian region; however, stopped the steep incrase at the beginning of 1974. The demand is forecast to recover to 80% of the 1973 level. Consequently, it is expected that the present production capacity will amply cover the demand increase at least until 1977.

(3) Future International Price Prospect

In view of the ability in supply, Japan will still remain as the major exporter to Southeast Asian countries. In view of the past records of export prices from Japan, the level of FOB prices will fluctuate between the domestic exfactory price and the marginal cost. Under the circumstances in which domestic exfactory prices and the marginal cost increase along with the increment in the prices of naphtha and ethylene, the FOB price will not drastically decrease.

(4) Production Cost for Ethylene

1) The fixed cost portion in the total production cost is rather small when compared with the variable cost. Further, in evaluation of the variable cost elements, the raw materials price is observed as the most essential element.

2) In the comparison of different raw materials (i.e., naphtha, gas oil, LPG and LNG), naphtha and gas oil indicated satisfactory results. LPG indicated disadvantageous results due to its high cost, and heavy fraction in LNG was found impractical due to its difficulty in economical utilization of residual proportion in large lots in the Philippines.

Thus, it is suggested that both LPG and LNG be discarded in the further studies.

3) The cost difference by the production scale in the ethylene plant is found to be less significant.

(5) Production Cost for LDPE

1) Although the production economy of LDPE is largely dependant on the price of primary raw materials (i.e., naphtha, etc.), the production cost of LDPE in the Philippines will be still competitive with imported LDPE which is taxed by a 30% import duty and other impositions.

2) The cost difference by the production scale in the LDPE plant is larger than that in the case of ethylene production.

(6) Operational Rate and Production Cost

The cost difference by operational rate has an overall significance. In particular, the difference in LDPE production cost is much more significant than that in the ethylene production cost.

(7) International Competitiveness of Olefins Production Cost

1) In general, the production cost of olefins is advantageous in the oil and/or natural gas producing countries.

2) The production cost by newly established plant in Japan is higher than that in the oil/gas producing countries. However, the average production cost of Japan including existing plants will still be competitive.

3) The production cost in the Philippines will not be competitive with the production cost in the other exporting countries and that in the oil/gas producing countries.

COMMENTS

(1) In view of possible oversupply and severe price competition among the exporting countries, the domestic market projection should be made on a conservative side, without involving substantial amounts of export of olefin resins which would affect project economy.

(2) In order to realize economical operation of the complex, and to ensure contribution to the national benefit enhancement, a positive policy on market development and price control on raw materials and products will be required.

(3) Project size should be determined by considering as the essential elements higher operational rates for respective plants in the complex and scale enlargement for the down-stream plants as much as possible.

2.3 Aromatics and Synthetic Fiber Raw Materials

SUMMARY

(1) The forecast domestic demand of synthetic fibers in the Philippines are as follows:

	1979	1980
Polyester	43,300 (ton)	47,400 (ton)
Nylon	17,200	18,200

(2) The production economics has been studies for the following cases:

1) Production of synthetic fiber raw materials based on imported intermediates, i.e., cyclohexane and p-xylene.

2) Production of aromatics and synthetic fiber raw materials based on domestic raw materials, i.e., naphtha and pyrolysis gasoline.

The production scale of caprolactam and p-TPA/DMT is tentatively established as 30,000 MTA and 70,000 MTA (as p-TPA) respectively based on the demand projection in the Philippines.

(3) Production economics based on imported intermediates indicates generally preferable figures, and in particular, production economics of p-TPA based on imported p-xylene indicates the most preferable results among the cases.

(4) Production economics based on the domestic naphtha (i.e., cyclohexane--caprolactam and p-xylene--p-TPA) indicates that, if naphtha price is given as calculated including tax and duties, the caprolactam price and p-TPA/DMT price will not be competitive with imported products.

COMMENTS

(1) The foremost priority should be given to the production of p-TPA/DMT, among other synthetic fiber raw materials, for turning out polyester fiber in the early 1980's by taking into account the growth of the domestic demand, and the potential for the development of an export-oriented textile industry.

(2) The production of caprolactam for nylon is not considered to be a preferable project for the early 1980's because of the insignificant domestic demand even then.

(3) The lowest priority should be given to the production of p-xylene, a raw material for p-TPA/DMT, based on a reformate from naphtha. This is because of the possible rise in the production cost due to the higher price of raw materials and scale of the production.

(4) In view of international competition, the production of p-xylene at a scale of 50,000 MTA is too small when compared with the announced plants for 200,000 MTA to 330,000 MTA in Taiwan and Indonesia. Further, if the p-xylene production is planned in Singapore, the plant capacity will most likely be on the same level as that of Taiwan and Indonesia. It may therefore be a better policy to delay the commencement of aromatics production, if the availability of p-xylene from foreign country is confirmed.

RECOMMENDATION

It is recommended that the other subsequent studies for further elaboration including the following items be conducted.

(1) Elaboration of the market study on the synthetic fibers and their raw materials, and other aromatic derivatives, especially taking into account the development of the textile production activities into an export-oriented industry.

(2) Study on the development of production of synthetic fiber raw materials, i.e., p-TPA/DMT and caprolactam, and aromatics, i.e., B.T.X, cyclohexane, p-xylene, and o-xylene based on the market study above mentioned.

2.4 Nitrogenous Fertilizer

SUMMARY

(1) Agricultural productivities of major food crops in the Philippines are extremely low, particularly in the case of rice production. Therefore positive and long-run implementation of the Masagana 99 Program including extension of fertilization is highly desired.

(2) Conservative estimates on the nitrogenous fertilizer consumption in the Philippines in the year 1980 is given as 279,000 tons on the N-nutrient basis. It seems possible to establish a large scale nitrogenous fertilizer plant in the Philippines.

(3) It is forecast that nitrogenous fertilizers in the international market will turn to oversupply from the last half of the decade of the 1970s and the first half of the 1980s. The presently prevailing abnormally high level of fertilizer price will gradually fall from the present point towards future.

(4) The forecast future FOB Japan price of urea are as follows, while assuming a 7% annual inflation factor.

1976	US$330/ton
1980	US$200/ton
1982	US$220/ton

(5) The raw material-wise urea production cost in 1980 with a 10% ROI based on the raw material price without miscellaneous taxation factors can be stated as follows:

Raw Material	Price ($/ton)	Urea Price ($/ton)
Imported naphtha	160	224
Domestic naphtha	217	260
Imported LPG	270	285
Domestic fuel oil (H.S.)	131	249
Imported crude oil	133	243

COMMENT

In comparison with the above price, the production of fertilizer on imported naphtha and domestic fuel oil on the basis of a 100% operational rate show a promising result. Therefore, establishment of a large scale fertilizer plant will contribute to the national benefit, although some governmental subsidies will be necessary for the industry.

RECOMMENDATION

As is evident from the foregoing, it is recommended that further detailed study be made concerning the imported naphtha and domestic fuel oil as the major raw materials to be fed into a large-scale fertilizer plant.

3. Major Premises

The following are the major premises for the evaluation of the project in the orientation study. These premises shall be reconfirmed and revised, if required, after discussion based on the results of the study.

3.1 Time of Operation and Construction

(1) The complexes are expected to commence commercial operation in mid-1979.

(2) A period of 3.5 years is taken for the construction of the complex, and the contracts for the construction are to be concluded by early 1976.

3.2 Priorities in the Philippines

The petrochemical complexes are assumed to be granted by the Government of the Philippines with a certificate of priority industry.

3.3 Operation Conditions

(1)	Plant life	:	15 years
(2)	Number of operation days	:	330 days
(3)	Annual production	:	Rated capacity x 100%

3.4 Price Escalation

Price escalation on the required items are assumed on the basis of an inflation factor of seven(7) per cent per year on current prices through 1980. Thus it is calculated as follows:

$$(1 + 0.07)^6 \doteqdot 1.5$$

3.5 Period of Evaluation and the Basic Year

The prices, costs, etc. employed in the production cost estimation are in expected figures for the year 1980 and/or in yearly average throughout 10 years of operation starting in mid-1979 when the commercial operation commences.

3.6 Financial Categories

Own capital	:	30% of the fixed capital requirement
Long term foreign loan	:	70% of the fixed capital requirement
Repayment	:	Equally divided ten annual instalments

3.6 Prices of Raw Materials

Prices of raw materials are assessed on the basis of the prices equivelant to the refirmed products including import duty and Specific Tax.

4. Olefins

4.1 Comments

In this Orientation Study, scrutinization has been made on the possibility and the means for the implementation of a petrochemical industry.

An assumption is made that it is possible to apply the correlation between the size of the market and the price of the products as tentatively shown in the study of market in 3.2 of this part. The results of the study imply that the following points should be considered whilst proceeding with the petrochemical industrialization.

For a plant with a capacity of 110,000MTA of LDPE to which the Government to the Philippines has given priority in the Seventh plan, and also for a 200,000MTA ethylene plant, the price of naphtha or gas oil will have to be kept at a low level to ensure the profitability of the operation and the scale of market.

The prices of the products must be lower than that of the imported product as estimated in Annex I.

For this, tax exemption for the raw materials, and further, the deduction of price for the raw materials will be required.

In the case of a smaller plant, 80,000MTA for instance, the price of the raw material may be set higher, as the size of the market for the products will be smaller. In this case, the profitability of the operation is directly geared to the comparative economy in the raw material price.

However, in view of the national economy, it is recommendable that deduction of the import duty be effected to lower the price of the raw materials to ensure the market, and eventually to help the overall and long-term development of the petrochemical-related industries.

Both naphtha and gas oil are considered as the selection of the raw material for the petrochemical complex. Naphtha presents no problem in its property; however, the total quantity of available naphtha will not be able to cover the required amount of raw materials for the petrochemical industries.

Gas oil which is scheduled to be delivered from the vacuum unit, according to the proposal by the Government, may present some problem because of its high sulfur content and heavy distillation.

In this study, the gas oil from the atomospheric unit has been examined and the desulfurization cost has been added to the gas oil price. When making a study on the availability of the raw materials, detailed availability scrutinizations of gas oil suitable for the production of ethylene must be made.

4.2 Demand Forecast and Prospect of Market

(1) Domestic Market

The consumption of the products in the Philippines is indicated in Figure 1 which shows that consumption has been declining recently.

This tendency will have become more conspicuous by the autumn of 1974, however, the outcome may not be as serious as that observed in other Southeast Asian countries.

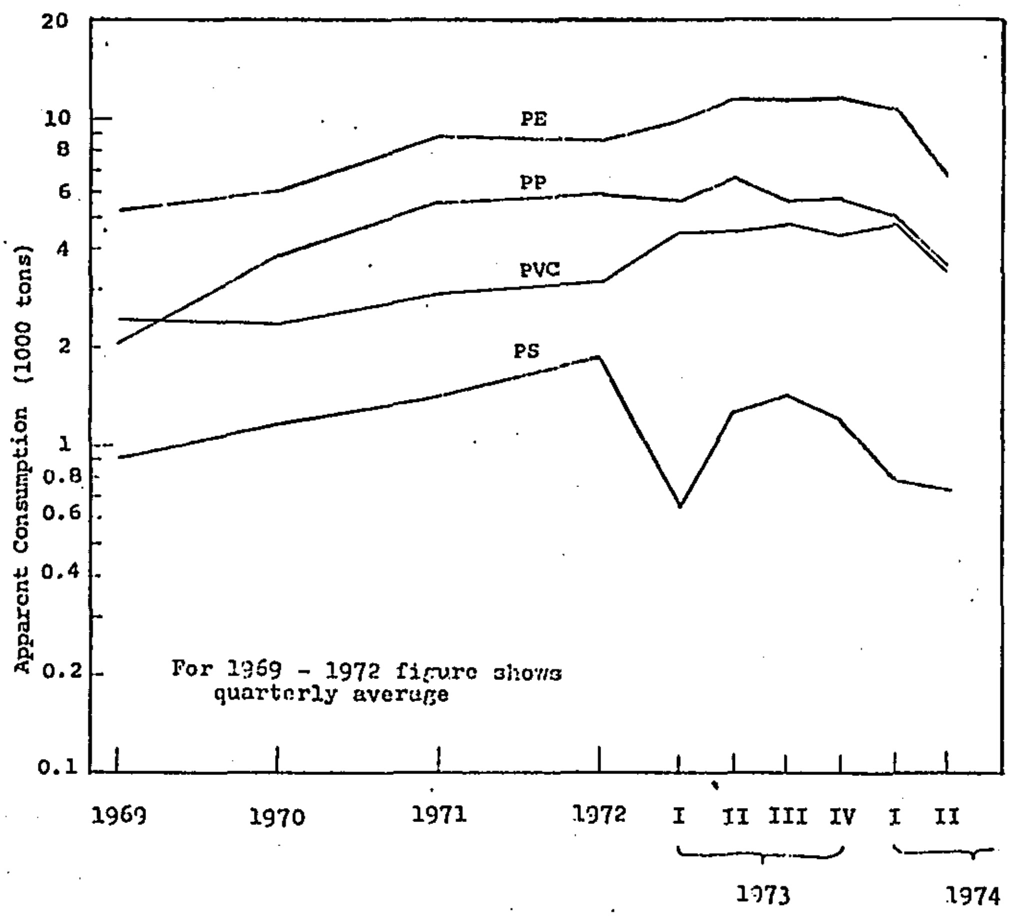


Figure 1 Apparent Consumption of Plastics Raw Materials

On the other hand, a domestic market forecast by BOI of the Philippines shows a considerable increase. It seems that this estimation has not taken into account the above decline which has since been caused by the enhancement of petrochemical products prices.

For the estimation of future market in the Philippines, the price elasticity and GDP elasticity of market demand have been taken into consideration. These elasticities mean the demand fluctuation due to price increase and GDP growth.

Figure 2 has been prepared for the study of the relation between the price and actual demand. The dotted lines show the apparent consumption and the solid lines show the calculated actual consumption when the elasticity factors are B=1 and B=2, respectively. The gap between the real and apparent consumption indicates the estimated inventories of the products.

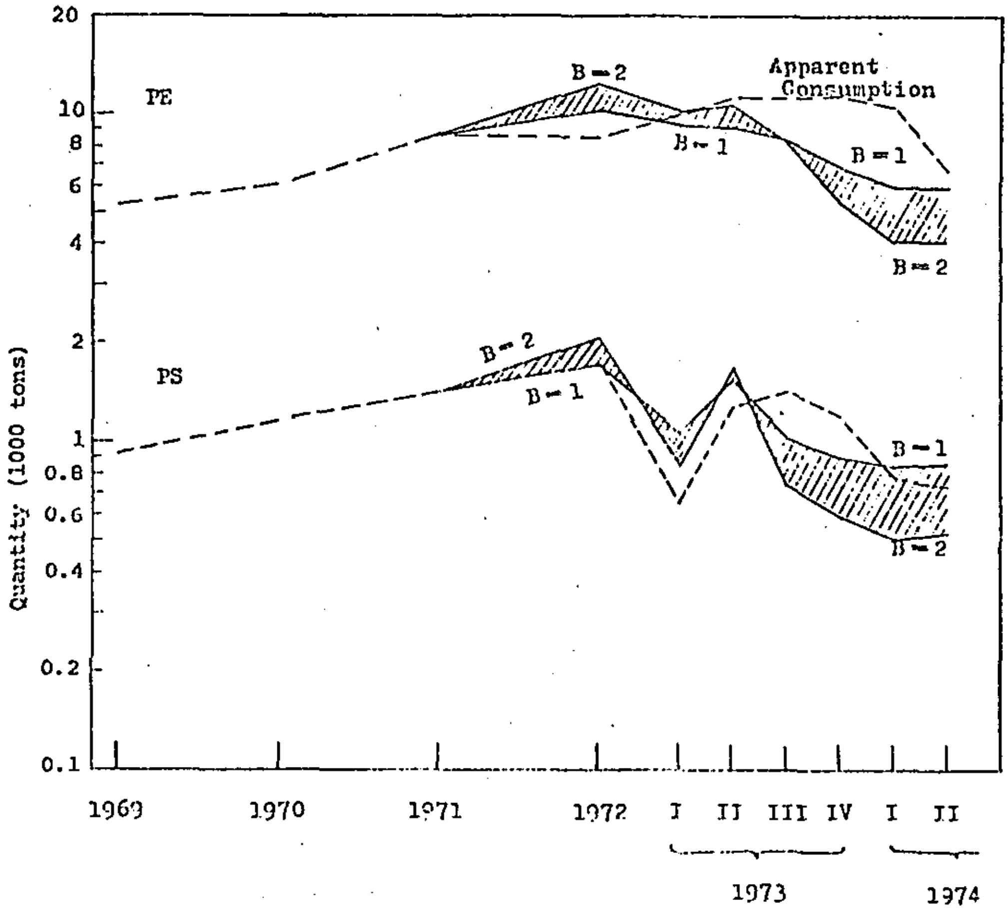


Figure 2 Supply/Demand Balance for PE and PS

Through analyses of past trends in the Philippines, the GDP elasticity factor has been estimated to be at a level between 2.5 and 4.0, depending on the kind of plastic resin. In this study, elasticity factors are tentatively applied as 1.5 for price and 3.0 for GDP.

LDPE has been studied here, and the consumption of LDPE in 1974 in the Philippines has been estimated to be 23,000 MTA, which is the level of 70% of the consumption of the preceeding year, assuming a further decline in the demand. The current price of LDPE as of this September, 1974 is about US$1,200/ton.

Table 1 was obtained by using the above-mentioned elasticity factors. This table shows that the price of LDPE must be less than $840/ton to keep the domestic market of 210,000 MTA which has been forecasted by BOI before the oil crisis. If a similar demand forecast is applied on the basis of the fixed price in 1973 before the oil crisis (i.e., approx. US$600/ton) the estimated demand in 1980 is a little more than 210,000 t/y.

Table 1 Calculated Exfactory Prices for LDPE Corresponding to Sales Amount in 1980

Year	Demand (1,000 tons)	Ratio of real price	Actual landed price 2),3) (US $/ton)
1974	23	1.00	1,200
1980	60	1.08	1,940
	80	0.89	1,600
	100	0.77	1,380
	120	0.68	1,220
	140	0.61	1,100
	210	0.47	840

Notes: 1) Price elasticity: 1.5
GDP elasticity: 3.0

2) Increase ratio of GNP deflator: 7%

3) Import exchange rate: ₱ 10.5/US $
Exchange rate: ₱ 6.8/US $

In order to undertake sound operations of a commercial scale plant, as proved in the historical records both in the U.S.A. and Japan, the market price of the plastics products turned out by the plant must be kept at a reasonably low level. This is an essential point for consideration in the planning of a new project.

(2) International Tendency of Petrochemical Products Supply/Demand

In the United States, about 15 ethylene plants are being planned. At this stage eight of the projects are already implemented, and the total capacity is informed to be 3,300,000 MTA.

However, the olefins supply will be still insufficient to accomodate the demands in the U.S.A. towards the end of 1970s even if all the above plants were constructed. Therefore, Japan, which will keep production capacity in excess of the domestic demand, will lead the export market price of petrochemical products in the Asian area.

Further, oil producing countries including Indonesia, Malysia, and Mideast countries will not be able to become price leaders in the regional market due to their lack in practical ability to supply the product, although they may have a potential to produce cheaper products.

Demand/supply balance of petrochemicals in the area around the Philippines will differ greatly from the forecast performed before the oil crisis. The increase in the prices due to the hike of hydrocarbon raw materials caused a slowdown or lowering of the demand.

The plastic resin demands in 1974 are estimated at 60% to 70% of the 1973 level in Asian countries.

However, the price of plastic resins terminated steep increase at the beginning of 1974. Consequently, along with the slowdown of inflation, the market for plastic finished products began to show an uptrend since the last half of 1974.

In the past, the FOB prices for export differed from domestic prices greatly, and exports have been made at a level close to the marginal prices.

However, the future trend of export prices will not differ significantly from the exfactory prices for the domestic market. The portion of the marginal cost will comprize a great part of the total exfactory price due to the price rise of hydrocarbon raw materials such as naphtha.

Table 2 shows actual records of consumption and estimated demands for major plastics previously forecast in Asian countries. The country-wise consumption and estimated demands are shown in Appendix I. The demand estimations do not involve the rise of the price caused by the oil crisis. Therefore, the results now appear to be an exaggeration.

Table 2 Actual and Estimated Consumption of Major Plastics Materials in Asian Countries

(unit ton)

	1969	1970	1971	1975	1976	1977	1978	1979	1980
LDPE	652,571	806,980	893,920	1,424,100	1,560,300	1,705,700	1,871,700	2,062,600	2,275,300
HDPE	263,324	324,304	312,420	695,000	752,000	877,300	987,000	1,103,500	1,230,800
PVC	1,001,049	1,095,328	1,032,164	1,561,600	1,669,600	1,702,750	1,906,000	2,050,500	2,216,460
P.P.	705,704	860,954	517,226	784,200	866,800	952,500	1,060,500	1,146,700	1,264,800
P.S.	202,484	300,971	412,868	625,190	697,770	779,340	869,450	970,660	1,032,600

Note : Actual up to the year of 1971

It is impossible to predict the decrease of demand in the same manner, because the demand fall in major plastics differs depending on their types and consuming countries. A demand decrease was observed to a level less than 50% of the previous year in Thailand even in the middle of 1974.

Generally, in countries in Asia other than Thailand, the demand fell to 60% to 70% of the 1973 level. As shown in Figure 3. the total demand for LDPE in Asia except Korea and Taiwan, is estimated to be about one third of 1973. In the year 1973, the demand may be regarded as being almost the same as the demand in 1972 because of the conspicuous shortage of supply in 1973.

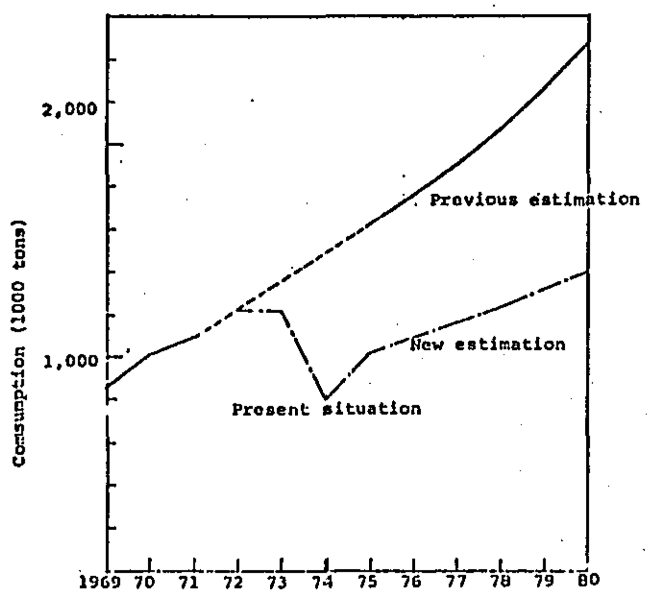


Figure 3 Estimation of LDPE Consumption under High Material Price in Asian Countries

However, the price of plastics resin have shown a plateau or a decrease since the peak in the January to February, 1974. Consequently, along with the slowdown of the inflation and emergence of signs for the recovery of economy, the market for plastic finished products became active since August and October when the demand hit the bottom. Therefore, the demand is forcast for 1975 to recover to more than 80% of the 1973 level.

The price of plastic resins will still maintain the 1974 level. Therefore, the demand will not demonstrate as high a growth rate as it has been showing in the past year.

In Japan, the future LDPE growth rate of demand, is forecast to be 7% to 8% per year. The growth rate in the plastic resin importing countries is estimated to be also in the vicinity of 8% per year.

The rate of the growth of economy in these countries will be average 4% per year, and the that the plastic resin demand growth rate will be twice as high as the economy growth rate (i.e., the average GDP elasticity is assumed to be 2.0)

On the basis of the above mentioned assumption, the demand of LDPE in Asia has been obtained in Fig. 3. The figure shows that the present production capacity will amply cover the demand increase at least until 1977. Actually, the petrochemical industrialization projects in Thailand has been postponed by three years, and modifications are being incorporated in the projects in Korea, Iran, etc. The outline of the presently contrmplated projects are shown in Appendix I. Incessant modifications have been made to these projects commensurate with the demand trend. Therefore, it should be noted that the projects are subject to change.

(3) Future International Price Prospect

In view of the ability in supply, Japan will still remain the major exporter to Southeast Asian countries. In Japan, normally the FOB price for export were lower than the exfactory price whenever the supply was excessive

Figs. 4 through 7 shows the past records of the trend in this respect in Japan. The figures clearly show that the FOB prices constantly stay below the domestic exfactory price level.

By the year 1973, because of global supply shortage, the gap between the two price levels became narrower. From the last half of 1973 until the first half of 1974, FOB prices even exceeded the domestic prices. However, since October, 1974, the market largely softened to such an extent that the FOB prices began to decrease to a level lower than that of the domestic prices.

Thus, the level of FOB prices will fluctuate between the domestic exfactory price and the marginal cost (Exfactory price less fixed cost shall hereinafter be called the "variable cost" or the "marginal cost".) Fig. 8 illustrates the exfactory price and the marginal cost of LDPE. Here, the exfactory price figures have been cited from the previous report. The FOB prices will fluctuate within the diagonally lined range in accordance with the market situation. (The domestic exfactory prices will assume a position slightly higher than the upper line. The figures in this illustration are for the existing plants only.)

This figure implies that both domestic exfactory prices and the marginal cost increase along with the increment in the prices of naphtha and ethylene. However, the difference between the domestic exfactory price and the marginal cost is almost constant, thereby gradually reducing the ratio of the difference in the total.

The export FOB price will stay between the exfactory price and the marginal cost as mentioned earlier. This suggests that the FOB price will not drastically decrease.

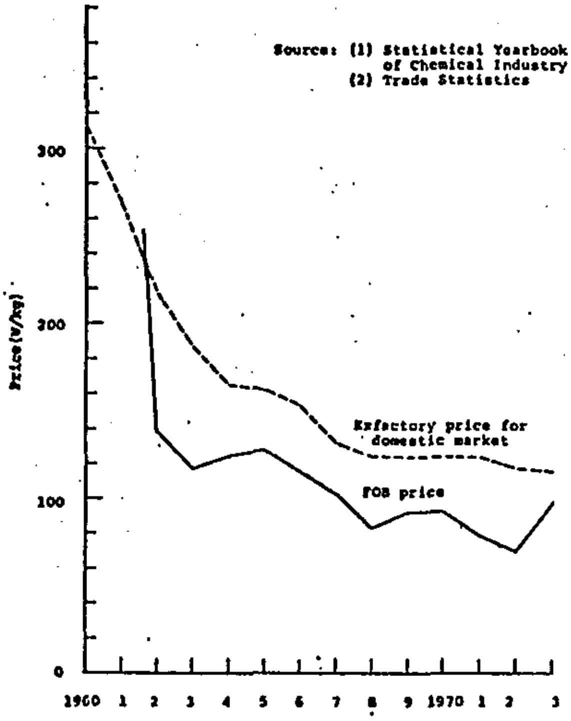


Figure 4 Comparison of Domestic Price and FOB Price in Japan (PE)

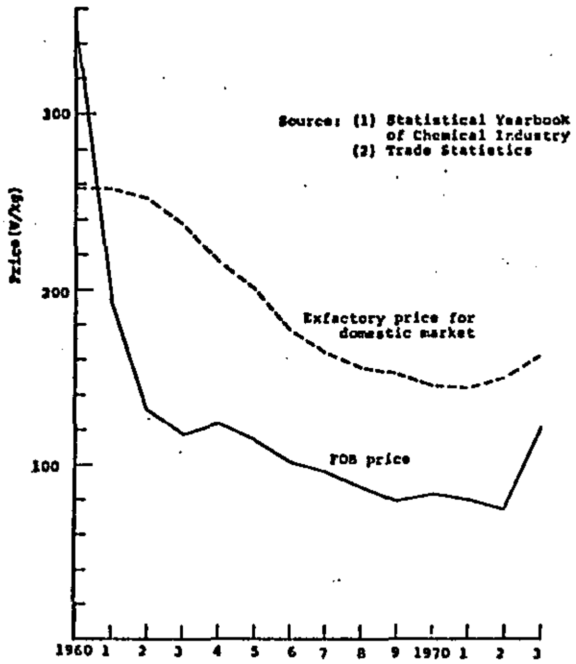


Figure 5 Comparison of Domestic Price and FOB Price in Japan (PS)

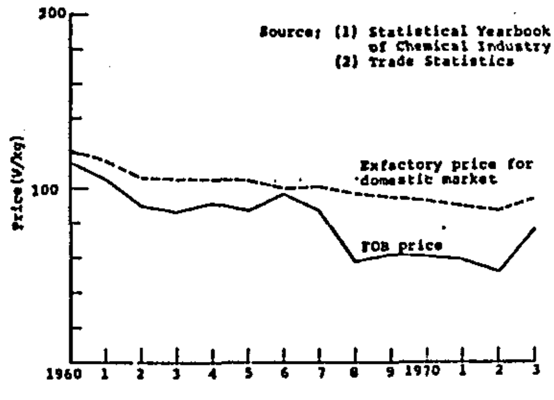


Figure 6 Comparison of Domestic Price and FOB Price in Japan (PVC)

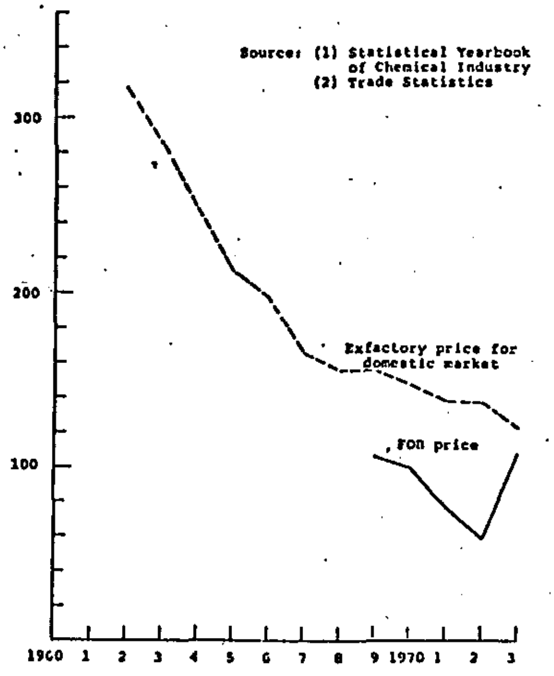


Figure 7 Comparison of Domestic Price and FOB Price in Japan (PP)

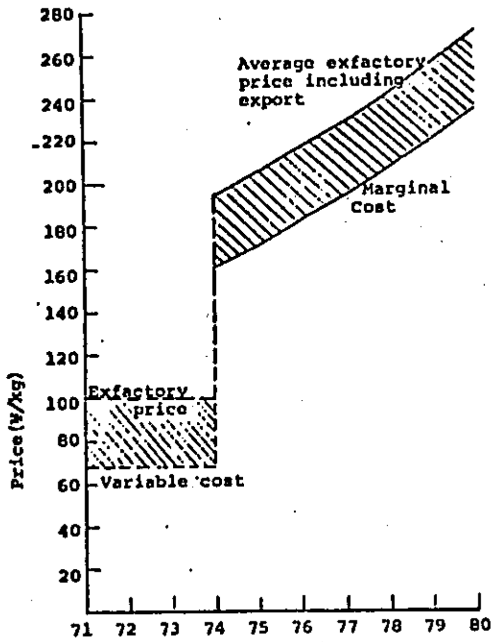


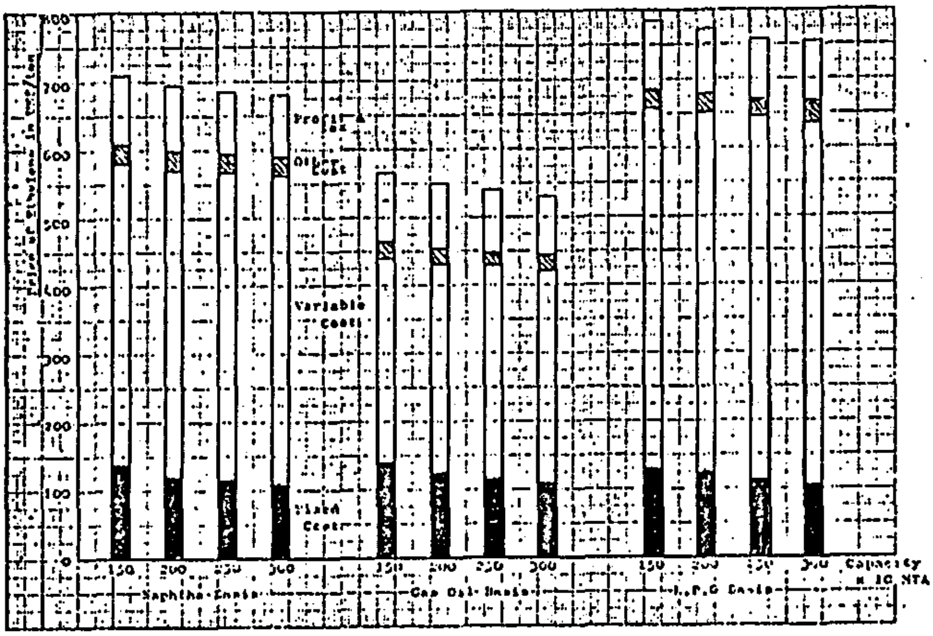
Figure 8 Exfactory Price and Marginal Price for LDPE

4.3 Production Economy

4.3.1 Comparison of Ethylene and LDPE Production by Different Raw Materials and Different Capacity - Comparison of Raw Materials

The production cost of ethylene by different raw materials is as shown in Figure 9. It is apparent that fixed cost in the production cost is a small portion when compared with the variable cost. This means that the construction cost which comprizes a significant portion in the fixed cost may be affected by the type of raw materials and plant capacity, but it does not greatly influence the production cost of ethylene. Therefore, evaluation of the variable cost items, especially the raw material price, will be essential.

Figure 10 shows the production costs of LDPE by different capacities and different prices of ethylene. The price of locally produced LDPE seems to be lower than the price of imported LDPE which includes 30% of import duty and other necessary levies and charges for importation. (The total percentage will be about 54% of imported CIF price)



Note 1) The price of Raw Materials for the estimation as follows

Naphtha	US$ 274/t
Gas Oil	US$ 211/t
L.P.G	US$ 350/t

Figure 9 Production Cost of Ethylene in the Philippines

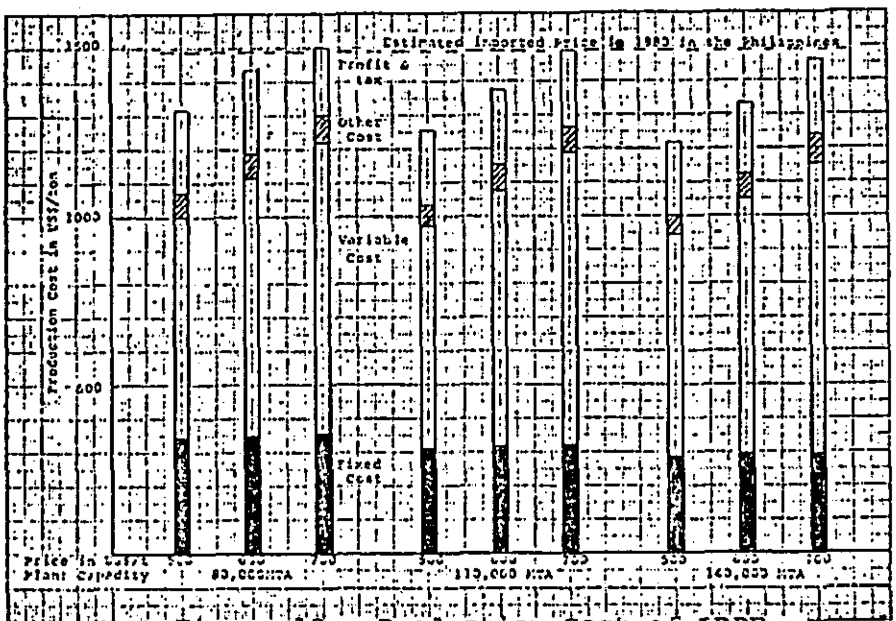


Figure 10 Production Cost of LDPE in the Philippines

However, as shown in Figure 11, in accordance with the hypothetical relations between the sales price and market size as described in the earlier part of this report, the market demand of 110,000 MTA may be kept by the price of raw materials as US$180/ton for gas oil and US$192/ton for naphtha respectively, both of which are lower than the estimated prices excluding Specific Tax.

Therefore, the price of raw materials or ethylene shall be determined by taking the expected market scale into consideration.

In view of the total national benefit, the price of raw materials shall be adjusted to a practical level with an adequate political preference within the framework of the expected national benefit.

As to LPG as a raw material for ethylene production, the required amount is not available indigenously in the Philippines. Nevertheless, the employment of imported LPG is more disadvantageous than other raw materials due to high transportation cost.

The price of naphtha in the Philippines is estimated as follows:

(1) The price of gasoline in the Philippines has been taken as the price of naphtha. Thus adopted price for naphtha is on a level higher than that normally applied in other countries.

(2) The Specific Tax on naphtha is the same as that on gasoline.

On the other hand, the levels of the price of gas oil and Specific Tax thereon are rather low when estimated from applicable prices and tax rates on kerosene and diesel oil. Gas oil is more advantageous than naphtha when these raw materials are compared with each other in terms of ethylene production. If the selection is whether naphtha or gas oil, gas oil is advantageous.

Further, gas oil still has an advantage over naphtha even when these are compared on the without-Specific-Tax basis. The prices of these two materials on this basis are estimated to be US$217/ton and US$193/ton respectively. However, when the technical aspects of the ethylene production are taken into consideration, naphtha would be for a much higher practical advantage, provided that there is no large price difference between the two.

The technology for applying heavy gas oil to petrochemical industry is not as yet established. Therefore, gas oil produced from an atomospheric unit has been tentatively used in this study. Even when using this atmospheric gas oil, detailed studies will be imperative before proceeding with the implementation of this project.

Either one of these two materials may be selected as the subject of study depending on their availability, provided that there is no significant difference in their prices.

In the case when wide capacity of LNG, from which necessary amount of condensates for ethylene production can be separated, is utilized in the Philippines, there is a possibility of producing ethylene from condensates.

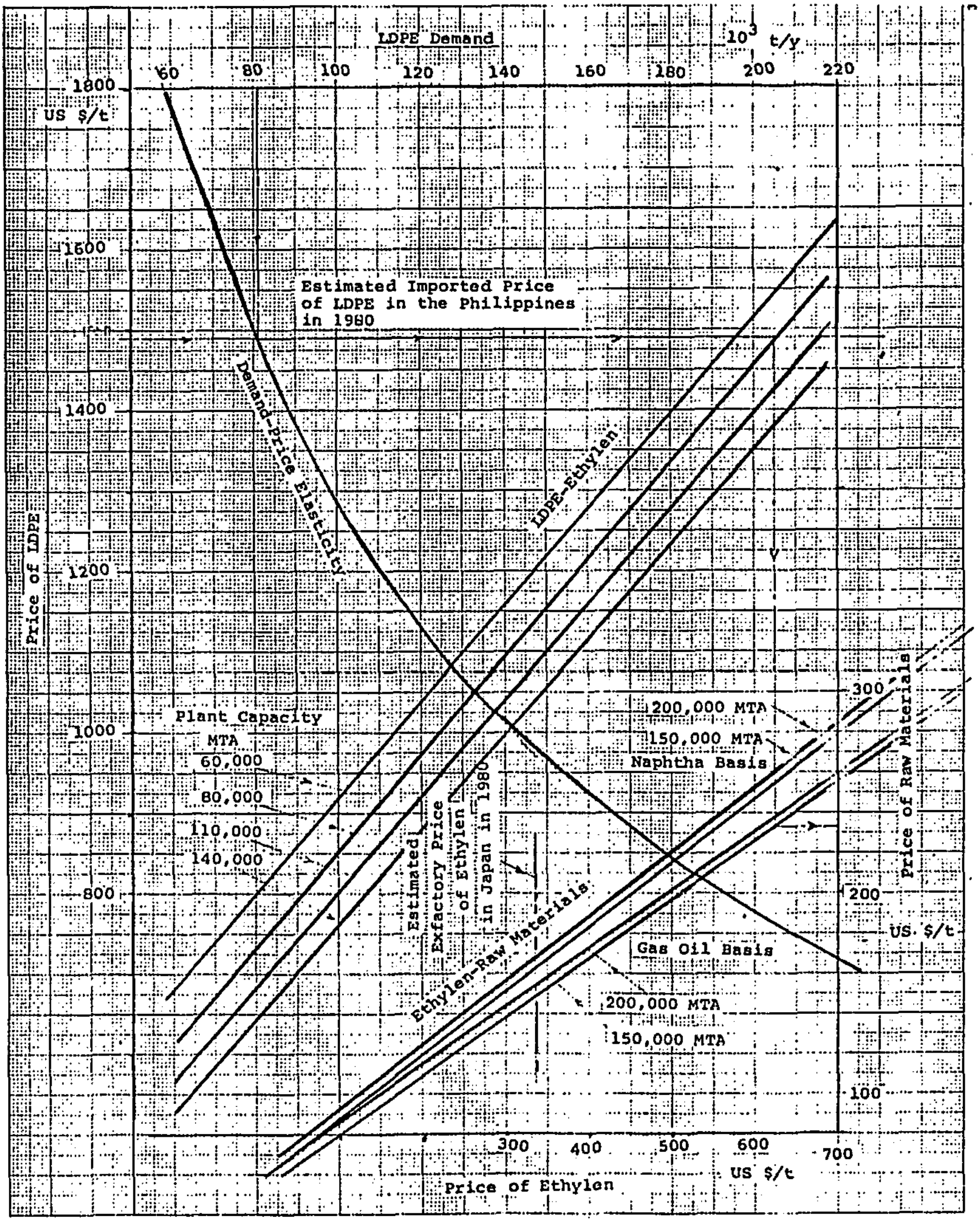


Figure 11 Relation between Price of Raw Materials and Ethylene and LDPE/Price Elasticity of LDPE Demand

The required amount of LNG will be about 2,000,000 t/y for the production of 200,000 MTA,and to utilize such an amount of LNG, almost unrealistic number of ammonia plants are required, which is far greater than the required capacity of fertilizer in the Philippines.

Therefore, the utilization of condensate from LNG is not necessary unless a drastic change should take place in the energy supply policies or in the demand for fertilizers.

4.3.2 Plant Scale and Production Cost

(1) World Trends in Production Capacity

The plant capacities of 50,000 t/y to 100,000 t/y for HDPE, 45,000 t/y to 280,000 t/y for LDPE and 40,000 t/y to 100,000 t/y for PP are reported to be the prevailing figures in the advanced countries.

The proposed plant capacities for the Philippines in Table 3, which are listed in the 7th Priority Plan by BOI, are small except the products of LDPE when compared with the production capacity now under planning in North America and Japan, although both countries have several exceptionally small plants.

Table 3 Olefins Plant Scale in the Philippines by the Priority Plan

Ethylene Plant*	185,000 MTA
Electrolysis Plant*	32,300 MTA as Chlorine
VCM Plant	54,600 MTA
PVC Plant	25,000 MTA
LDPE Plant	36,000 MTA
PP Plant	40,000 MTA

Note* Calculated from the down flow plant capacities.

(2) Plant Scale and Production Cost

As has been described in the foregoing clause, each of the proposed plants in the Philippines, except LDPE production plant, is of a comparatively small capacity on international standards, especially when compared with plants in advanced countries.

Table 4, which has been quoted from the results of the orientation study, shows the production cost of ethylene by plant capacity difference. The production costs are estimated on the plant capacity figures of 150,000; 200,000; 250,000; and 300,000 MTA. The costs are then classified into variable costs,fixed costs, and other costs.

Table 4 Production Cost of Ethylene on Different Capacities

cost in $/ton

Plant Capacity	150,000 MTA		200,000 MTA		250,000 MTA		300,000 MTA
Variable Cost	445	(-3)	448	(-3)	451	(-2)	453
Fixed Cost	134	(11)	123	(7)	116	(6)	110
Other Cost	29	(0)	29	(1)	28	(0)	28
Total Cost	608	(8)	600	(5)	595	(4)	591

Note 1) Naphtha has been selected as Raw Material
2) Price of Naphtha ; $274/ton
3) Figures in ( ) show the cost difference between the different capacity.
4) Operational rate; 100%

In the table, the variable cost increases as the plant capacity becomes larger. This is due to the evaluation of coproduct propylene. The price of propylene is evaluated as 0.8 times the prices of ethylene, and the price of propylene as well as price of ethylene will reduce as the plant capacity increases.

As a result, from the point of ethylene production, the deduction cost of by-products including propylene becomes low when the plant capacity increases.

Therefore, variable cost in the product of olefins shall be deemed to be the same at any plant capacity, and the difference shown in the table must not be taken into account. The cost difference in the "Other Cost" is almost nonexistent, and therefore the cost difference in the "Fixed Cost" is the only point to be discussed.

The cost difference of $25/ton between the fixed cost of production by the capacity of 150,000 MTA and 300,000 MTA, may appear as not-so-great a difference when the total production cost of ethylene is around $600/ton in the Philippines. (in 1980)

However, in the estimation, the price of raw material naphtha has been set at a level considerably higher than that in industrialized countries, and the portion of variable cost will be decreased when the raw material price is lowered to the level of that in advanced countries.

Further, internationally prevailing price of ethylene in 1980 has been estimated to be around $400/ton in the international market study.

Therefore, the cost difference by plant scale should not be *ignored in view of the effects of ethylene price to down flow olefin* industries.

Table 5 shows the difference of LDPE production cost, which is also quoted from the results of the orientation study.

The fixed cost portion in the total production cost is conparatively high for LDPE production, and the fixed cost difference of $70/ton between the production cost by plant capacity of 60,000 MTA and 110,000 MTA affects more seriously the production cost of LDPE at the internationally prevailing price level of $800/ton, than in the case of ethylene.

For maintaining an internationally competitive product prices, it may well be a possible scheme to construct one or two large-scale capacity plants for producing a limited variety of products.

Table 5 Production Cost of LDPE on Different Capacities

cost in $/ton

Plant Capacity	60,000 MTA		80,000 MTA		110,000 MTA		140,000 MTA
Variable Cost	765	(0)	765	(0)	765	(0)	765
Fixed Cost	384	(35)	349	(35)	314	(23)	291
Other Cost	74	(2)	72	(2)	70	(2)	68
Total Cost	1,223	(37)	1,186	(37)	1,149	(25)	1,124

Note 1) Price of Ethylene ; $600/ton
2) Figures in ( ) show the cost difference between the different capacity.
3) Operational rate; 100%

4.3.3 Relation between Plant Operational Rate and Plant Capacity

In evaluation project economics, the factor of operational rate is essential. The fall in the operational rates is mainly caused by market fluctuation, mechanical trouble, labor problems, power failure, shortage of raw materials, etc.

Maximum operational rate throughout a year is reported to be around 95% for petrochemical industries in Japan. In the case of fertilizer industries, average operational rate in developing countries is around 60%. Even in some advanced countries, such as France, U.K., etc., 70% to 80% operational rate is seen.

Table 6 shows the effects of operational rate on ethylene production.

The demerit in variable cost shall be ignored in the same manner as the case of 4.3.2, and the cost difference in fixed cost alone shall be considered to be the total production cost difference.

The cost difference of $50/ton between the production cost at operational rate of 100% and 66% is large even at the price level of ethylene of $600/ton, and further the cost difference becomes more serious at the estimated international price level of $400/ton for 1980.

A more obvious difference is present in the production of LDPE as shown in Table 7.

Table 6 Production Cost of Ethylene by Different Operational Rate

Bases: Plant Capacity - 300,000 MTA
Raw Material - Naphtha
Price of Naphtha - $274/ton

Cost in $/ton

Operational Rate *	100 %		83 %		66 %
Variable Cost	453	(-7)	446	(-10)	436
Fixed Cost	110	(20)	130	(30)	160
Other Cost	28	(1)	29	(2)	31
Total Cost	591	(14)	605	(22)	627

Notes: 1) The Operational Rates are selected to meet the production of 250,000 and 200,000 MTA.

2) Figures in ( ) show the cost difference between the different operational rates.

Table 7 Production Cost of LDPE by Different Operational Rate

Bases: Plant Capacity - 100,000 MTA
Price of Ethylene - $572/ton

Cost in $/ton

Operational Rate	100 %		80 %		60 %
Variable Cost	713		713		713
Fixed Cost	321	(72)	393	(120)	513
Other Cost	67	(4)	71	(6)	77
Total Cost	1,101	(76)	1,177	(126)	1,303

Note:1) Figures in ( ) show the cost difference between the different operational rates.

4.4 Price Competitiveness Comparison of Ethylene and LDPE

A price competitiveness comparison of LDPE in 1980 among potential export countries in the Asian region is as shown in Figure 12.

This comparison chart was made on a hypothetical basis as described in the "Basis for comparison" and in Table 8. This comparison is made for a case in which LDPE produced in the respective countries is shipped to Manila and imported in the Philippines.

As far as the results shown in the Fig. 11 are concerned, the price of LDPE produced in the Philippines is not significantly different (approx. 13%) from the case of a new plant in Japan.

However, it must be noted that the raw material (naphtha) price in the Philippines adopted for this calculation is US$222.-/ton (US$163/kl) in 1980 or equivalent to US$148.-/ton (US$108.-/kl) in present price which is the price of regular gasoline without Specific Tax.

The target price of LDPE which will be competitive in the regional market in 1980 is predicted to be US$907.-/ton (FOB Japan) or US$971.-/ton (CIF Manila). This target price is equivalent to the average price of LDPE produced in Japan.

However, this price is predicted under normal market conditions. Thus, even if the regional market in 1980 were seriously disturbed, particularly by excessive competition due to oversupply, Japan would still be able to bring down the export price, because of the dual price system; one for export and another for domestic market. The Japanese domestic price is normally higher than the export price, and the domestic consumption may occupy a major proportion (70% - 80%) of the total production. Further, in such a critical event, export-oriented petrochemical industry will be seriously affected because of its inability to absorb such deficits as have been caused by a market price lower than a normally produced price.

Basis for comparison

(1) Products and plant capacities

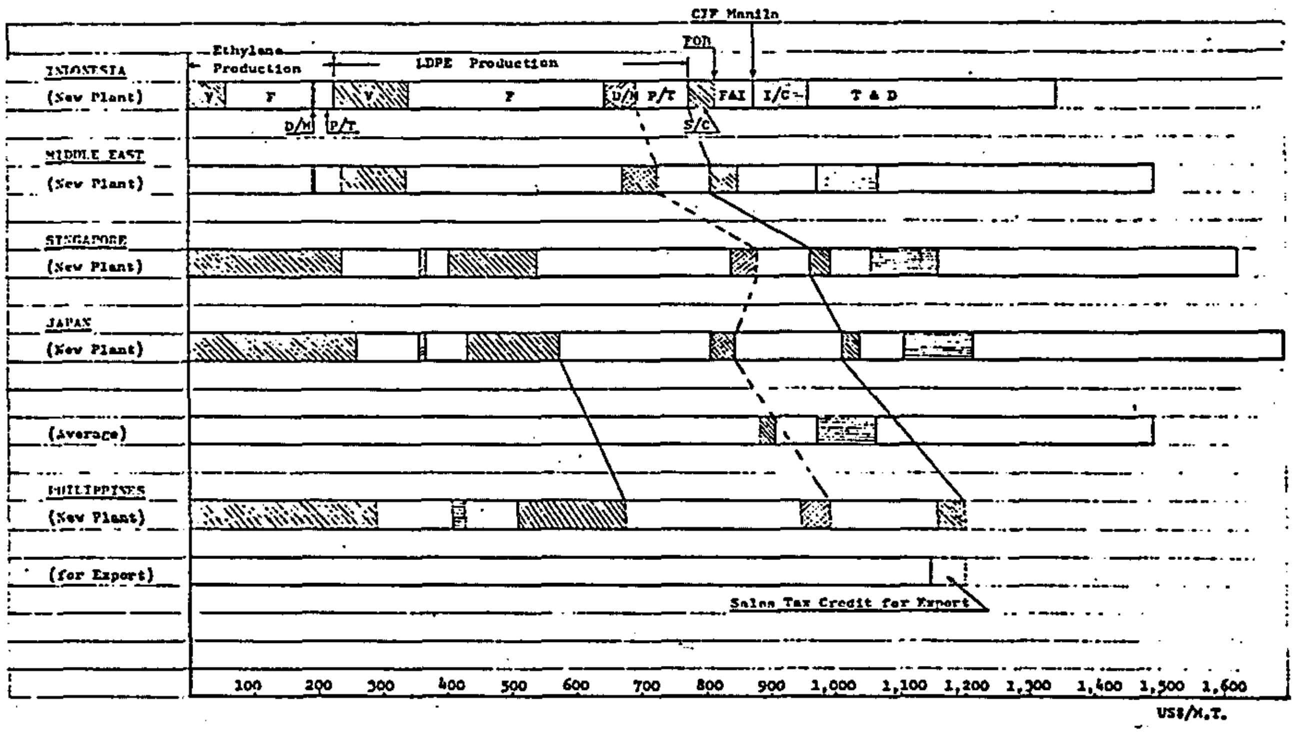
Regardless of the economical plant scale, the applicable plant scale is determined depending upon the marketability of the products therefrom. However, in this comparison, a naphtha basis ethylene plant with 300,000 MTA production capacity, and LDPE plant with 120,000 MTA production capacity are employed as a common base.

(2) Time of start-up and production cost comparison

The time of mechanical completion of the plant construction is assumed to be mid-1979. The production costs are compared on a 1980 basis.

(3) Inflation

As to the elements of production cost, inflation of 7% per annum is taken for the estimation of the future costs. However, the plant construction costs are estimated by taking into account the practical trends of recent costs.



Legends

V ; Variable Cost
F ; Fixed Cost
D/T ; Distribution & Administration
P/T ; Profit & Tax
S/C ; Shipping Charge
F&I ; Freight and Insurance Premium
I/C ; Importing Charge
T&D ; Tax and Duty

Figure 12 Price Competitiveness for Ethylene and LDPE

(4) Profit from ethylene production

In order to establish the delivered price of ethylene to the LDPE plant, adequate levels of return on investment are presumed for ethylene production.

For the Philippines, 10% of fixed capital per annum is assumed as annual return on investment in 1980. A calculated IRR of 15% in 1980 obtained from the D.C.F. computation is taken for other countries.

Table 8 Prerequisite Conditions for Comparison of Production Cost

	Indonesia	Middle East	Japan	Singapore	Philippines
Rate of Operation	85%	80%	95%	90%	90%
Raw Material	Light Gas Condensate	Light Gas Condensate	Light Naphtha	Light Naphtha	Light Naphtha
Price of Raw Material* $/MT	70	28.8	185	160	222
Fuel Price* $/MMKcal	FG60	FO2.26	FO9.52	FO9.24	FO16.8
Labour Cost* $/Year	2,500	4,500	10,500	2,900	3,920
Tax :					
Tax Holiday	5 years	5 years	-	1 - 5 y 0% 6 - 8 y 4% over 8 y 40%	***
Tax on Profit	45%	55%	53 - 54%	40%	35%
Tax on Capital & Insurance	1.4%	2.5%	1.7%	2%	2%
Interest :					
Long Term Loan	7.5%	7.5%	8%	9%	8.6%
Local Loan	12%	12%	10%	20%	18%
Project Life	10 years	10 years	9 years	10 years	15 years

* Estimated on the basis of 1980
** Guarantee fee 1%/year is included
*** Tax holiday on Sales Tax of average 50% and Tax Credit for expenses on investment.

5. Aromatics

5.1 Comments

At present in the Philippines, the demand for synthetic fiber raw materials is not high, as the production of synthetic fiber is still on a low level. However, a number of synthetic fiber production expansion plans are being made. By the time when these plans are embodied, the production capacity for polyester will have increased to 40,000 t/y to 60,000 t/y and the capacity for nylon to 15,000 t/y to 20,000 t/y. Thus produced synthetic fiber will be consumed only within the domestic market. Once the expansions are embodied, the production of synthetic fiber raw materials in general, monomers in particular, will become practicable.

The present exports of synthetic fiber products from the Philippines are still small; however, if the Philippine Government should carry out a positive policy to promote the exports of synthetic fiber products, the demand for synthetic fiber raw materials will certainly increase, and consequently the commencement of synthetic fiber raw materials production will be expedited. Further, even the BTX production may become feasible.

The feasibility of synthetic fiber raw materials production has been studied in this report, on the basis of a domestic demand forecast.

The foremost priority should be given to the production of p-TPA/DMT, among other synthetic fiber raw materials, for turning out polyester fiber in early 1980's by taking into account the growth of the domestic demand, and the potential for the development of an export-oriented textile industry.

The production of caprolactam for nylon is not considered to be a preferable project for early 1980's because of the insignificant domestic demand even then.

The lowest priority should be given to the production of p-xylene, a raw material for p-TPA/DMT, based on a reformate from naphtha. This is because of the possible rise in the production cost due to the higher price of raw materials and smaller scale of the production.

In view of international competition, the production of p-xylene at a scale of 50,000MTA is too small when compared with the existing plans for 200,000MTA to 330,000MTA in Taiwan and Indonesia. Further, if the p-xylene production is planned in Singapore, the plant capacity will most likely be on the same level as that of Taiwan and Indonesia. It may therefor be a better policy to delay the commencement of aromatics production, if the availability of p-xylene from foreign country is confirmed.

It is recommended that the Philippines conducts further studies as described hereunder, concerning the synthetic fiber and aromatics industries.

(1) Elaboration of the market study on the synthetic fibers and their raw materials, and other aromatic derivatives, especially taking into account the development of the textile production activities into an export-oriented industry.

(2) Study on the development of production of sunthetic fiber raw materials, i.e., p-TPA/DMT and caprolactam, and aromatics, i.e., B.T.X., cyclohexane, p-xylene, and o-xylene based on the market study above mentioned.

5.2 Demand Forecast and Prospect at Market

(1) Domestic Market

At present in the Philippines, the demand for synthetic fiber raw materials is not high, as the production of synthetic fiber is still on a low level (refer to Table 9).

Table 9 Manmade fiber consumption in the Philippines

(ton)

	1967	1968	1969	1970	1971	1972	1973
Nylon	2,627	5,639	7,278	6,086	11,331	10,807	12,977
Polyester	3,100	4,744	5,658	7,642	12,545	12,261	14,357
Acrylic	852	1,675	1,818	1,361	1,969	3,151	4,044
Other Synthetic	1,452	1,930	1,410	1,858	3,533	2,029	3,311
Synthetic Fiber Total	8,031	13,988	16,164	16,947	29,378	28,248	34,689
Regenerated Fiber	20,373	23,552	24,667	22,649	23,806	22,965	23,530
Other Manmade Fiber	2,344	4,857	5,193	4,664	7,819	5,758	6,487
Total Manmade Fiber	30,748	42,397	46,024	44,260	61,003	56,971	64,706

Source: Export Statistics of the Foreign Countries

However, a number of synthetic fiber production expansion plans are being made. By the time when these plans are embodied, the production capacity for polyester will have increased to 40,000 t/y to 60,000 t/y, and the capacity for nylon to 15,000 t/y to 20,000 t/y. Thus produced synthetic fiber will be consumed only within the domestic market (refer to Table 10).

Once the expansions are completed, the production of synthetic fiber raw materials in general, monomers in particular, will become practicable.

Table 10 Forecast on synthetic fiber demand in the Philippines

(ton)

	1973	1974	1975	1976	1977	1978	1979	1980
Polyester	15,872*	21,700	26,600	31,200	35,600	38,800	43,300	47,400
Nylon	14,346*	15,100	15,200	15,200	15,500	16,000	17,200	18,200
Acrylic	4,471*	5,300	5,700	6,000	6,300	6,800	7,100	7,300
Total	34,689*	42,100	47,500	52,400	57,400	61,600	67,600	72,900

* Synthetic Fiber "Others" are allocated to Polyester, Nylon, Acrylic.

(2) Future outlook of the market of synthetic fiber raw materials

Synthetic fiber raw materials are not polymers, but monomers. Therefore, the difference in producing processes or the difference in producers do not result in significant consequences in the characteristics or the properties of the monomers. It is not necessary to provide technical services at the time of synthetic fiber raw material sales unlike in the case of polymers such as polyolefins. Transportation of synthetic fiber raw materials is easier than polymer. Therefore, in this sense, synthetic fiber raw materials are more of international commodities than polymers are.

However, as has been described in the previous chapter, synthetic fiber raw materials, especially monomers, have no use other than as raw materials for synthetic fiber production. Therefore, they are not international commodities in the strict sense of the term, as the trade of synthetic fiber raw materials is not freely carried out.

One of the most important points in reviewing the future supply/demand situation is the influence of inflation caused by the oil crisis. It has been said that the growth of the fiber demand will decrease along with the progress of stagnation of the economy. Especially in developing countries, due to the increase in food expenses, it is forecast that the growth of the fiber demand will decrease along with the fall in textile expenses.

On the other hand, the world synthetic fiber production plans are scheduled to meet the expected demand increase in synthetic fiber which was projected before the days of oil crisis. If all these plans are embodied, synthetic fiber raw materials supply would be evidently in excess. However, due to the recession, it seems that some plans for producing synthetic fiber raw materials will be postponed. Now that some of the synthetic fiber production plans will be postponed and with a worldwide decrease in synthetic fiber demand forthcoming, synthetic fiber raw materials will not be in short supply for some years to come.

(3) Synthetic fiber raw materials in Southeast Asia

The largest synthetic fiber producing country in Southeast Asia is Japan. A number of synthetic fiber producing companies in Southeast Asia are somehow related to Japanese enterprises.

Japan's share figures of synthetic fiber and synthetic fiber raw materials producing capacity in Southeast Asia are as follows.

Synthetic Fiber	80%	1,533.6	10^3 t/y in 1973
Caprolactam	100%	469	" " "
p-TPA/DMT	94%	775	" " "

As shown above, Japan has the dominating majority of the share. In the future, Japanese share will decrease year after year; however, Japan will still keep the majority of the share for some time to come.

Therefore, supply/demand situation of synthetic fiber raw materials in Southeast Asia will be highly influenced by the Japanese synthetic fiber industry. However, the share of the oil producing countries in BTX, p-xylene and cyclohexane market will increase by the end of the 1970's.

(4) Influence of international situation on the Philippine synthetic fiber industry

The Philippines will increase synthetic fiber production, even if some delay in start-up of new plant may happen. Along with the increase in synthetic fiber production, the Philippines will import monomers instead of synthetic fiber FY and SF.

1) Raw materials for polyester

In the next two or three years, the demand for raw materials for polyester will not attain a level of minimum economic size of polyester monomers production. During this period, the Philippines will be able to import p-TPA/DMT easily. However, the demand for p-TPA/DMT will increase to about 50,000 t/y by the end of the 1970's, a figure which warrants the minimum economic size for producing p-TPA/DMT in the Philippines. Therefore, it may be feasible to produce p-TPA/DMT by importing p-xylene as raw material.

Two processes are considered to produce p-TPA/DMT, one is to import p-xylene and the other is to produce BTX from naphtha. The selection between the two must be finalized by taking into consideration the availability of naphtha or p-xylene and the utilization potential of product benzene and toluene.

2) Raw materials for nylon

For the production of caprolactam, much larger investment is required than in the case of the p-TPA/DMT production. Further, when producing caprolactam, a large amount of ammonia and sulfuric acid is required, and a large amount of ammonium sulfate is by-produced. Therefore, production cost of caprolactam is higher than that of p-TPA/DMT.

As synthetic fiber, the share of nylon for textile use is being taken over by polyester. Therefore, caprolactam expansion plans are less in number than that for p-TPA/DMT, and it is estimated that caprolactam supply will tend to be less than p-TPA/DMT.

Demand for caprolactam in the Philippines is estimated at about 20,000 t/y in 1980. This amount is not considered to be ample to produce caprolactam economically from imported or domestically produced benzene. On the other hand, the import of caprolactam will become more difficult than that of p-TPA/DMT. Therefore, it may become necessary for the Philippines to investigate into the feasibility of caprolactam production in collaboration with the neighboring countries.

5.3 Production Economy

The feasibility of synthetic fiber raw materials production has been studied in this report, on the basis of a domestic demand forecast.

The production economics has been studied for the following cases:

(1) Production of synthetic fiber raw materials based on imported intermediates, i.e., cyclohexane and p-xylene.

(2) Production of aromatics and synthetic fiber raw materials based on domestic raw materials, i.e., naphtha and pyrolysis gasoline.

The production scale of caprolactam and p-TPA/DMT is tentatively established as 30,000 MTA and 70,000 MTA (as p-TPA) respectively based on the demand projection in the Philippines. The production scheme for the aromatic production is prepared to supply the required amount of the intermediate for synthetic fiber raw material production as shown in Figure 13.

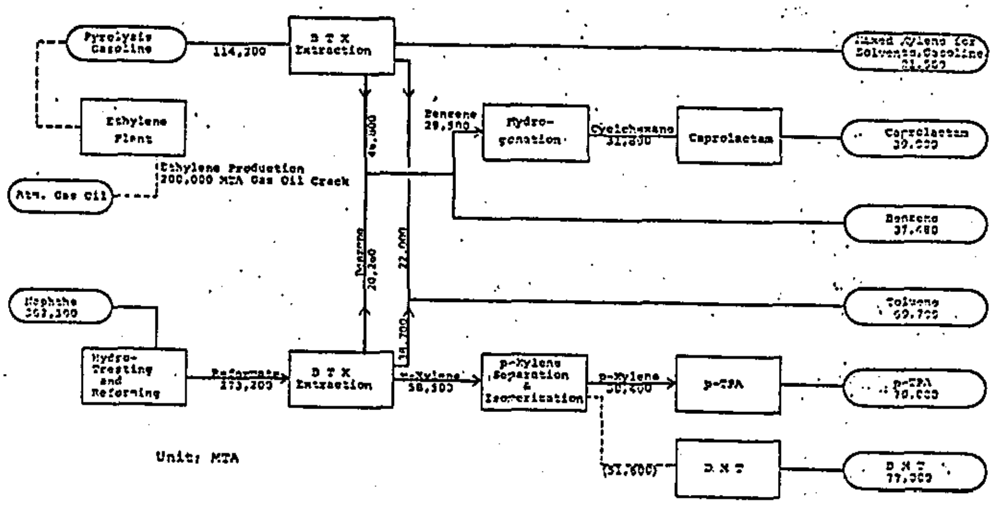


Figure 13 Production Scheme for Caprolactam p-TPA/DMT Based on Domestic Raw Material

The production economics based on imported intermediates is shown in Tables 11 and 12.

Table 11 Prices of Caprolactam and Raw Materials based on Imported Cyclohexane

Cyclohexane	591 $/MT
Ammonia	305
Sulfuric Acid	76
Ammonium Sulfate	171* (179)
Produced Caprolactam	1,661
Imported Caprolactam	1,646

Note: * indicates the price excl. sales tax, and values in ( ) are the price incl. sales tax.

Table 12 Prices of p-TPA/DMT, Raw Materials based on Imported p-Xylene, Methanol, Acetic Acid

p-Xylene	720 $/MT
Methanol	442
Acetic Acid	610
Produced p-TPA	1,184
Produced DMT	1,357
Imported p-TPA/DMT	1,546

The relation of the price of raw materials and exfactory product price is shown in Figure 14 for p-TPA/DMT production, and in Figure 15 for caprolactam production. The production economics based on the price of naphtha including Specific Tax is shown in Table 13. It seems likely that there is no possibility of production based on the naphtha price including Specific Tax.

Table 13 Prices of Aromatics and Raw Materials of Domestic Supply Based on the Price of Naphtha Including Specific Tax

Naphtha	$274/t	p-Xylene	$1,723/t
Reformate	$364/t	p-TPA	$2,014/t
Mixed Xylene	$1,140/t	DMT	$2,130/t
Benzene	$495/t		

Table 14 shows the allowable prices of intermediates and naphtha for the domestic production of p-TPA/DMT to be competitive against imports.

Figure 14 Effect of the Price of Raw Material on Exfactory Price of Products (1)

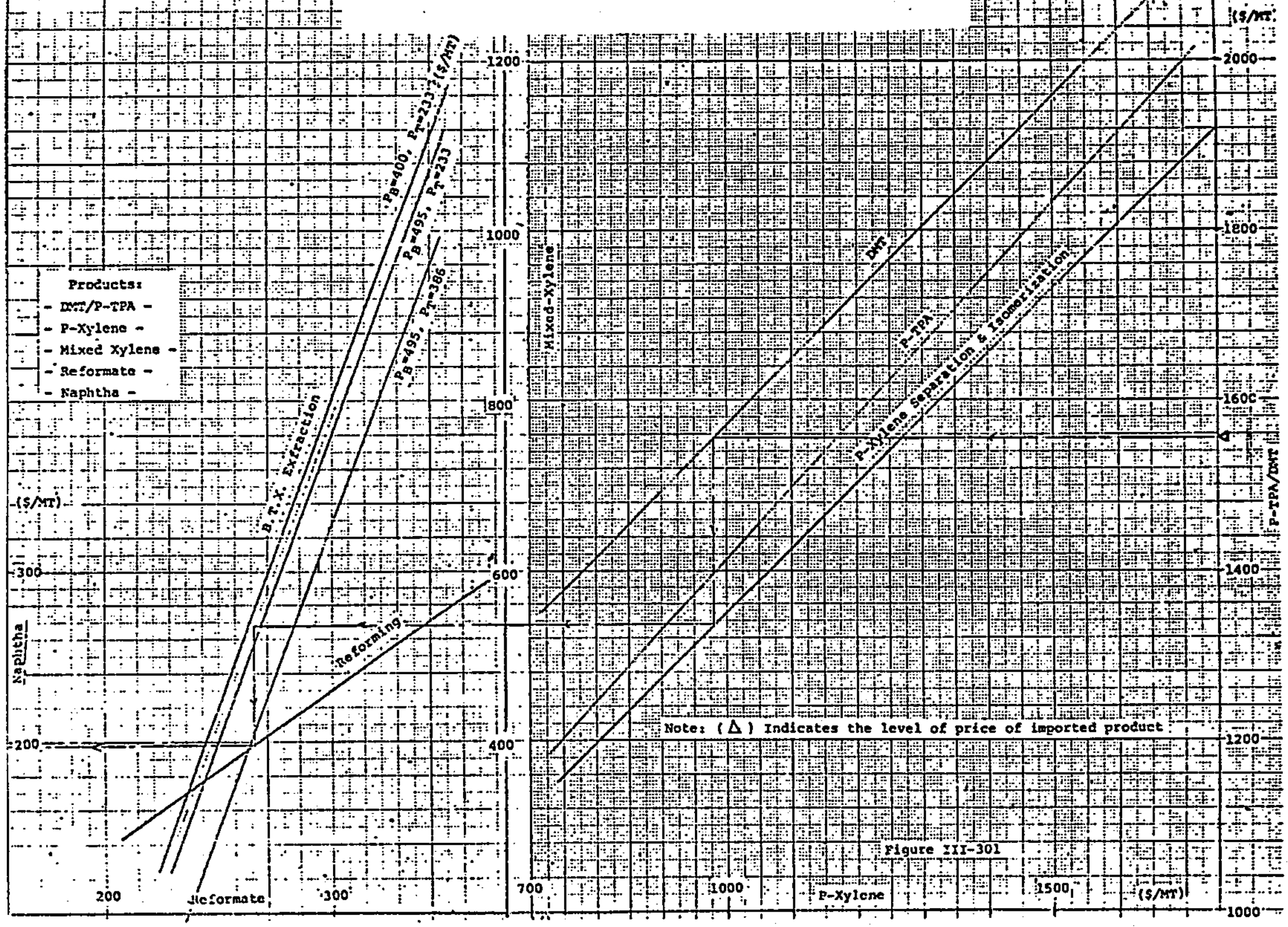


Figure 15 Effect of the Price of Raw Material on Exfactory Price of Products (2)

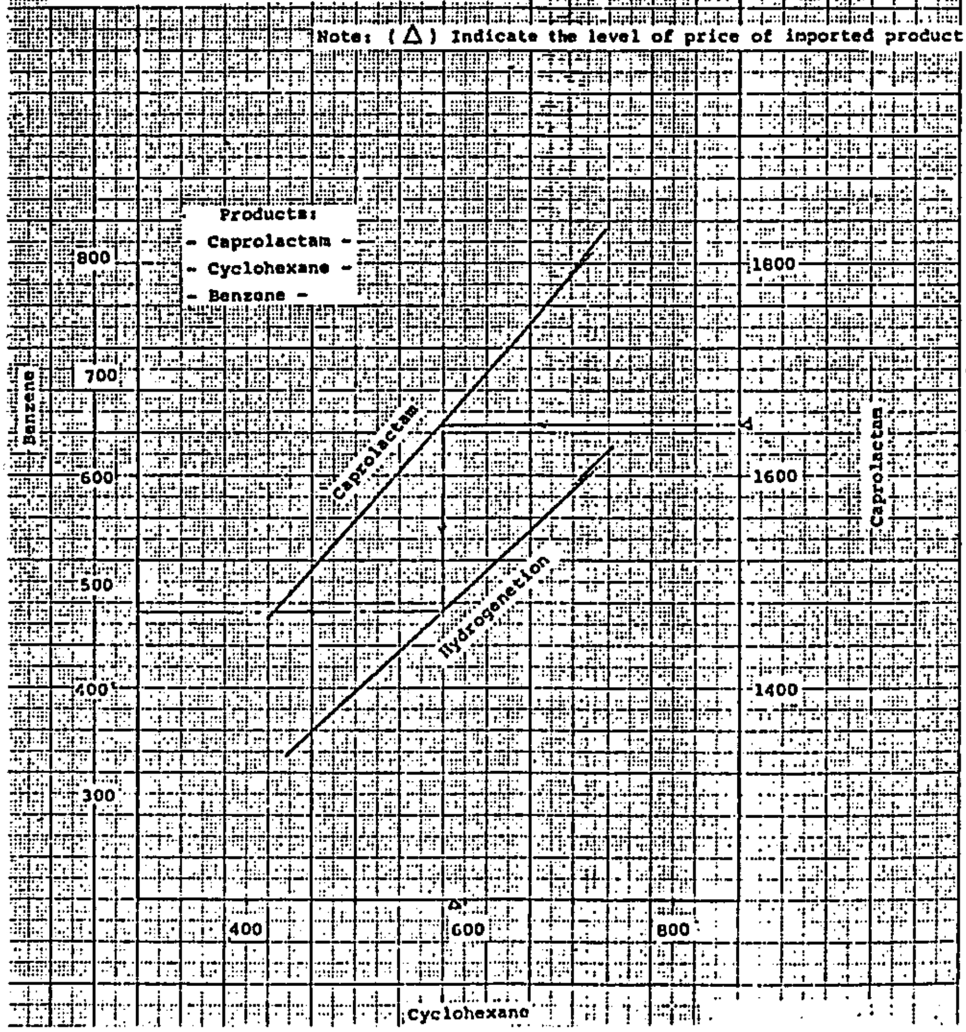


Table 14 Prices of Aromatic Intermediates and Naphtha for the Production of p-TPA/DMT Competitive against the Imports

Competitive price against imports		Remarks
Naphtha	$198/t	
Reformate	$254/t	
m-Xylene	$535/t	
Benzene	$470/t	The allowable prices for caprolactam production.
p-Xylene DMT*	$980/t	

Note *) DMT is a selected representative of p-TPA/DMT for the evaluation of the price if naphtha, because of its higher production cost than that of p-TPA

The foremost priority should be given to the production of p-TPA/DMT, among other synthetic fiber raw materials, for turning out polyester fiber in early 1980's by taking into account the growth of the domestic demand, and the potential for the development of an export-oriented textile industry.

The production of caprolactam for nylon is not considered to be a preferable project for early 1980's because of the insignificant domestic demand even then.

The lowest priority should be given to the production of p-xylene, a raw material for p-TPA/DMT, based on a reformate from naphtha. This is because of the possible rise in the production cost due to the higher price of raw materials and scale of the production.

In view of the international competition, the production of p-xylene at a sclae of 50,000 MTA is too small when compared with the existing plants for 200,000 MTA to 330,000 MTA in Taiwan and Indoensia. Further, if the p-xylene production is planned in Singapore, the plant capacity will most likely be on the same level as that of Taiwan and Indonesia. It may therefore be a better policy to delay the commencement of aromatics production, if the availability of p-xylene from foreign country is confirmed.

It is recommended that the Philippines conduct further studies as described hereunder, concerning the synthetic fiber and aromatics industries.

(1) Study on the synthetic fiber industry in the Philippines, especially for the development of the Philippines' textile production activities into an export-oriented industry.

(2) Study on the optimum feasible measures for the procurement of synthetic fiber raw materials by taking into consideration of the establishment of an export-oriented synthetic fiber industry.

6. Nitrogenous Fertilizer

6.1 *Comments*

It is forecast that nitrogenous fertilizers will turn to oversupply from the last half of the decade of the 1970's and the first half of the 1980's. The presently prevailing abnormally high level of fertilizer price will gradually fall from the present point towards future. However, in the Philippines, demand corresponding to the capacity of a 1,000 t/d ammonia plant is forecast to emerge by 1980. Therefore, the necessity for constructing a large-scale fertilizer plant in the Philippines does not diminish. An extermely unstable situation will result in the fertilizer supply, and eventually in the food supply within the country, if more the majority of the domestic fertilizer demand should continue to depend on import supply for a long time.

The results of the foregoing discussion will be concluded as follows:

(1) The construction of a large-scale fertilizer plant within the Philippines at the earliest possible time in the future is significant in view both of economic viability and national benefit to the country.

(2) The imported naphtha or domestically available fuel oil shall be selected as the subjects of choice as the raw materials for fertilizer production.

It will be seldom that the problems pertaining to the raw materials for fertilizer production should affect the planning of the refineries and petrochemical projects. The reason is that the allocation of domestically available naphtha for fertilizer production will be disadvantageous in view both of quantitative availability and economic viability. Therefore, the remaining problems are to confirm whether the domestic fuel oil is amply available in quantity and what is the price of such fuel oil.

Therefore, the Consultant recommends that a detailed feasibility study be commenced as soon as possible for the implementation of the fertilizer project independently from the petrochemical project. The recommended feasibility study for this fertilizer project should include such items as enumerated hereunder.

(1) Demand forecast of nitrogenous fertilizer in the Philippines

(2) Determination of production capacity and types of nitrogenous fertilizer

(3) Selection of feedstock for ammonia production

(4) Detailed estimation of capital requirement

(5) Selection of the plant location considering production cost and distibution cost on the various condidate site

(6) Establishment of project management systems

(7) Establishment of marketing and distribution systems for nitrogen and other types of fertilizer in the Philippines

(8) Evaluation of financial and economic rate of return and national economic benefit on the project

6.2 Demand Forecast and Prospect of Market

6.2.1 Domestic Market

(1) General

In consideration of important facts such as high population growth rate which exceeds by far the annual growth rate of rice production, a great number of agricultural population, etc., the improvement of agricultural production is no doubt a truly essential objective of a nation.

A brief status of major agricultural products are as follows:

Rice-

Rice is consumed by 80% of the total population as the main diet, and comprises about 50% of the total food crop area. However, when compared with international standard, or even with other Asian countries, the productivity is still on a far lower level.

Corn-

Corn is consumed by 20% of the total population, however, like the case of rice, the national average productivity of corn is till extreamly low.

Coconut-

As the third largest crop by area following only rice and corn. The coconut crop area has been rapidly expanding supported by favourable international market situation. However, the production technique improvement on the part of small plantation holders seems imperative.

Sugar Cane-

Although crop area for sugar cane is far smaller than that for the above three major crops; however, the benefit rate per unit area is higher than any other crops. However, no great expansion in the export seems possible in the future.

(2) MASAGANA 99 Rice Production Program

It is remarkable that, in spite of low productivity of rice, the HYV extention ratio is extremely high. This implies that the improvement in the productivity of rice cannot be materialized by merely introducing high yield varieties, and that harmonization of overall yield improvement technology including fertilizer application is imperative for the attainment of the purpose. Therefore, it is strongly hoped that the MASAGANA 99 Program will be implemented without termination under proper supervision and assistance by the Government.

(3) Fertilizer Consumption

Fertilizer consumption in 1972 and 1973 in the Philippines is as shown in Table 15 and 16. The repid growth is recorded for the period from 1969 onwards, and the average annual growth rate for the period of 1960/74 is 9%. However, due to the hike in the fertilizer price in the international market, the present fertilizer price seems to be rather discouraging for fertilizer consumption to further grow, despite the governmental privilege in fertilizer price for food crops and the governmental support price of ₱40/50 kg of paddy.

Table 15 Typewise and Sectorwise Fertilizer Consumption in 1972 and 1973

(tons)

	1972			1973		
	Food Crops	Commercial Crops	Total	Food Crops	Commercial Crops	Total
Urea	75,000	105,000	180,000	71,500	87,300	158,800
Ammonium Sulfate	40,000	80,000	120,000	66,881	101,019	167,900
T S P	-	8,000	8,000	-	-	-
KCl	-	64,000	64,000 (K_2SO_4 2,000)	-	57,100	57,100
18 - 46 - 0	-	45,000	45,000	5,000	41,800	46,800
16 - 20 - 0	20,000	20,000	40,000	34,512	20,538	55,050
14 - 14 - 14	22,000	23,000	45,000	30,703	21,222	51,925
12 - 24 - 12	10,000	5,000	15,000	7,400	1,100	8,500
12 - 12 - 12	8,000	2,000	10,000	23,143	1,672	24,815
10 - 5 - 20	-	3,000	3,000	4,092	6,398	10,490
Total	175,000	355,000	530,000	243,231	338,149	581,380

Source: FIA

Table 16 Typewise and Sectorwise N Consumption

(N 10^3 ton)

	1972				1973			
	Food Crops	Commercial Crops	Total	(%)	Food Crops	Commercial Crops	Total	(%)
Urea	34.5	48.3	82.8	(63)	32.9	40.2	73.1	(53)
Ammonium Sulfate	8.4	16.8	25.0	(19)	14.1	21.2	35.3	(26)
Compound	8.5	15.6	24.1	(18)	14.8	14.7	29.5	(21)
Total	51.4	80.7	131.9	(100)	61.8	76.1	137.9	(100)

Source: Table AIII - 205

(4) Future Prospect of Fertilizer Consumption

Among numbers of fertilizer demand forecast, USAID/TVA report is a forecast which is based on a detailed analysis. Forecast figures in the above USAID/TVA report is as shown in the attached Table 17.

When adjusted in the possible crop area and fertilization area on the forecast figures in the USAID/TVA report according to MASAGANA 99 Program for rice and for other crops by corrected estimates, nitrogenous fertilizer consumption in the year 1980 is as shown in Table 18. Regarding the two commercial crops (i.e., coconut and supar cane) and other crops shown in this table, the figures seem to be reasonable; however, concerning the figures for palay and corn, the estimates seems to be considered optimistic.

Table 19 shows conservative figures after further adjustment by several corrections and up-dating on the estimated fertilization area, crop requirements, etc. However, it must be noted that the figures in the Table 19 do not take into account any constraints caused by tight supply and abnormally high price of fertilizers.

Table 17 Fertilizer Demand Projection by USAID/TVA

(Nutrient ton)

	N	P_2O_5	K_2O
1971	127,883	41,742	53,836
1972	138,799	45,466	57,881
1973	149,340	49,172	61,740
1974	160,707	52,984	65,766
1975	171,972	56,846	69,796
1980	238,000	85,000	100,000

Source: The Fertilizer Industry in the Philippines, USAID/TVA

Table 18 N Demand Projection in 1980

	Crops Area (10^3 ha)	% Fertilized	Fertilized Area (10^3 ha)	N Dosage (kg/ha)	Consumption (N ton)
Palay	3,200	69	2,208	80	176,640
Corn	2,400	63	1,512	40	60,480
Sugar Cane	450	91	410	120	49,200
Coconut	2,800	4	112	40	4,480
Other Crops	1,100	29	319	80	25,520
Total	9,950	46	4,561	69	316,320

Table 19 Modified N Demand Projection in 1980

	Fertilized Area (10^3 ha)	N Dosage (kg/ha)	Demand (N ton)
Palay	2,000	80	160,000
Corn	1,000	40	40,000
Sugar Cane	410	120	49,200
Coconut	112	40	4,480
Other Crops	319	80	25,520
Total	3,841	73	279,200

6.2.2 Preliminary View of International Market and Its Influence on the Philippines Market

From 1973 onwards, the fertilizer demand in the world suddenly increased owing to the urgent necessity for food production increase, caused by the abnormal climate during the previous year. However, the supply or the operational rate of production facilities failed to grow for various reasons including the effects of the oil crisis which took place in the Autumn of 1973. This being the case, the stocked fertilizer altogether went to the market. From 1974 onwards, the fertilizer prices kept increasing because of the clear manifestation of long-term and global fertilizer shortage, repeated price increase for crude oil, and progress of inflation. The present fertilizer price level is six times as high as the lowest level record in 1971.

Such a situation naturally gave incentive for fertilizer production plant construction for both fertilizer exporting and importing countries. At present, a number of construction projects have been and being announced in various parts of the world. According to TVA's Statistics, the total capacity figure of the fertilizer production plants, which are being constructed or projected to be constructed, amounts to 34,139,000 N tons which corresponds to 54.7% of the existing production capacity as of the end of 1973. In other words, the secondary fertilizer plant construction boom seems to be forthcoming.

However, because new construction of a plant will normally require three to four years until completion, fertilizer short supply will continue for another two years, i.e., until 1976. From 1977 onwards, when a number of newly constructed plants start operation, the balance will turn towards an obvious ease. Then, from 1978 onwards, a number of new plants will go into full production operation, thereby again inviting surplus capacity and consequential oversupply of fertilizers.

In this respect, the Consultant maintains that short supply will not emerge for at least tow to three years after 1980.

Regarding the nitrogen demand and supply balance in Southeast Asis, the following points are worthy of attention. Including the Philippines, all the countries in the Southeast Asian area are so-called agricultural countries. The fertilizer consumption in this area has been growing over the past six years at a rate as high as average 18% per year. In spite of this, the number of fertilizer manufacturing plant in this area is small in scale.

Therefore, until today, this area has been an import region into which a considerable extent of fertilizers has been supplied from outside. Of these countries, Indonesia, Malaysia and Burma have natural gas resources. A number of fertilizer plant construction projects are being established or contemplated in these countries.

Nevertheless, the Consultant maintains that supply shortage will take place within the region by 1979/80 period, thereby necessitating partial importation. However, if all the presently publicized plant construction projects should be implemented on schedule, self-sufficiency status will be attained for the period after 1980/81.

The forecast has assumed that one 1,000-ton NH_3 plant will be constructed inside the Philippines.

Regarding the type of fertilizer in world production, the popular types of nitrogenous fertilizers are, urea, ammonium sulphate, and

ammonium nitrate. Of these, the production of urea in particular has lately been showing an increase year after year.
The present rate of urea comprized in the total nitrogenous fertilizer production is 30%; however, it is forecast that the rate will grow to 36% by the year 1978. The urea production rate is particularly high in the Asian Region where it is expected that the rate will be as high as 67%. This is due to the lower production cost of urea and the suitability to paddy field application.

The present price level of urea on a FOB basis in the world varies according to the origin. Japanese urea is quoted at around US$300/t, while $350 and $400 approximately are being priced for West Europe and East Europe urea respectively. It is clear that the present price level is abnormally high, although the extent of shortage in supply is not necessarily great.

In this respect, the Consultant's opinions are as follows:

(1) Short supply conditions will persist for approximately two years. The price will slightly increase in proportion to the extent of shortage. In view of the already abnormal present level, no vast price increase is likely. Thus, the price will maintain a plateau for another two years to come.

(2) By 1977, a number of newly constructed plants will be put on-stream and they will go into full production during 1978 when some oversupply may take place. Therefore, the fertilizer price will soften around 1978 and then will show a gradual fall.

(3) The expected oversupply from 1978 onward will not be as vast as the one emerged during the last half of 1960s decade; however, the condition may persist for at least four to five years because of operational rate improvements, etc. Therefore, the price will show a gradual decrease; however, the level will never reach the production cost. An eventual stability of price level will be attained at a production-cost-plus-adequate-profit (marginal price level).

(4) The Consultant forecasts the future FOB Japan price of urea as follows, while assuming a 7% annual inflation factor.

1976	US$330.00
1980	US$200.00
1982	US$220.00

Regarding the subject of the influence of future prospects of world market on the Philippines, the following points are raised by the Consultant.

It is estimated that the world nitrogenous fertilizer demand and supply balance shows at present a supply shortage of approximately one million N tons, or 2.6% of the total estimated production, and it is expected that this shortage will persist for about two years to come. Thereafter, a slightly oversupply period will last for four to five years. Thus, on an assumption that a new plant is to be constructed in the Philippines, the completion of the plant will be made sometime around the commencement of the oversupply period.

Nevertheless, as far as the demand supply forecast within Southeast Asia alone is concerned, an equilibrium of supply and demand will almost be attained if all the presently announced plant projects (eight plants) were to be implemented as scheduled. A project for constructing a plant of 1,000 NH_3 ton/day capacity in the Philippines is included within the scope of these eight plants. Therefore, no problem will be present regarding the implementation of the construction of this plant in the country in view of the fertilizer production amount consideration.

The 1980 price level will be stabilized on a level around US$200 /ton FOB Japan. Thus, the C&F Philippines price will be approximately US$230/ton. Therefore, if the 'production-cost-plus-adequate-profit price (marginal price) of the products to be turned out from the newly projected plant is estimated to be lower than this C&F price level, prompt decision should be made concerning the finalization of the plant construction project. If estimates show a marginal price level higher than the C&F price, further careful studies should be conducted in view of the national benefit aspect of the project implementation.

6.3 Fertilizer Industry in the Philippines

It is forecast that nitrogenous fertilizers will turn to oversupply from the last half of the decade of the 1970's and the first half of the 1980's. The presently prevailing abnormally high level of fertilizer price will gradually fall from the present point towards future.

Even if such a forecast is valid, the necessity for consturcting a large-scale fertilizer plant in the Philippines does not diminish. An extremely unstable situation will result in the fertilizer supply, and eventually in the food supply within the country, if more than the majority of domestic fertilizer demand should continue to depend on import supply for a long time.

The taxation systems on raw materials for fertilizer are artificially enacted institutions and are subject to alteration by the effects of fertilizer policies, etc. Therefore, when comparing advantage rating of various raw materials, the comparison should be made after subtracting miscellaneous taxation factors. The raw material-wise urea production cost with 10% ROI based on the raw material price without miscellaneous taxation factors canbe stated as follows:

Urea Production Cost

Raw Materials Prices in $/ton			Urea in $/ton
Imported naphtha	:	160	224
Domestic naphtha	:	217	260
Imported L.P.G.	:	270	285
Domestic fuel oil	:	131	249
Imported crude oil	:	133	243

The imported LPG involves high level of transportation cost (cryogenic vessels to be employed for the transportation), thereby affecting its economical viability. This material also lacks the stability in supply. Therefore, imported LPG should nog selected as the main raw material for the operation of large-scaled fertilizer plant in the Philippines.

There is a certain extent of doubt as to the quantity of supply of domestic naphtha if it is to be employed as the raw material for fertilizer production. The economical viability of this material is also inferior to the imported naphtha. Therefore, the domestic naphtha should be regarded as a supplementary raw material for the production of fertilizer and should be employed as and when any domestic naphtha surplus becomes available.

The imported crude oil seems to be considerably advantageous in view both of economy and supply stability for use as the raw material for fertilizer production.

However, if it is possible to utilize the domestic fuel oil amply in quantity as a raw material for fertilizer production, it is more recommendable that the domestic fuel oil be employed in view of the national benefit considerations. This means that the crude oil should be used as a feed for refining, and the fuel oil produced from the refineries should be used as the fertilizer raw material in order to enhance the efficiency of crude oil utilization.

The international price of urea, which has been estimated from international demand/supply conditions, is US$230/t CIF Manila in 1980. In comparison with the above price, the production of fertilizer on imported naphtha and domestic fuel oil on the basis of 100% operational rate show a promising result. Therefore, establishment of a large-scale fertilizer plant will contribute to the national benefit, although some governmental subsidies will be necessary for the industry.

As is evident from the forgoing, it is recommended that further detailed study be made concerning the imported naphtha and domestic fuel oil as the major raw materials to be fed into a large-scale fertilizer plant.

ANNEX I

PRELIMINARY VIEW
OF
OLEFINS PRODUCTION

ANNEX I PRELIMINARY VIEW OF OLEFINS PRODUCTION

1. Preliminary View of Domestic Market Prospects in the Philippines

1.1 Forecast Demand of Plastics Estimated by BOI

Past and forecast demand of general-purpose plastics in the Philippines estimated by BOI is shown in Table AI-1

1.2 Current Problems of the Market

Demand of plastics is decreasing considerably not only in the Philippines but most of the countries in the world. Reasons for demand decreases of plastic raw materials are as follows:

(a) Demand decrease of plastic products due to deterioration of household economy by the aggravation of the inflation

(b) Dilation of inventory of plastic raw materials and processors' hesitancy in purchasing raw materials, and,

(c) The intrinsic decrease of plastic demand due to price increase

Of the reasons described above, (a) and (b) seem to be passing phenomena, and the former will recover by future increase in wages, cash earnings of farmers at harvesting, etc. Concerning the latter, the importers' inventories of raw materials is said to have expired already, and are being shifted from factory to factory for cashing. The inventories of most of the processors is expected to be normalized within a few months except in the case of larger firms.

The problem is price increase in plastic raw materials due to the sudden rise in the oil price. The demand decrease caused by price rise is not expected to be easily recovered.

Table AI-2 and Figure AI-1 show trends of apparent consumption of general-purpose plastics since 1969 to the second quarter of 1974. The apparent consumption is estimated on the export statistics of major countries, e.g., Japan, the USA, West Germany, and Hong Kong, which altogether are considered to comprize more than 90% of the total exports to the Philippines. For PS and PVC, the sales quantity of domestically produced raw materials was added.

Figure AI-1 shows a rapid decreases in apparent consumption of each item of plastics in the second quarter of 1974. For instance, a 40% decrease was displayed from the same quarter of 1973 for PE, 45% for PS, 43% for PS, and 25% for PVC. This trend will continue for another one or two quarters.

On the other hand, as shown in Table AI-3 and Figure AI-2, prices of plastic raw materials increased quite drastically. However, price of plastic raw materials will maintain the same level as that of the second quarter of 1974 for the time being.

Table AI-1 . Past and Future Trend of Plastics Demand in the Philippines Estimated by BOI

Past Demand [1)]

	P E Total	LDPE	HDPE	P P	PVC
1962	1206			2062	3107
1963	2905			2848	3693
1964	2934			3959	4857
1965	3596			3666	4828
1966	5755			5573	5992
1967	7829			5654	7881
1968	16525			7664	8400
1969	16485			6313	9725
1970	15437			6818	11051
1971	25236			6213	16499
1972	30051			5206	16457

Demand Projections

	2)	2)	2)	3)	4)
1974	54768	41076	13692	28530	24095
1975	73937	55453	18484	32040	29155
1976	99815	74861	24954	35770	35277
1977	134750	101062	33688	39490	42685
1978	181912	136434	45487	43220	51649
1979	229074	171806	57268	46900	62445
1980	276236	207177	69059	50670	75619

Notes: 1) Importations
2) PE projections based on past annual growth rate of 35 % up to 1978, beyond 1978 -- straight line projection. LDPE 75 % total PE, HDPE 25 % total PE.
3) Projected demand based on future demand for bags, injected and extruded articles.
4) Projected PVC demand based on average growth rate of 21 %.

Table AI-2 Estimation of Resin-wise Apparent Consumption

(Tons)

		PE	PP	PS			PVC [2]		
		Imports [1]	Imports	Imports	Production	Total	Imports	Production	Total
1969		21,063	8,255	3,678			1,962	7,732	9,694
1970		24,167	15,046	4,660			2,291	7,119	9,410
1971		34,864	22,022	5,602			2,569	9,036	11,605
1972		34,281	23,109	6,767			2,954	9,849	12,803
1973	I	9,890	5,477	652			528	(3,960)	4,488
	II	11,304	6,524	1,287			585	(3,960)	4,545
	III	11,269	5,651	1,407			891	(3,960)	4,851
	IV	11,431	5,721	1,204			449	(3,960)	4,409
1974	I	10,633	5,069	482	301	783	1,341	3,406	4,747
	II	6,711	3,551	372	358	730	548	2,841	3,389

Source: Trade Statistics of Japan, USA, West Germany and Hong Kong.
Hearing from PPPI
Annual Reports of Mabuhay Vinyl Corporation

Notes: 1) Imports were estimated by summing up those from Japan, USA, West Germany, and HK.

2) Quantity of PVC is estimated by
(PVC resin) + $\frac{1}{2}$(PVC compound)

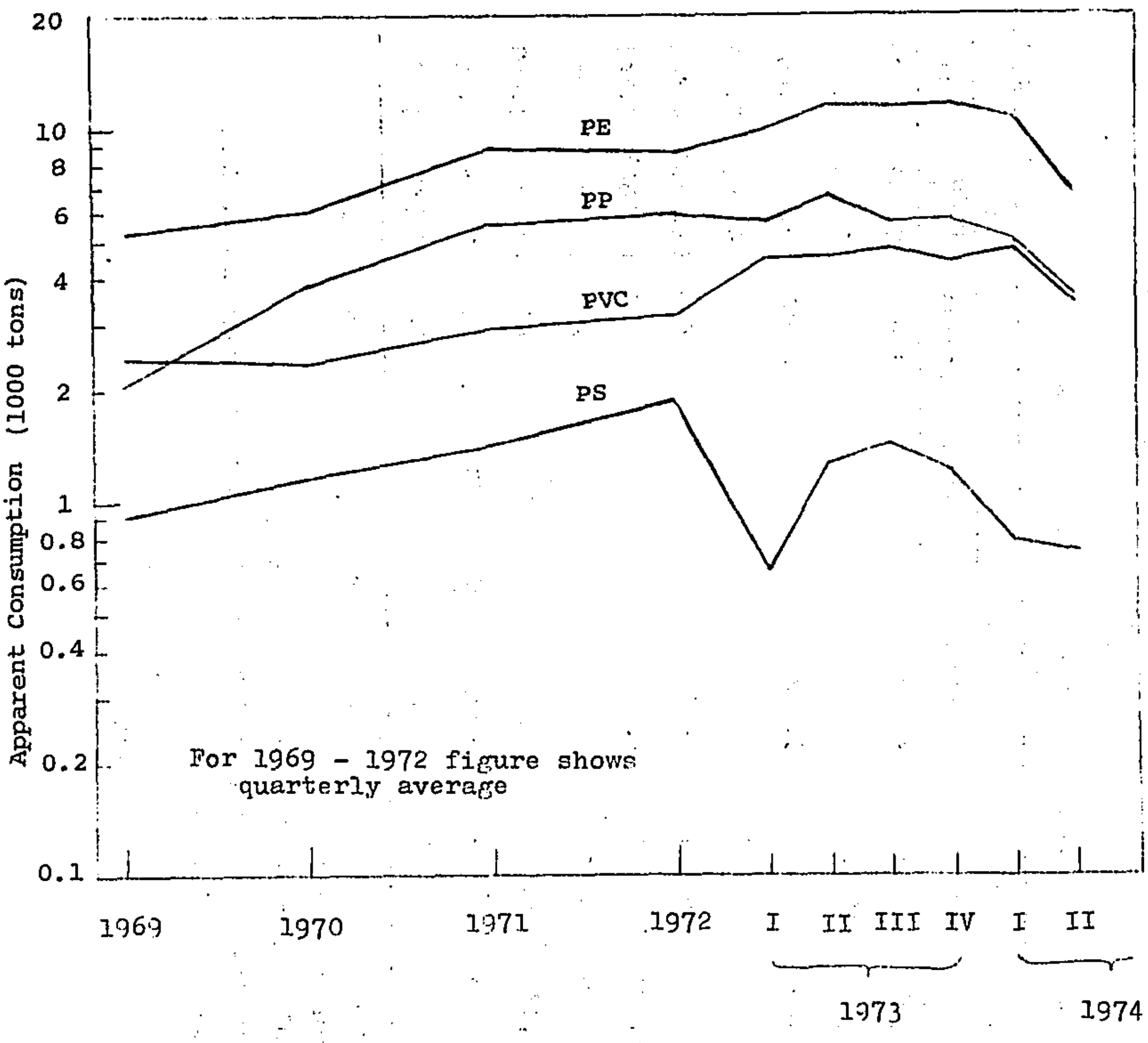


Figure AI-1 Apparent Consumption of Plastic Raw Materials

Table AI-3 Estimation of Import Price Index of Plastics Raw Material

		PE	PP	PS	PVC Resin	PVC Compound
1969		60	69	58	65	88
1970		99	108	91	94	113
1971		100	100	100	100	100
1972		92	94	89	92	101
1973	I	111	125	154	68	121
	II	121	148	115	117	125
	III	144	172	191	142	166
	IV	193	207	233	225	213
1974	I	261	272	296	286	263
	II	285	301	317	252	324

Note: Import price index is obtained from average FOB price which is the average of FOB prices of exporting countries, and converted to Peso. Prices in 1971 are taken as 100.

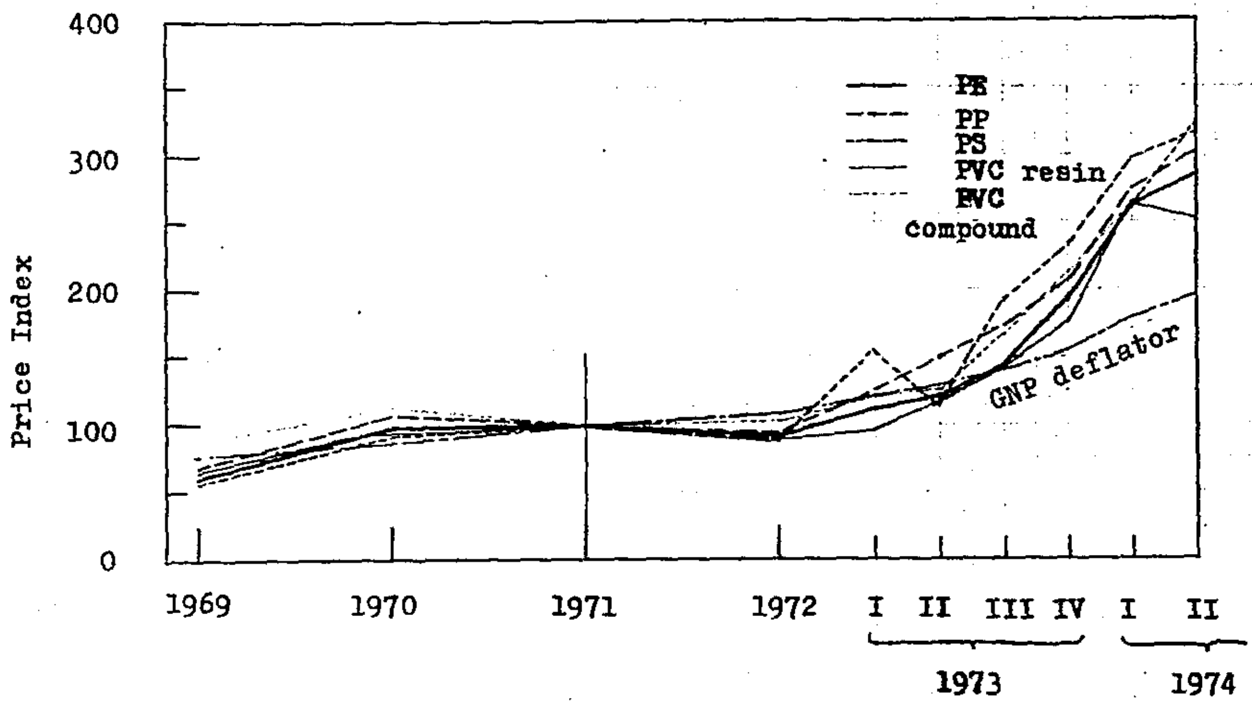


Figure AI-2 : Import Price Index of Plastics Raw Materials

1.3 Study on Demand Decreases of Plastics

Figure AI-3 schematically shows recent supply and demand situation of plastics raw materials. In the first half of 1973, the supply of raw materials was not sufficient because of worldwide shortage of plastics. As the result of short supply and price rise of crude oil, price of plastic raw materials increased considerably since the beginning of 1973, and actual demand of plastic products began to decrease since the middle of 1973. In the latter half of 1973, plastics raw materials were purchased continuously, some of which was speculative buying, and balance of supply and demand was piled up as surplus inventories.

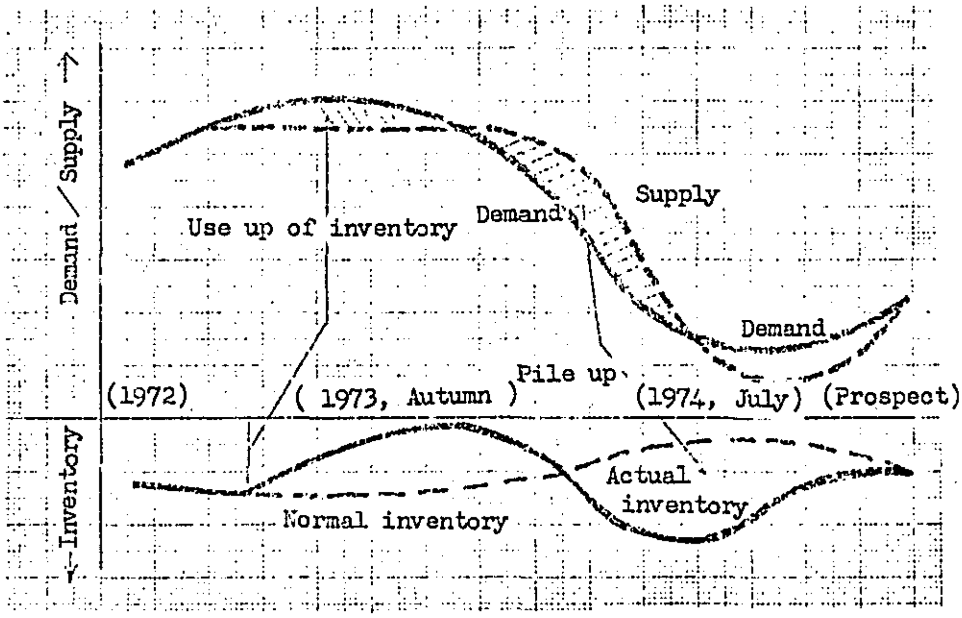
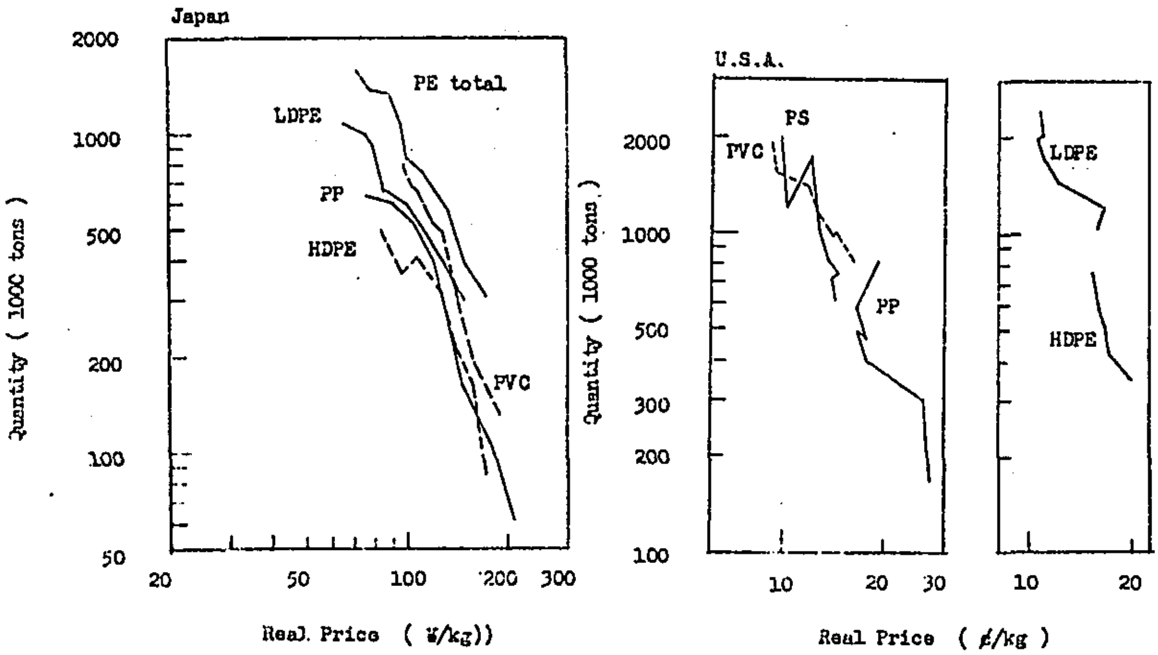


Figure AI-3 Schematic Explanation of Recent Supply/Demand Situation of Plastics Raw Materials

Imports and sales by domestic manufacturers of plastics raw materials will decrease until this surplus stock is totally consumed, and an optimum inventory of two to three times monthly material tion is attained. Actual demand shown by a heavy line in Figure AI-3 is calculated by means of price elasticity of plastics.

Prices of plastics raw materials and products decreased and demand increased continuously in the past. There is a correlation between price and demand of plastics. The past trends in Japan and the U.S.A. are shown in the following figures.



Prices shown in these figures are real prices, i.e., the prices divided by GNP deflator. The price elasticity obtained from the relations between the real price and the demand by the kind of plastics raw materials is as follows:

Item	Japan	U.S.A.
Low density polyethylene	1.60	1.38
High density polyethylene	3.38	2.76
Polypropylene	2.51	1.88
Polystyrene	2.83	1.71
Polyvinyl chloride	1.61	1.36

In general, the demand for plastics seems to depend mainly on the real price of plastics and the gross domestic product (GDP) which can be expressed by the following equation:

$$\log Q = A - B \log \tilde{p} + C \log \tilde{D}$$

Where; Q: plastic demand
$\tilde{p}$: real price of plastics
$\tilde{D}$: GDP at constant price

In a short term analysis, GDP may be deemed to remain constant for the sake of convenience. In this case, the following relation will be obtained:

$$\log Q = A' - B \log \tilde{p}$$

Figures AI-4 to AI-6 show the calculated results for general-purpose plastics. The apparent consumption and the real price in

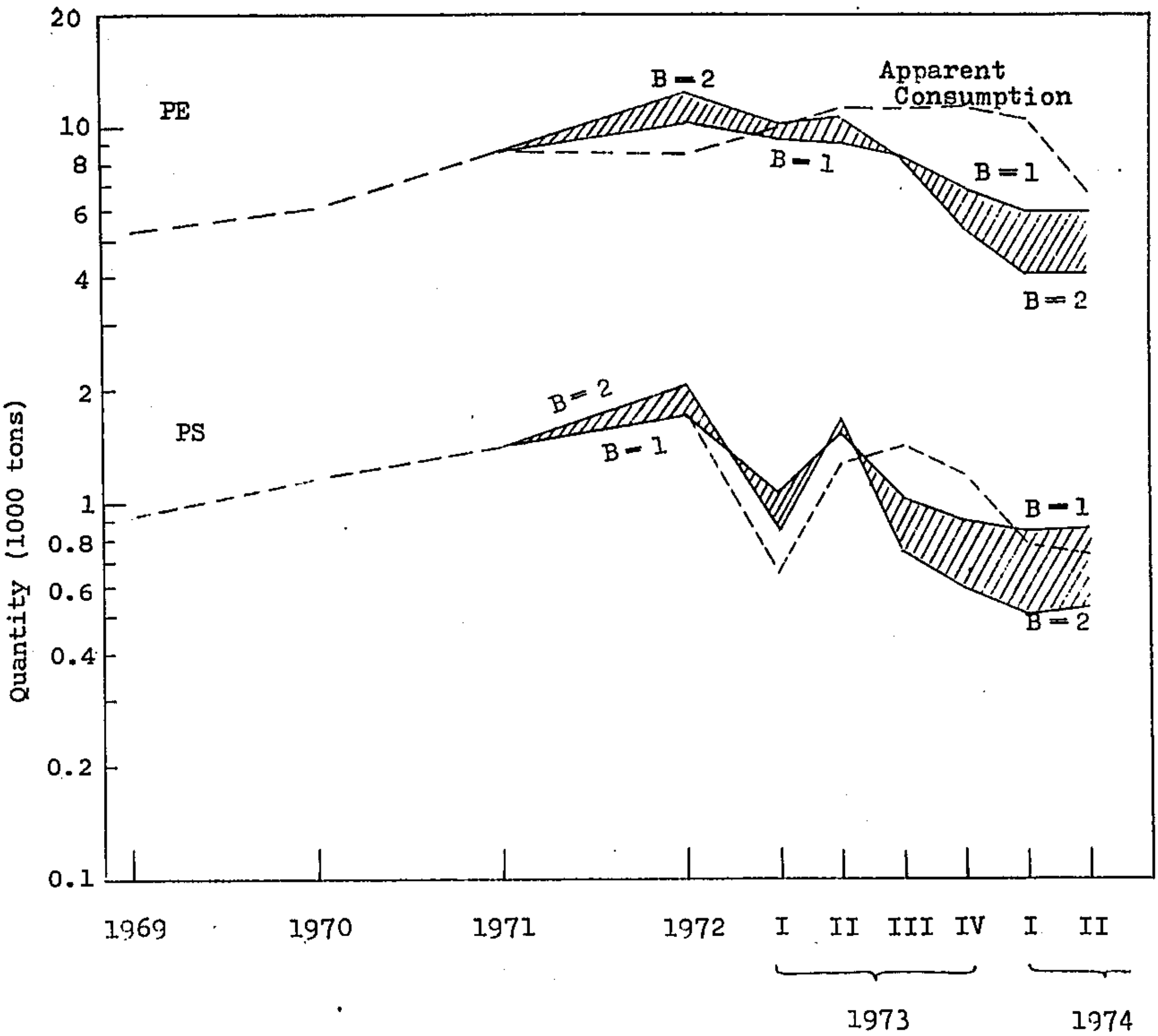


Figure AI-4 Supply/demand balance, PE and PS

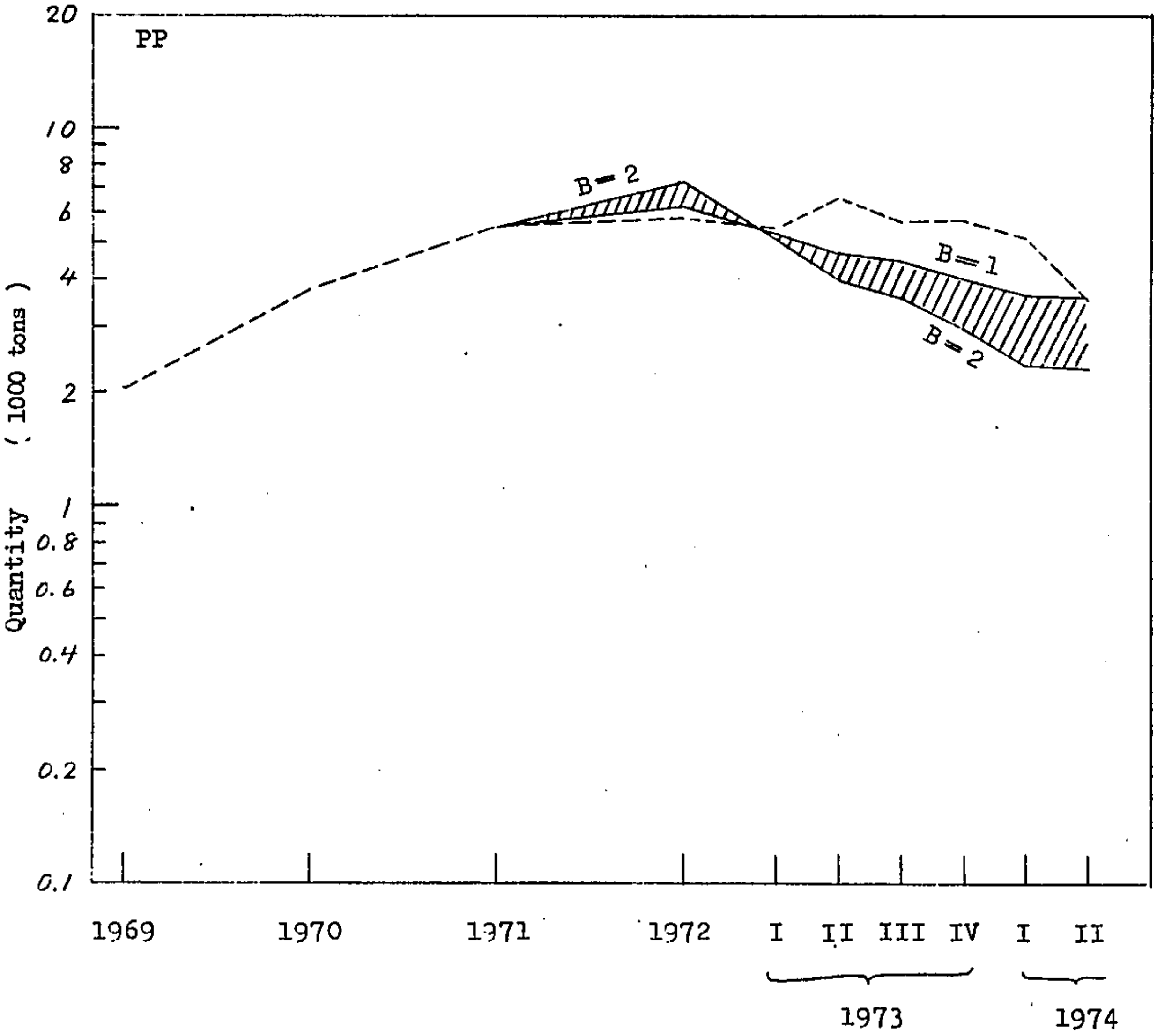


Figure AI-5 Supply-demand balance, PP

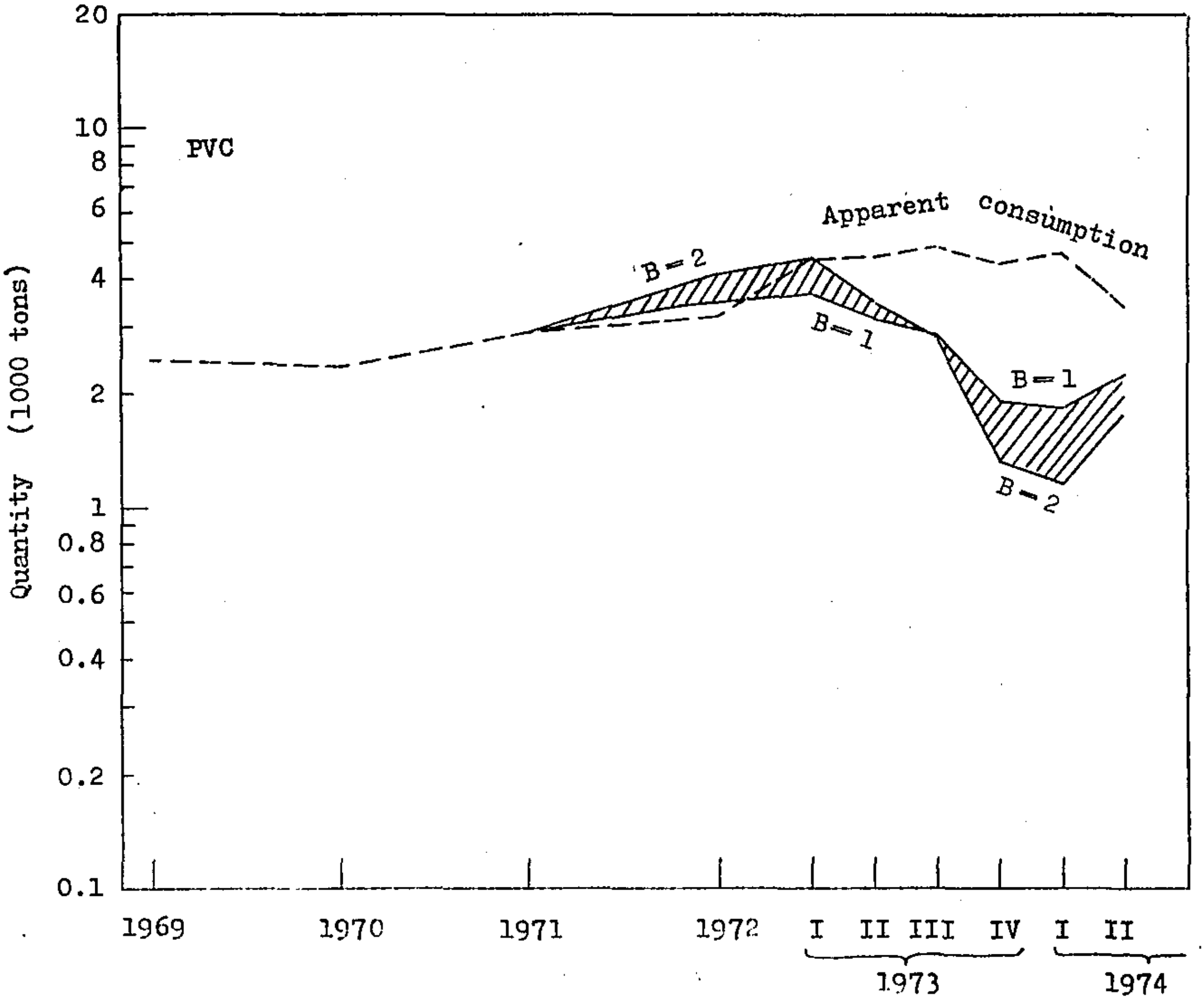


Figure AI-6 Supply-demand balance, PVC

1971 were taken as the criteria, because, while the export price from Japan reached the bottom, the consumption in the Philippines market did not increase as was expected in 1972. The hatched part in the figures shows the actual demand calculated by the equation described above, substituting 1 and 2 for B as the upper and lower limits.

Although the price elasticity B may not be determined accurately without observing the future trend of the apparent consumption for another quarter or so, it is estimated that the value is approximately 1.5 for each item of plastics.

To obtain GDP elasticity C, calculations were made for each item of plastics for the apparent consumption during 1969 to 1973. During the period of 1969 to 1973, the price elasticity for most of the plastics was neary zero. Unlike countries producing plastic materials, the plastics market in the Philippines seems to be short of the raw material, without showing any high dependency on prices.

The GDP elasticity calculated for each items of plastics is listed below:

PE	3.03
PP	4.22
PS	2.29
PVC	2.76

1.4 Preliminary Prediction on Domestic Consumption of LDPE:

By substituting 1.5 and 3.0 for price elasticity B, and GDP elasticity C, respectively, an equation is obtained for LDPE as follows:

$$\log Q = A - 1.5 \log p + 3.0 \log D. \text{ - - - - - - } (1)$$

If the domestic demand, the real price, and the GDP in 1974 are taken as Q_0, $\widetilde{P}_0$, and D_0 respectively, the following equation will ensue:

$$\log \frac{Q}{Q_0} = -1.5 \log \frac{\widetilde{P}}{\widetilde{P}_0} + 3.0 \log \frac{\widetilde{D}}{\widetilde{D}_0} \text{ - - - - } (2)$$

GDP at constant price is assumed to increase at 6.3% per annum, then Dn in the n'th year (n=0 for 1974) is expressed as follows:

$$\widetilde{D}n = (1 + 0.063)^n D_0, \text{ - - - - - - } (3)$$

By substituting Dn in the equation (2), the following relation will be obtained:

$$\log \frac{Qn}{Q_0} = -1.5 \log \frac{\widetilde{p}n}{\widetilde{P}_0} + 0.0796n \text{ - - - - - - } (4)$$

The relation among the domestic demand Q_6, the real price P6 in 1980, and Q_0 and p_0 in 1974 is shown in Table I-4 and Figure I-7.

In this figure, the relations in which GDP elasticity values are assumed to be 2.5 and 3.5, are also described for reference, where, the estimated domestic demand in 1973 is 23,000 tons per year, which corresponds to approximately 60% of the previous year.

Table AI-4 Calculated Ex-factory Price Corresponding to Sales Quantity in 1980 (LDPE)[1)]

Year	Demand (1,000 tons)	Ratio of Real Price	Actual Landed Price (US$/ton) [2), 3)]
1974	23	1.00	1,200
1980	60	1.08	1,940
	80	0.89	1,600
	100	0.77	1,380
	120	0.68	1,220
	140	0.61	1,100
	210	0.47	840

Notes: 1) Price elasticity: 1.5
GDP elasticity : 3.0

2) Increase rate of GNP deflator: 7%

3) Import exchange rate: P 10.5/US$
Exchange rate : P 6.8/US$

If the real price were kept on the same level as in 1974, i.e., US$780 CIF Manila in current price, 60 to 70 thousand tons of demand would be expected in 1980. In general, the real price of plastics raw materials decreases to some extent except during the time of price rise of crude oil. If the real price were to decrease by 1% per annum, the domestic demand for LDPE in 1980 would be 70 to 80 thousand tons.

According to the BOI's prediction, the domestic demand for LDPE in 1980 is 207,177 tons, and this is the latest estimation which revised the prediction made in 1971. If the price of LDPE were kept on the same level as in 1972, and the GDP elasticity assumed as being 3.0, the prediction by the formula described above would well agree with the forecast by BOI.

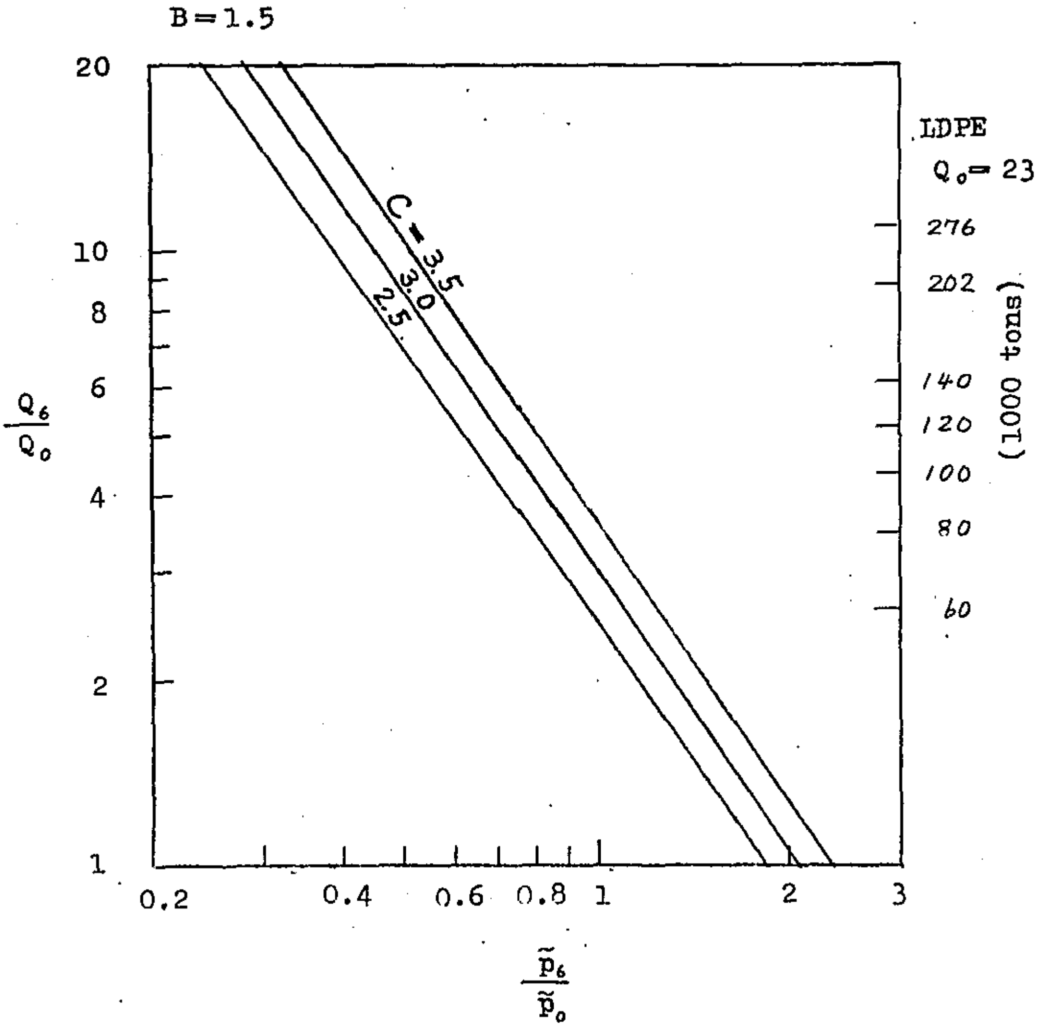


Figure AI-7 Calculated Result of LDPE Demand in 1980

2. Future Outlook of International Market and its Influence on the Philippine Market

2.1 Current World Situation of Olefins and Plastics

2.1.1 Olefins

Olefins, mainly ethylene and propylene, are transported locally; however, no means of transportation is available to warrant economical shifting of an enormous volume of olefins. Therefore, olefins are manufactured at the place of consumption. This is the most significant difference between olefins, and aromatics and plastics.

There are several methods for producing ethylene, and production amount of the related by-products differs according to the manufacturing processes. The commercially adopted Processes are as follows:

Raw Material	Natural Gas Ethane	Natural Gas Off Gas Propane	Naphtha Medium-Density Oil
Pyrolysis	Steam/Pyrolysis	Steam/Pyrolysis	Steam/Pyrolysis
Main Product (Yield)	Ethylene (85%)	Ethylene (45%) Propylene (13-25%)	Ethylene (30%)
By-Product (Yield)	Fuel Oil	Fuel Oil	Propylene (17%) C_4 (5%) Aromatics (10%)

Pyrolysis of natural gas is widely employed in the USA, and pyrolysis of naphtha and gas oil in Europe and Japan.

Although it is quite difficult to assess the actual production amount of ethylene in the world, the general outlook is shown in Table AI-5, except the communist countries. Table AI-6 shows the production capacity of olefin plants in the world at the end of 1973, except the communist countries

Total production capacity is about 30 million tons per annum as ethylene, and a 35% each is comprized by North America on one hand, and the seven countries in EEC on the other. While a 15% is held by Asian countries including Japan. A rather small share is held by the communist countries. In Asian and communist countries, nearly the same amount of planned ethylene production as in North America and EEC is now taken into consideration.

It seems that the realization of petrochemical industrialization is penetrating into Asian and communist countries gradually from the developed industrial countries.

Table AI-5 Olefins Production in the World (1971)

Unit: 1,000 ton

Country	Ethylene	Propylene	Acethylene
Argentina	--	--	14.7
Bergium	--	--	3.4
Canada	421.0	--	8.1
Czechoslovakia	122.8	61.0	14.1
Denmark	--	--	4.1
Germany, Fed. Rep.	2,004.7	903.2	335.1
Greece	--	--	1.4
Hungary	15.8	7.8	--
India	66.5	26.6	6.2
Israel	22.8	--	--
Italy	1,014.8	501.1	203.4
Japan	3,536.8	2,455.3	--
Mexico	63.4	--	--
Philippines	--	--	1.3
Portugal	--	--	0.3
Sri Lanka	--	--	0.2
United Kingdom	1,040.0	506.0	--
United States	8,301.1	2,523.5	453.3

(UN Statistical Year Book)

Table AI-6 Production Capacity of Olefins in the World (At the End of 1973)

Unit: 1,000 ton/year

Area	Country	Existing Production Capacity		Capacity Under Planning	
		Ethylene	Propylene	Ethylene	Propylene
E E C	West Germany	3,736	2,108	+1,340	+380
	Belgium	450	200	35	-
	Denmark	40	30	-	-
	France	1,815	1,177	300	97
	Netherlands	2,140	1,095	80	-
	Italy	1,877	1,162	1,190	640
	England	1,695	1,160	450	300
	Total	11,753	6,932	+3,395	+1,417
Europe (Excluding E E C)	Austria	70	54	70	38
	Spain	327	165	325	160
	Finland	150	70	-	-
	Greece	15	-	-	-
	Norway	-	-	250	-
	Portugal	-	-	200	-
	Sweden	250	150	-	-
	Total	812	439	+845	+198
North America	U.S.A.	10,600	6,250	2,900	700
	Canada	579	n.a.	454	n.a.
	Total	11,179	6,250	+3,354	+700
Central America	Mexico	251	n.a.	182	110
	Argentina	47	-	320	110
	Brazil	224	93	513	n.a.
	Bolivia	-	-	Estimated 35	Estimated 15
	Chile	45	40	-	-
	Colombia	35	17	50	-
	Venezuela	130	95	-	-
	Total	732	245	+1,100	+235
Africa	Algeria	-	-	150	-
	Egypt	35	-	-	-
	South Africa	158	-	-	-
	Total	193	-	150	-
Middle East	Iraq	32	-	120	-
	Israel	24	-	126	-
	Total	56	-	+246	-
Asia	Japan	3,900	Estimated 2,500	1,600	n.a.
	South Korea	100	65	350	n.a.
	Taiwan	54	n.a.	354	-
	India	175	100	130	n.a.
	Australia	283	n.a.	300	n.a.
	Iran	24	-	12	-
	Thailand	-	-	150	n.a.
	Singapore	-	-	300	n.a.
	Turkey	60	40	300	200
	Total	4,596	2,705	+3,496	+
Communist Country	East Germany	220	140	330	150
	Bulgaria	128	75	250	150
	Red China	-	-	300	n.a.
	North Korea	n.a.	-	260	n.a.
	Hungary	25	n.a.	250	125
	Poland	145	50	250	n.a.
	Rumania	360	200	400	n.a.
	Czechoslovakia	Estimated 150	65	200	100
	USSR	?	?	?	?
	Yugoslavia	50	20	200	90
	Total	1,078	550	+2,440	+615
World Total		30,400	17,120	15,000	3,360

According to the information obtained from the Association of Petrochemical Industries in Japan, newly planned production capacity of ethylene is 200 thousand tons per annum in the minimum size, and the largest one which is planned by CONOCO to be completed in 1978 reaches about 600 thousand tons per annum. It shows the tendency of recent petrochemical industry which is the magnification in the scale.

(1) U.S.A.

The olefin production method employed in USA is quite different from those in Europe and Japan. Because the natural gas resources in the USA, raw materials of ethylene, propylene and butadiene are different from each other.

Therefore, in contrast with the olefin plants in Europe and Japan which produce ethylene, propylene and butadiene at the same time, in many cases in USA, manufacturing of the products mentioned above is separated in independent plants.

However, due to the predicted future limitation in natural gas supply and surplus in the residue of lower octane number naphtha as a result of lead-free gasoline production, newly planned olefin plants in the USA are directed to use naphtha and/or gas oil as the raw material, thereby gradually changing the production pattern.

The supply/demand position of olefins in the USA is listed in Table AI-7

(a) Ethylene

The production capacity of ethylene of the USA is the largest in the world, and demand for ethylene amounted to more than 10 million tons per year in 1973. As shown in Table AI-7, more than 5.3 million tons per annum of supply shortage is predicted for 1980. Eight ethylene plants are now under construction or being planned to make up for this supply shortage, and each of them is a large scale plant having a capacity of more than 450 thousand tons per annum, totalling in excess of 3.7 million tons per year.

Production of ethylene in the USA by raw materials is shown below:

(Unit: 1,000t)

Raw Material	1974 (expected)		1980 (estimated)	
Ethane	5,575	(55)	5,975	(39)
LPG	3,024	(30)	2,420	(16)
Naphtha	662	(6)	2,520	(16)
Gas Oil	953	(9)	4,520	(29)
TOTAL:	10,214	(100)	15,435	(100)

(ACS 168TH Meeting)

Table AI-7 Demand and Supply of Olefins in the U.S.A.
(including Puerto Rico)

(Unit: 10^3 tons)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
ETHYLENE											
Market scale	8,989	9,988	10,896	11,350	11,622	11,668	-	-	-	-	-
Demand	8,172	8,308	9,352	10,170	10,987	12,031	12,803	14,029	-	-	17,797
Plant capacity	9,352	9,806	10,033	10,987	11,168	11,804	13,302	13,847	-	-	-
At 90% operation	8,399	8,807	9,035	9,897	10,079	10,524	11,986	12,485	-	-	-
Surplus (Shortage)	227	499	(318)	(272)	(908)	(1,407)	(817)	(1,135)	-	-	(5,312)
PROPYLENE											
Market scale	-	-	5,176	5,448	5,720	6,129	-	-	-	-	-
Demand	-	-	4,404	4,903	5,403	5,811	6,211	6,810	-	-	8,626
Operation rate of down flow	-	-	85%	90%	95%	95%	-	-	-	-	-
By-product from ethylene plant	-	-	2,633	2,860	2,996	3,314	3,950	4,222	-	-	-
Shortage	-	-	(1,771)	(2,043)	(2,406)	(2,497)	(2,361)	(2,588)	-	-	(4,404)
BUTADIENE											
Demand	-	-	-	1,907	1,952	-	-	-	2,315	-	2,542
Supply	-	-	-	1,634	1,680	-	-	-	2,179	-	2,361
Shortage	-	-	-	(272)	(272)	-	-	-	(136)	-	(182)

Source: Hydrocarbon Processing, July, 1974

The estimation of ethylene price in the USA is rather difficult, as the pricing of raw materials heavily affects the assessment. For 1980, 17 to 20¢/lb is predicted for example as shown in Table AI-8.

Table AI-8 Forecast of Ethylene Price

	1974	1977	1980
Foreign Crude Oil	9.5 \$/BBl	10.70	12.05
Naphtha	115 \$/t	120	135
Gas Oil	90 \$/t	100	113
NG	1.25\$/MMBTU	2.24	2.25
Ethane	3.9 C/LB	6.1	7.1
Ethylene	6-8 C/LB	14-17	17-20

(HYDROCARBON PROCESSING, July 1974)

The supply of ethylene in the USA will not be enough even after the construction of the planned facilities is completed. It is forecast that further plans to construct new ethylene plants will be forthcoming in succession; however, it seems highly difficult to expand the ethylene production to meet the demand increase up until 1980, due to the difficulty in obtaining raw materials, to the rising cost of plant construction, difficulty in the procurement of investment for construction (which is said to be approximately 4 billion dollars), insufficient abilities of constructors in ethylene plant construction, and poor supply capacity of the facilities.

Therefore, it is expected that supply shortage in ethylene (also in propylene) will continue in the future.

(b) Propylene

Striking dissimilarity to Europe and Japan is that in that in the USA, propylene is supplied from refinery as a by-product and also produced by steam cracking of propane.

The supply/demand position of propylene in the USA is shown in Table AI-9.

Table AI-9 Supply/Demand of Propylene in the USA

(Unit: 10^3 tons)

	1974 Capacity	1974 Est. Actual	1975 Est.	1976 Est.
SUPPLY:				
Propane Steam Cracker	3,602	2,782	2,991	3,520
Refinery Gas	9,259	7,500	7,591	7,768
Import	-	60	100	20
Total	12,861	10,342	10,682	11,308
DEMAND:				
Chemicals	4,736	3,881	4,181	4,388
Plastics	1,340	1,167	1,268	1,426
Alkylate	6,636	5,136	5,068	5,068
LPG	-	109	192	292
Export	-	-	-	-
Total	12,712	10,293	10,709	11,174

(c) Butadiene

Sixty-eight percent of butadiene is produced by dehydrogenation of butane or butene, and the latter is obtained by catalytic cracking in refineries. The remainder, 32% of butadiene, is the by-product gas from ethylene plants. However, as shown in Table AI-7, the supply of butadiene in the USA has been insufficient, and this shortage has been covered by importation from Europe and Japan.

The consumption of butadiene in the USA increased by 6.76% per annum in the decade from 1964 to 1973, and even if, the increase rate dropped to 4.2%, the consumption will still reach 2.5 million tons per year in 1980.

(2) Europe

The production capacity of ethylene in Europe is approximately 12.5 million tons per year in total, which represents approximately one-third of the world capacity. One of the main characteristics of olefin plants in Europe is that many firms are established on a joint-venture with foreign companies.

In view of the country-wise ethylene production capacity, West Germany has the largest production facilities.

The ethylene production capacity of Rheinisehe Olefin Werke (Wesseling) which is a joint-venture of BASF and SHELL, has the world's largest capacity of 1.05 million tons, and the plant will be expanded to 1.35 million tons in 1974.

The Netherlands owns an ethylene capacity next to West Germany, and there are numerous modern plants of more than 300,000 tons/year capacity except that of Shell's Pernis Plant (140,000 tons/year).

In Italy, Montedison owns an ethylene capacity in total of about 1 million tons/year, for which an expansion by 500,000 tons/year is scheduled for completion by 1977.

In England, ICI (Wilton) and BP Chemicals (Baglam Bsy & Grangemouth) are holding about 90% market share, and the 450,000 tons/year plant now under planning is a joint-venture by three companies, i.e., ICI, BP and Shell. These three companies are dominating figures in the British ethylene production.

In other countries, Belgian Petrochim (a subsidiary of Phillips) owns an ethylene capacity of 450,000 tons/year, Calvo Sotello of Spain possesses 260,000 tons/year, and the Entasa is now constructing an ethylene plant in Tarragona having 320,000 tons/year capacity.

The supply/demand relation in ethylene, propylene, butadiene in the West European countries are as shown in Table AI-10.

(3) Asia and Japan

In Asia, except Japan, several ethylene plants of about 20,000 - 30,000 tons/year capacities are operating in India; CPI's 55,000 tons/year plant in Formosa, and 100,000 tons/year plant in Urusan, Korea run by Taikan Sekiyu (Great Korean Petroleum) - these are the only plants now in operation. There are some other plans for complexes emphasizing on ethylene plants in the Philippines, Korea, Formosa, Thailand, Singapore, Turkey and Iran; these are all still on the planning stage.

On the other hand, since the very first operation of the ethylene plant in early 1957, Japan has been increasing the production at an annual rate of more than 30%, and now has an actual ethylene capacity in total of 5,100,000 tons/year.

Japanese olefin plants are based on the naphtha cracking and various derivatives plants are surrounding the major olefin (ethylene) plant; under the form of the so-called petrochemical complex. At present, the number of such complexes is ten by

Table AI-10 Western Europe's Supply-Demand Forecast for Olefins

Western Europe's Supply-Demand Forecast For Ethylene
('000 metric tons)

No downstream capacity constraints in Europe or U.S.
Past Trade Pattern Unchanged

	Probable		Maximum	
Year	Production	Excess capacity	Production	Excess capacity
1972	8,300	4,760	10,300	2,760
1973	9,400	5,030	11,600	2,830
1974	10,700	5,140	13,200	2,640
1975	12,000	5,120	14,900	2,220
1976	13,500	3,620	16,700	420
1977	14,800	2,320	18,300	-1,180

Downstream capacity constraints in both Europe and U.S.
Trade Pattern Chanted

Year	Production	Excess capacity	Production	Excess capacity
1972	8,380	4,680	10,820	2,240
1973	9,660	4,770	12,580	1,850
1974	11,260	4,580	14,360	1,450
1975	12,830	4,240	15,450	1,670
1976	14,910	2,210	17,320	- 200
1977	15,800	1,320	18,750	-1,630

Western Europe's Supply-Demand Forecast For Propylene
('000 metric tons)
High severity naphtha cracking

	Propylene: Probable production		Propylene: Maximum production	
Year	Required	Excess	Required	Excess
1972	4,400	-400	5,500	-400
1973	4,740	-140	5,940	60
1974	5,140	160	6,440	160
1975	5,650	400	7,050	250
1976	6,300	750	7,800	300
1977	6,990	510	8,690	-590

Western Europe's Supply-Demand Forecast For Butadiene
('000 metric tons)
High Severity naphtha cracking

	Butadiene: Probable production		Butadiene: Maximum production	
Year	Required	Excess	Required	Excess
1972	1,070	30	1,340	80
1973	1,160	110	1,460	200
1974	1,250	230	1,570	220
1975	1,350	340	1,700	340
1976	1,450	510	1,820	440
1977	1,550	530	1,950	310

Western Europe's Supply-Demand Forecast For VCM
('000 metric tons)

	VCM: Probable		VCM: Maximum	
Year	Production	Excess capacity	Production	Excess capacity
1972	3,320	2,750	4,000	2,070
1973	3,690	3,180	4,620	2,250
1974	4,070	2,990	4,950	2,110
1975	4,570	2,790	5,450	1,910
1976	5,040	2,320	5,450	1,910
1977	5,440	1,920	5,450	1,910

(Chem Age 11-3-72 p 14 (A))

area, and 17 in terms of the core ethylene plants. These ethylene plants are employing the processes as shown in Table AI-12.

Future estimations on Japanese ethylene supply/demand are as follows:

(Unit: 10^3 tons)

Year	1974	1975	1976	1977	1978
Ethylene Supply/Demand	4,285	4,600	4,940	5,300	5,700
Required Expansion Capacity	-	-	390	600	1,030

The current capacity is 5,100,000 tons/year with an operational rate of 93%. In other words, up until 1975, the demand and supply will be balanced at the present capacity; however in 1976 an expansion by 39,000 tons/year will be required, and by 1,030,000 tons/year in 1978. For these requirements, plans with a total of 1,500 thousand tons/year are being presented.

As far as propylene is concerned, this particular product is being completely by-produced in Japan. The production relation between propylene and ethylene is given below.

Table AI-11 Transition of Ethylene/Propylene Production

(Unit: 1,000 tons)

	1968	1969	1970	1971	1972	1973
Production of Propylene	1,326	1,726	2,146	2,455	2,605	2,825
	(128)	(130)	(124)	(114)	(106)	(106)
Production of Ethylene	1,793	2,340	3,097	3,537	3,775	4,170
	(131)	(131)	(132)	(114)	(107)	(108)
Propylene Yield Against Ethylene	73.9	71.9	69.3	69.4	69.0	67.7

Butadiene is being obtained through extraction of C_4 fraction which is the by-product of ethylene production. The relative correlation is given in Table AI-13.

Table AI-12 <u>Trends of Process-wise Production Capacity</u>

(Unit: 10^3 tons)

year / Process	1969		1970		1971		1972		1973	
	Capacity	Ratio	Capacity	Ratio	Capacity	Ratio	Capacity	Ratio	Capacity	Ratio
S & W	1,365	56	1,965	54	1,965	47	1,965	41	1,965	41
Lummus	500	21	1,100	30	1,700	40	1,700	36	1,700	36
E R E	205	9	205	6	205	5	505	10	505	10
U O P	300	12	300	8	300	7	300	6	300	6
Lurgi	44	2	44	1	44	1	44	1	44	1
Selas	-	-	-	-	-	-	300	6	300	6
TOTAL	2,424	100	3,600	100	4,214	100	4,814	100	4,814	100

Table AI-13 Relation between the Production of Butadiene and Ethylene

(Unit: 1,000t)

	1971		1972		1973	
	Quantity	Ratio comparing preceding year	Quantity	Ratio comparing preceding year	Quantity	Ratio comparing preceding year
Ethylene production	3,537	114	3,851	109	4,170	108
B-B distillate	1,554	117	1,682	108	1,752	104
(yield against ethylene)	(43.9)		(43.7)		(42.0)	
Butadiene production	580	117	643	111	652	101
(Yield against B-B distillate)	(37.3)		(38.2)		(37.2)	

(4) Central and South America

In Central and South American countries, Brasil, Mexico and Venezuela are active in ethylene production. Petrochemical industry in these countries assumes a form of Government participation such as Petrobras of Brasil, Pemex of Mexico and IVP of Venezuela, all employing medium size plants of about 15,000 - 20,000 tons/year.

(5) Communist Countries

Information on the situation in communist bloc is not fully available; however the integration of fragmentary information implies the following:

(a) East Germany -

A total ethylene capacity of 220,000 tons/year is in operation. Of this capacity, 120,000 tons/year located in Leuna is said to be based on naphtha cracking by the Sand Cracker of Lurgi. The scheduled 300,000 tons/year plant in Bohlen is incorporating the naphtha cracking Selas process.

(b) Bulgaria -

At present, two plants, each having about 60,000 tons/year level. A new plant is scheduled for construction in 1976 for 250,000 tons/year.

(c) People's Republic of China -

At present, no plant of ethylene plant is in operation. However, in 1975, a naphtha cracking 300,000 tons/year is scheduled to be completed in Shing Yang district (Mukden) by using the Lummas process.

(d) People's Republic of Korea -

The current status of this country is not known. One 200,000 tons/year and one 60,000 tons/year plants are contemplated; however, it seems they are not realized.

(e) Hungary -

Hungary is fully dependant on the Russian technology. By the end of 1974, a process of 250,000 tons/year is planned to be constructed on the combined Linde/Selas process based on naphtha cracking. This plant will be managed by the Government.

(f) Poland -

At present, there are three ethylene plants, of which the largest is a naphtha cracking plant located in Plock. This plant is based on the Linde/Selas process, with an ethylene capacity of 95,000 tons/year.

In Plock, a plant of 200,000 tons/year plant is scheduled to be newly expanded by 1976/77. In addition to the above, another plant is now under study for construction near Warsaw, Pruskov with a 300,000 tons/year capacity.

(g) Rumania -

At present, in Pitesti, 100 km northwest of Bucarest, a major ethylene plant based on the Lurgi process with a capacity of 32,000 tons/year is in operation. In Constata by the Black Sea, a plant of 400,000 tons/year is planned.

(h) Czechoslovakia -

In Blatislava, an ethylene plant with 60,000 tons/year capacity is operating. This plant was constructed by TEC (Toyo Engineering Co.) of Japan. A new expansion is scheduled for this plant to bring the capacity up to 200,000 tons/year. A plant located in Novaky employing Hoecht's HTP process for ethylene/acethylene production is an unusual plant having 50,000 tons/year.

(i) U.S.S.R. -

The only known plant is a Lummus process ethylene plant having 400,000 tons/year located in Nizhne Kamsk. It is reported that several other ethylene plants must be in operation at present; however, no details have been made available.

(j) Yugoslavia -

At present, Yugoslavia has only one ethylene plant which has a capacity of 50,000 tons/year constructed by Foster Wheelen. This plant is scheduled to commence operation in 1974. This is a naphtha clacking 200,000 tons/year plant.

2.1.2 Plastics

Table AI-14 shows the world's plastics production statistics compiled by the U.N. In 1971, the world production amounted to 30,000,000 tons, which consists of 8,200,000 tons by U.S.A., 5,200,000 tons by Japan, and 4,600,000 tons by West Germany. These three countries are the leaders of the world in plastics production. Polyethylene and polyvinyl chloride take up an overwhelming majority of the total plastics production, followed by polystyrene and polypropylene as shown in Table AI-15.

As the transportation of the plastics products in simple, and also owing to the availability of additional value higher than in the case of the production of ethylene, etc., the plastics products are traded as "International merchandises".

Figure AI-1 shows a flow diagram drawn on the basis of trade statistics of major plastics exporting countries regarding plastics raw materials trades in 1972.

The general trade structure of plastics in the world is as follows:

(a) In the western bloc, the majority of the trades is conducted in the form of intra-territorial trades, and this category of trade comprizes approximately 70% of the whole.

(b) Transactions among the three regions, i.e., Europe, North America, and Asia are small in scale, and most of the deals are carried out among the countries within each region. However, the flow of trades from the U.S.A. to the Western bloc is relatively significant, having a considerable influence upon the supply/demand balance of plastics raw materials in Western Europe.

(c) In the other regions, the flow of trades is considerably clear as follows: (Table AI-14)

U.S.A.	Central & South America
Western Europe Bloc	Communist Bloc, Africa, Middle East
Japan	South East Asian Countries

However, at present, many countries in Southeast Asia, Mideast, and Central and South America are envisaging their own projects to establish domestic production of the plastics. Therefore, the trade flow chart will greatly change when these projects are implemented.

(1) U.S.A.

The U.S.A. is the largest plastic consuming country in the world. The U.S.A. is outnumbered only by Japan in the consumption of the urea and melamin resins in both production and consumption (Table AI-16).

This is due to the fact that in Japan, urea resin is being utilized to produce adhesives for laminated boards, while in the U.S.A., phenolic resins are mostly used for producing the adhesives.

The picture of resin-wise market is comparatively clear in the case of U.S.A. In this country, the importance of construction materials, packaging materials, and electric equipment is greater than other directions of use of plastic resins.

(2) Western Europe

The plastics production in Western Europe amounts to approximately 150,000,000 tons, of which West Germany is holding slightly less than 5 million tons, followed by Italy, France, England, and the Netherlands. All of these countries named have more than one million tons production capacity.

(a) West Germany -

The plastic production in West Germany is summarized in Table AI-17. Table AI-18 shows the relationship among production, exports, imports, and domestic demand for the plastics.

The plastics industry in West Germany shows a complete oligopoly. The major chemical industrial group of the country, the so-called IG group, consisting of BASF,

Table AI-14 Plastics Production in the World

(Unit: 1,000t)

	Country	1967	1968	1969	1970	1971	1972
Asia	Japan	2,675.4	3,462.3	4,275.3	5,127.5	5,216.0	5,674.8
	Korea	11.5	12.6	14.0	44.9	53.8	84.6
	India	36.2	55.1	85.0	93.0	103.0	110.4
	Taiwan	61.8	67.7	68.1	106.6	130.9	171.8
	Israel	30.0	30.0	30.0	32.0	36.0	(40.0)
	China	(200.0)	(250.0)	(280.0)	(320.0)	(400.0)	(400.0)
	Pakistan	(18.0)					
	Sub Total:	3,032.9	3,877.7	4,752.3	5,724.0	5,939.7	6,481.6
Africa	South Africa	(40.0)	(40.0)	(45.0)	(45.0)	(50.0)	(50.0)
West Europe	U.K.	1,112.0	1,244.0	1,346.0	1,458.0	1,580.0	1,608.0
	Netherlands	372.3	546.3	682.6	910.0	998.0	1,080.0
	Belgium	131.0	148.5	180.0	230.0	350.0	557.0
	Spain	182.0	272.0	292.5	380.0	448.0	460.0
	Portugal	17.9	18.6	25.6	26.0	27.0	32.8
	France	885.0	1,008.0	1,319.3	1,515.0	1,650.0	2,100.0
	Italy	1,310.0	1,425.0	1,490.0	1,740.0	1,890.0	2,124.0
	Switzerland	48.0	54.0	60.3	65.0	68.0	(70.0)
	Greece	6.0	9.0	20.3	20.3	37.0	(40.0)
	W. Germany	2,635.0	3,250.0	3,963.0	426.0	4,760.0	5,514.0
	Denmark	13.0	13.5	18.0	20.0	78.0	(80.0)
	Norway	78.0	81.0	94.5	100.0	130.0	(140.0)
	Sweden	180.0	229.5	276.7	310.0	345.0	420.0
	Finland	28.0	30.7	62.0	68.0	70.0	80.0
	Austria	106.0	127.4	158.6	190.0	208.0	233.0
	Sub Total:	7,104.2	8,457.5	9,989.4	11,358.3	12,639.0	14,538.8
East Europe	Poland	167.0	196.0	234.0	244.0	267.0	299.0
	Hungary	36.0	43.0	50.0	60.0	82.0	100.0
	Czechoslovakia	185.0	197.0	210.0	240.0	265.0	298.0
	Bulgaria	51.0	70.0	75.0	80.0	89.0	106.0
	Romania	108.0	135.0	170.0	225.0	251.0	274.0
	E. Germany	273.0	311.0	330.0	340.0	370.0	409.0
	Yugoslavia	75.0	95.0	95.0	96.0	97.0	113.0
	USSR	971.0	1,312.0	1,386.0	1,553.0	1,860.0	2,040.0
	Sub Total:	1,866.0	2,459.0	2,550.0	2,838.0	3,281.0	3,639.0
North America	U.S.A.	6,207.0	7,110.0	8,339.0	8,820.0	9,473.0	11,597.0
	Canada	273.6	296.1	350.2	380.0	431.0	504.0
	Sub Total:	6,480.6	7,406.1	8,689.2	9,200.0	9,904.0	12,101.0
Central & South America	Argentina	78.2	85.0	105.0	118.3	135.3	146.4
	Brazil.	141.0	155.0	170.0	189.4	228.8	(240.0)
	Venezuela	30.0	40.0	50.0	66.5	75.2	(80.0)
	Mexico	85.4	90.7				
	Chile	15.0	(90.0)	(200.0)	(220.0)	(240.0)	(260.0)
	Puerto Rico	30.0					
	Colombia	30.0					
	Peru	11.0					
	Sub Total	420.6	460.7	525.0	594.2	679.3	726.4
Oceania	Australia	169.0	192.0	210.0	240.0	254.3	303.6
	Grand Total:	19,113.3	22,893.0	26,760.9	29,999.5	32,747.3	37,840.4

Figures in ( ) are estimated.

Source: Japan Plastics, June, 1974

Table AI-15 Production of Main Plastics Resins in 1971

(Unit: ton)

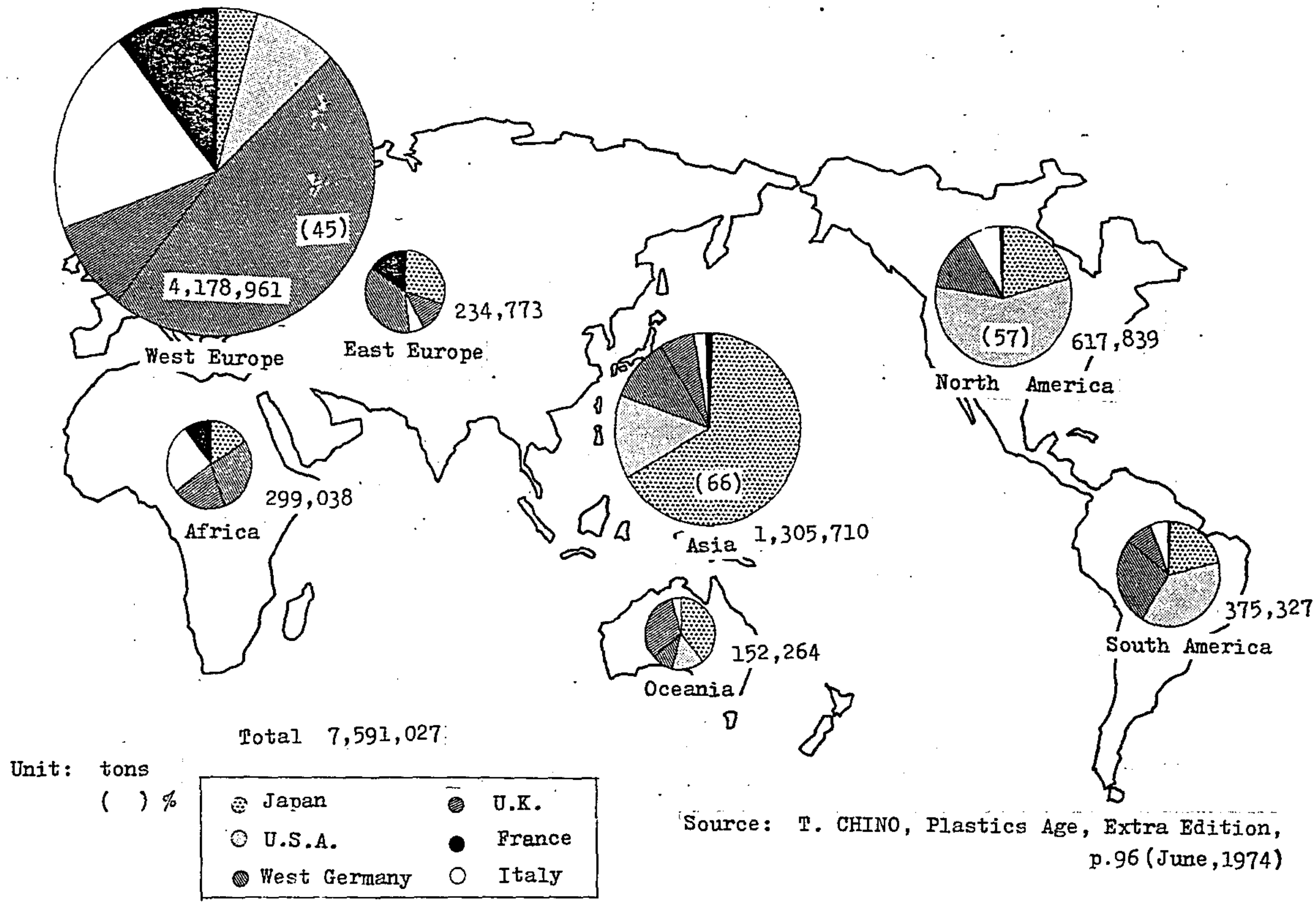
	Phenol resin	Urea Melamin resin	PE	PS*4	PP	PVC
U.S.A.	513,450	307,350	2,878,200	1,687,500	565,650	1,544,850
Japan	217,650	648,000	1,340,000	694,900	627,150	1,034,500
W. Germany	167,900	91,550*2	928,200	-*3	80,300	918,700
Italy	90,000	179,000	505,000	199,000	61,000	560,000
U.K.	74,000	169,000	368,000	182,000	78,000	335,000
France	22,500*1	-*3	499,000	147,000	24,600	455,000
TOTAL	1,085,500	1,394,900	6,518,400	2,910,400	1,436,700	4,848,050

NOTES: *1 Total of molding material only.

*2 Total of molding material only.

*3 Unknown.

*4 Includes polystyrene molding material, foaming, AS and ABS resin.



Source: T. CHINO, Plastics Age, Extra Edition, p.96 (June, 1974)

Figure AI-8 Area-wise Exportation of Plastic Materials from Major Countries (1972)

Table AI-16 U.S. Plastics Sales 1971/1973

(Unit: 10^3 tons)

Material	1971	1972	1973
Acrylic	-	208	233
Alkyd	132	290	342
Cellulosics	68	75	77
Coumarone-indene and petroleum resins	166	137	157
Epoxy	69	83	99
Nylon	-	67	80
Phenolic	540	651	654
Polyester	316	416	496
Polyethylene, high density	864	1,062	1,254
Polyethylene, low density	1,974	2,372	2,664
Polypropylene	590	766	978
Polystyrene and styrene copolymers	1,337	2,111	2,407
Polyvinyl chloride and copolymers	1,571	1,975	2,171
Other vinyls	284	370	391
Urea and melamine	357	411	464
Urethane foam	414	493	593
Others*	348	110	122
Total	9,030	11,597	13,182

*---Includes polyacetal, fluoroplastics, polycarbonate, silicones, and others.

Source: Modern Plastics Jan. 1974

Table AI-17 W. Germany

	1971	1972	1973
PE	928,199	1,051,916	-
PP	80,319	124,114	-
PVC	918,689	1,103,804	-
Methacrylate plastics	158,168	185,824	-
Phenol resin	167,881	173,412	-
Urea Melamine resin	91,550	132,309	-
UP	250,190	288,484	-
Others (including PS)	2,161,004	2,454,137	-
Total:	4,760,000	5,514,000	-

Table AI-18

a) Plastics Materials

(Unit: t)

	1972	1973	Rate of Increase	Composite Rate
Condensation polymer	1,730,571	2,074,520	+20	32
Addition polymer	3,558,327	4,165,237	+17	65
Cellulosics polymer	182,517	196,104	+7.5	3
Total:	5,471,415	6,435,861	+17.5	100

b) <u>Domestic Sales of Plastics</u>

(Unit: t)

	1972	1973	Rate of Increase	Composite Rate
Condensation polymer	1,404,399	1,654,677	+18	30
Addition polymer	3,165,618	3,681,982	+16	68
Cellulosics polymer	107,995	114,402	+ 6	2
Total:	4,678,012	5,451,061	+16.5	100

c) <u>Importation of Plastics</u>

(Unit: t)

	1972	1973	Rate of Increase	Composite Rate
Condensation polymer	270,814	348,878	+29	
Addition polymer	912,660	1,093,596	+20	
Cellulosics polymer	30,567	30,560	± 0	
Others	18,336	24,156	+31.6	
Total:	1,232,377	1,497,190	+21.5	

d) <u>Exportation of Plastics</u>

(Unit: t)

	1972	1973	Rate of Increase	Composite Rate
Condensation polymer	600,581	696,296	+16	
Addition polymer	1,699,015	2,040,526	+20	
Cellulosics polymer	53,356	60,858	+14	
Others	6,453	7,774	+20.4	
Total:	2,359,405	2,805,454	+19	

Hoechst, and Bayer is exerting an extremely strong influence on the industrial sphere. As shown in Table AI-19, BASF and Hoechst are dominating the market as far as the major five types of resins are concerned. This extent of domination is not seen in any other countries of the world.

(b) Italy -

Italy produces 2,160,000 tons of plastics, thereby assuming the third place following West Germany and France as shown in Table AI-20. In the case of Italy, PVC resin assumes approximately one-third of the total plastics production as shown in Table AI-21. This is not only due to the high amount of the production of PVC itself, but also to the relatively low ratio of the production of phenolic resins, urea, melamine and other thermosetting plastics.

The breakdown of the products by application in Italy is given in Table AI-22. This table clearly shows that the application in packaging, construction and furniture industries is great, while the automotive parts, and electrical devices are rapidly growing as the fields of application.

(c) England -

The trend of plastics production in England is shown in Table AI-23.

(Unit: thousand tons)

Productions	1,886	Consumptions	1,830
Imports	510	Exports	745
Total Supply	2,396	Total Demand	2,575

As shown in the above table, the demand exceeded the supply in 1973. Especially in regards to HDPE for which the consumption was 96,000 tons and exports 19,000 tons, the production was only 75,000 tons. Further, approximately 40,000 tons, i.e., about 35% of the demand, was fulfilled b by imports from West Germany and U.S.A.

The per capita consumption in England in 1973 was 35kgs which is comparatively low for an advanced industrial country. However, it should be noted that raw materials for the production of plastics in England are regulated by a quota system.

The polyethylene production in England is suffering from a severe difficulty due to the shortage of benzene. This difficulty is felt not only by England, but also by other European countries and the U.S.A. as well. As a result, 10% of the total market demand which represents approximately 20,000 tons of polystyrene is in short. An adverse influence on the plastics industry is also exerted by the shortage of auxiliary materials for plastic production, for example, stabilizers and pigments.

Table AI-19 Plastics Oligopolic Table in W. Germany

(Unit: 10^3tons)
( ): %

	LDPE	HDPE	PP	PS	PVC
BASF Group	518		27	265	380
	(83.8)		(12.9)	(72.6)	(43.8)
HOECHST Group	-	265	150	-	207
		(62.8)	(71.8)	-	(23.9)
BAYER Group	100	40	-	10	-
	(16.2)	(9.5)	-	(2.9)	-
Total capacity in W. Germany	618	422	209	365	867
	(100)	(100)	(100)	(100)	(100)

(as of 1973-end)

Table AI-20

Production and Consumption of Plastics in Italy (1,000 ton)

	Consumption			Production	
	1972	1973	%	1972	1973
PS (including expandable)	190.0	213.0	13.7	188.0	218.0
ABS and SAN	43.0	54.6	26.9	35.0	42.0
PMMA	15.2	16.6	9.2	18.2	19.5
PA	11.8	16.4	39.0	11.0	15.5
PU foam	65.5	83.0	26.7	74.0	86.0
LDPE	407.0	486.0	19.4	450.0	515.0
HDPE	98.0	115.0	17.4	120.0	146.0
PP (excluding fibres)	73.0	92.0	25.9	113.0	160.0
PVC and copolymers	405.0	478.0	18.0	617.0	720.0
Polyesters	47.4	55.4	17.3	55.0	65.0
Phenolics	56.0	60.5	8.0	56.0	51.0
Other thermosettings	74.9	81.5	8.8	101.0	106.0
Others	20.2	26.2	29.7	6.0	7.0
Total	1,507.0	1,782.0	18.2	1,844.0	2,161.0

European Plastics News, June '74

Table AI-21 Production Ratio for Plastics in Major Countires

	U.S.A.		W. Germany		Italy		France		U.K.		Japan	
LDPE	20.2		19.8		23.9		24.7		23.3		16.3	
HDPE	9.5	37.1		22.0	6.8	38.1	5.8	32.4	4.0	35.1	9.6	37.2
PP	7.4		2.2		7.4		1.9		7.8		11.3	
PVC	16.5		20.2		33.3		25.6		21.7		20.2	
Styrenes	18.3		?		12.0		11.2		13.6		13.2	
TOTAL:	71.9		42.0 + α		83.4		69.2		70.4		70.6	

Table AI-22 Breakdown of Consumption by Sector

(Unit: 10^3 tons)

	1972	%	1973	%	1972/1973 %
Packaging	485.0	31.78	557.0	32.30	14.8
Building	176.8	11.58	182.1	11.50	2.9
Furniture	120.8	7.91	145.0	8.30	20.0
Housewares	68.0	4.45	74.4	4.40	9.4
Toys and sport	44.8	2.95	50.1	2.70	11.8
Radio/TV	18.6	1.22	20.0	1.10	7.5
Housewares	85.4	5.65	93.3	5.40	9.2
Electrical	80.4	5.26	97.0	5.60	20.6
Automobile/batteries	71.5	4.68	78.1	4.60	9.2
Agriculture	60.3	3.97	80.2	4.60	33.0
Technical applications	115.0	7.55	135.6	7.60	17.9
Others	180.0	13.0	269.5	12.60	49.3
TOTAL:	1,507.0	100.0	1,782.0	100.0	18.2

(Source: EUROPEAN PLASTICS NEWS, JUNE '74)

Table AI-23

Trend of Plastics Production in England

	1974	1972	1973
LDPE	307,000	385,000	420,000
HDPE	63,000	70,000	75,000
PP	78,000	115,000	148,000
PS (GP,HI,FS)	167,300	194,000	216,000
ABS,AS	28,000	32,000	40,000
PVC	326,000	370,000	410,000
Acrylic resin	16,000	20,500	24,000
Phenol resin	64,000	54,000	56,000
Urea-Melamine resin	172,000	149,000	155,000
UP resin	38,000	48,000	52,000
Others	320,700	170,500	290,000
TOTAL:	1,580,000	1,608,000	1,886,000

(d) France

France is an outstandingly well-off plastics producer in Europe, and assumes the second place next only to West Germany. The production in 1973 was approximately 2,500,000 tons as shown in Table AI-24. This production displays an increase by 18.5% over the previous year, and an increment by 11.8% in consumption, the total being 2,430,000 tons.

One of the most outstanding characteristics of plastics industry in France is the great amount of import effects in the year 1973.

(Unit: thousand tons)

Production	2,550	(71.2%)	Consumption	2,430	(68.8%)
Imports	1,030	(28.8%)	Exports	1,100	(31.2%)
Total :	3,580	(100%)	Total :	3,530	(100%)

The corresponding ratio in other major countries are: West Germany, 19.1% for imports and 38.6% for exports; Japan, 3.2% for imports and 17.1% exports; and the U.S.A. no import and 5.2% exports. It is interesting that the import/export position of France in the EEC has been floating.

(3) Japan

Japan is the world's major plastics producing country next only to the U.S.A. In 1973, Japan registered a total production of 6,535,000 tons which showed an increase by 15.2% over the previous year. The supply/demand balance of Japan is shown in Table AI-26.

The plastics raw materials mounted to approximately 800 billion yen, and in terms of plastics products, the amount was 1,260 billion yen. The raw materials for plastics comprize a share of about 24% in the chemical industry, and 80% in the petrochemical industry of the country. These percentage figures clearly show mutual dependency of these two industrial sectors.

The Japanese plastics industry is export-oriented, thereby showing a rate of 17.1% allocated for export which represents an amount of 1,150,000 tons. On the other hand, the import is almost none. However, the export has been decreasing by approximately 20% from the 1972 level of 1,400,000 tons. The reason for this decrease is the shortage of products available for export due to the active domestic demand growth. Of the products, polysterene and vinyl chloride showed a particularly acute decrease as shown in Table AI-25.

The domestic production for vinyl chloride was 1,300,000 tons, LDPE 1,060,000 tons, polystyrene 850,000 tons in total, followed by urea resin of 610,000 tons.

Table AI-24

Plastics Production in France

(Unit: ton)

	1971	1972	1973
LDPE	415,000	486,000	630,000
HDPE	84,000	121,000	149,000
PP	24,600	39,000	48,000
PP (GP,HI,FS)	147,000	182,000	191,000
ABS.AS resin	147,000	85,000	95,000
PVC	455,000	539,000	654,000
Methacryate plastics	18,000	26,000	33,000
Phenol resin	*22,500	62,000	85,000
Urea-Melamine resin	115,000	160,000	195,000
UP resin	55,700	66,000	76,000
Others	313,200	334,000	394,000
TOTAL:	1,650,000	2,100,000	2,550,000

* Molding material only.

The increase in the resin production was remarkable in fluoric resin, polycarbonate, epoxy, polyamide and other similar industrial resins rather than the general-purpose plastics. This point is worthy of attention, as this implies that the Japanese plastics industry began to turn into quality production rather than the quantity work. (Refer to Table AI-27.)

The operational rates of plastics plants in 1973 are shown in Table AI-21. The table shows that the rate was 75% in the case of thermosetting resins and about 90% for thermoplastics resins, of which HDPE and PP were at full operation.

As to the forecast on the increase in the production in Japan in the future is expected to stagnate because of the aggravating general economic recession in 1974. From then onwards, however, various plastics production will increase by approximately 8% to 10% per year because of the expected restoration of the economy in the U.S.A. and West Europe. Further in 1978, the production of LDPE will approach the level of 1,500,000 tons as shown in Table AI-29. Both PP and PS will also exceed the one-million-ton mark.

Table AI-25 Exportation of Plastics from Japan

	1972 (10^3 tons)	1973 (10^3 tons)	'73/'72 (%)
PVC	142	117.5	82.6
PVC Compound	63	33	52.2
PVC Products	99	68	68.1
PS	82	56	68.2
ABS Resin	36	25	67.9
PE	505.5	400	79.1
PP	174	141	81.1

(4) Other countries

Countries other than those mentioned in the foregoing involve only the U.S.S.R. which produces more than one million tons (as of 1972) as far as plastics are concerned. The second largest in this category is Belgium, followed by Spain. These two countries producing almost 500,000 tons together, followed by East Germany which is turning out 400,000 tons. No countries other than these is worthy of mentioning here in terms of the significance of the scale of production. The actual production and forecasts on the plastics industry (however, not in terms of resin-wise basis) in East European countries are shown in Table AI-30.

Table AI-26 Shipments of Japanese Plastics Industries

(Unit: 100 Million Yen/%)

	Plastic Raw Material		Plastic Products		Total of Plastic Raw material & Products		Entire Chemical Industry		Petroleum Products	
	Amount of Shipment (A)	Comparison with the previous year	Amount of Shipment (B)	Comparison with the previous year	Amount of Shipment (A) + (B)	Comparison with the previous year	Amount of Shipment (C)	Plastic Raw Material Chem. Ind. (A)/(C), %	Amount of Shipment (D)	Plastic Raw Material Petro. Products (A)/(D), %
1965	2,289	-	-	-	-	-	13,007	17.8	2,525	90.7
1966	2,795	122.1	3,652	-	6,447	-	14,881	18.8	3,281	85.2
1967	3,443	123.2	4,440	121.6	7,883	122.3	17,185	20.6	4,075	84.5
1968	4,310	125.2	5,324	119.9	9,634	122.2	20,151	21.5	5,034	85.6
1969	5,295	122.8	6,360	119.5	11,655	121.0	23,375	22.6	6,690	79.1
1970	6,181	116.7	7,723	121.4	13,904	119.3	26,452	23.4	8,299	74.5
1971	6,156	99.6	8,372	108.4	14,528	104.5	27,826	22.1	8,771	70.2
1972	6,649	108.0	10.026	119.8	16,675	114.8	29,948	22.2	9,287	71.6
1973	8,000	120.3	12,600	125.7	20,600	123.5	32,900	24.3	9,900	80.2

1973 Figures are all estimated.

Source: Year Book of Chemical Industries Statistics compiled by Minister's Secretariat, Ministry of International Trade and Industry, and Plastic Products Statistics.

Table AI-27 Trends of Plastic Production (1971-73)

Unit : Quantity in tons, Composite Rate in %

Items	1971 Quantity	1971 Comparison with the previous year	1972 Quantity	1972 Comparison with the previous year	1973 Quantity	1973 Comparison with the previous year	1973 Composite Rate
Phenol resin	217,628	99.3	250,922	115.3	312,071	124.4	4.8
Urea resin	533,219	99.5	563,883	105.8	614,668	109.0	5.4
Melanine resin	114,710	112.2	119,507	104.2	141,014	118.0	2.2
UP	127,625	111.8	153,164	120.0	188,035	122.8	2.9
Alkyd resin	101,971	107.9	108,891	106.8	131,000	120.3	2.0
EP	20,001	-	27,737	138.7	36,375	131.1	0.6
Silicon resin	10,289	120.2	13,800	134.1	16,322	118.3	0.2
Urethane foam	93,675	109.5	119,967	128.1	145,889	121.6	2.2
Thermosetting resin Sub Total:	1,219,118	105.1	1,357,871	111.4	1,585,375	116.8	24.3
PE (Total)	1,340,000	102.7	1,480,225	110.5	1,671,695	112.9	25.6
(LDPE)	950,715	106.3	997,212	104.9	1,059,963	106.3	16.2
(HDPE)	389,285	94.8	483,013	124.1	611,732	126.6	9.4
PS (Total)	694,874	104.0	795,758	114.5	854,998	107.4	13.1
(GP.HI)	409,088	101.3	408,789	99.9	426,844	104.4	6.5
(FS)	90,497	101.8	106,483	117.7	123,815	116.3	1.9
(AS)	41,915	112.6	85,390	139.3	56,863	97.4	0.9
(ABS)	153,374	110.9	222,096	144.8	247,476	111.4	3.8
PP	627,161	107.9	617,554	98.5	693,318	112.3	10.6
Polybutene	16,250	144.3	20,530	126.3	21,510	104.8	0.3
Petrqeum resin	46,152	121.7	59,022	127.9	70,296	119.1	1.1
PVC	1,034,521	89.1	1,079,669	104.4	1,318,351	122.1	20.2
PVA	94,162	102.6	99,602	105.8	112,462	112.9	1.7
Vinylidene chloride	20.007	113.7	21,440	107.2	25,378	118.4	0.4
Methacryate plastics	60,381	109.3	70,285	116.4	91,704	130.5	1.4
PA	21,672	133.1	28,731	132.6	37,416	130.2	0.5
PC	12,909	94.9	13,953	108.1	17,369	124.5	0.3
Fluorocarbon resin	1,090	78.3	1,263	114.9	1,835	145.3	0.0
Other thermoplastics	27,676	-	28,879	-	33,080	114.6	0.5
Thermoplastics Sub Total:	3,996,864	-	4,316,914	-	4,949,412	114.7	75.7
GRAND TOTAL:	5,215,982	-	5,674,785	-	6,534,787	115.2	100.0

Note: In the column, "other resins" contains polyvinylbutyral, polyvinylformal, acetyl cellulose, plastic, nitrocellulose (others), celluloid material (newly made), and proteinic adhesives.

Table AI-27 (b) Trend of Plastic Production in Japan

(Unit: t)

	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973*
Phenolic resin	42,803	76,379	98,326	125,441	153,323	186,567	219,118	217,628	250,922	304,000
Urea resin	127,904	249,107	292,682	338,605	408,783	471,574	535,935	533,219	563,883	600,000
Melamine resin	11,526	44,048	57,366	74,981	92,165	83,691	102,250	114,710	119,507	137,000
UP	14,429	37,539	46,388	57,969	75,892	95,677	114,143	127,625	153,164	185,000
Alkyd resin	18,917	51,201	59,550	76,205	78,428	89,538	94,544	101,971	108,891	128,000
EP								20,001	27,737	35,000
Silicone resin	1,417	2,569	3,428	4,839	5,367	7,281	8,560	10,289	13,800	17,000
Urethone form		39,668	47,367	46,489	52,737	66,338	85,536	93,675	119,967	140,000
Thermosetting resin Sub Total:	216,996	500,511	605,127	724,529	866,695	1,000,666	1,160,086	1219,118	1,357,871	1,546,000
LDPE	25,729	303,564	439,475	580,970	633,788	769,966	894,332	950,715	997,212	1,050,000
HDPE	15,450	92,700	116,908	166,785	222,835	319,448	410,438	389,285	483,013	620,000
PSC (molding material)	21,903	62,774	133,208	176,104	234,938	316,342	440,028	409,088	408,789	430,000
PS (for forming)		19,484	27,505	38,948	54,052	72,858	88,926	90,497	106,483	122,000
AS resin		11,141	13,378	20,386	24,924	32,750	37,222	41,915	58,390	55,000
ABS resin		12,073	26,047	42,573	69,128	102,886	138,277	153,374	222,096	242,000
PP		57,520	99,723	170,201	290,571	421,623	581,091	627,161	617,554	730,000
Polybutene							6,780	16,250	20,530	22,000
Petroleum resin						27,345	37,926	46,152	59,022	67,000
Acrylic resin	2,822	12,370	17,176	24,275	33,471	45,665	55,224	60,381	70,285	88,000
PVA (except textiles)					57,192	77,561	91,812	94,162	99,602	109,000
PVC	258,081	482,973	485,386	697,967	941,838	1,047,075	1,161,467	1,034,521	1,079,669	1,300,000
Vinylidene chloride (except textiles)	2,393	4,144	4,969	5,459	5,835	8,171	17,600	20,007	21,440	24,000
PA	658	4,123	6,320	8,184	10,213	12,343	16,281	21,672	28,734	36,000
Fluorocarbon resin	79	290	608	984	861	1,143	1,403	1,099	1,263	2,000
PC		3,698	3,626	4,253	5,919	8,817	13,598	12,909	13,953	18,000
Other resins	31,203	25,765	28,282	29,449	27,682	29,280	28,453	27,676	28,879	33,000
Thermoplastic resin Sub Total:	358,318	1,112,619	1,402,701	1,956,547	2,613,627	3,293,273	3,984,858	3,996,864	4,326,914	4,894,000
GRAND TOTAL:	575,314	1,613,130	2,007,828	2,691,076	3,480,322	4,293,939	5,144,944	5,215,982	5,684,785	6,440,000

(Year Book of Chemical Industry: Compiled by MITI)

NOTES: 1) Polystyrene (molding material) contains general purpose (GP) materials and high-impact resistant molding materials (HI).

2) In the column, "Other resins" contains polyvinylbutyral, polyvinylformal, acetyl cellulose, plastic, nitrocellulose (others), celluloid material (newly made), and proteinic adhesives.

3) 1973 figures are estimated.

Table AI-28 Trends of Production Facility Capacity of Major Plastics Production and Estimation of Operational Rate in 1973 (Japan)

	Capacity of Production Facility			Estimation of Actual Production in 1973	Operational Rate
	Dec. 1971	Dec. 1972	Sept. 1973		
Phenol resin	311,000	359,000	393,000	304,000	77.4
Urea resin	809,000	810,000	822,000	600,000	73.0
Melamine resin	178,000	178,000	200,000	137,000	68.5
U.P.	199,000	220,000	246,000	185,000	75.2
E.P.	46,000	51,000	51,000	35,000	70.6
LDPE	981,000	1,100,000	1,200,000	1,050,000	87.5
HDPE	493,000	600,000	600,000	620,000	103.3
PS	952,000	1,070,000	1,070,000	849,000	79.3
PP	647,000	767,000	767,000	730,000	95.1
Polybutene	23,000	23,000	23,000	22,000	95.7
PVC	1,684,000	1,650,000	1,600,000	1,300,000	81.3
Vinylidene chloride	25,000	25,000	39,000	25,000	64.0
PVA	251,000	253,000	255,000	111,000	43.5
Methacryate plastics	90,000	82,000	102,000	90,000	88.2
PA (Coprolactam)	(401,000)	(448,000)	(461,000)	36,000	-
PC	19,000	19,000	20,000	18,000	90.0
Petroleum resin	37,000	70,000	72,000	67,000	93.1

NOTES: * Source of Production Facility Capacity is Year Book of Chemical Industries Statistics compiled by Minister's Secretariat, Ministry of International Trade and Statistics.

** Polystyrene includes polystyrene molding material, foaming material, AS resin and ABS resin.

(Plastics - Jan. 1974)

Ref : Textile Materials

Unit: Quantity in tons, Composite Rate in %.

Items / Year Classification	1971 Quantity	1971 Comparison with the previous year	1972 Quantity	1972 Comparison with the previous year	1973 Quantity	1973 Comparison with the previous year	1973 Composite Rate
Vinyl acetate	438,484	97.6	455,308	103.8	497,974	109.4	44.5
PVA	91,048	97.5	83,204	91.4	85,689	103.0	7.7
Vinylidene chloride	5,478	110.1	4,761	86.9	4,307	90.5	0.4
Acetyl cellulose	60,979	112.7	67,344	110.4	70,029	104.0	6.3
Caprolactam	376,199	107.7	401,962	106.8	459,341	114.3	41.1
TOTAL:	972,188	102.2	1,012,579	104.2	1,117,340	110.3	100.0

Table AI-29 Estimation of Plastic Demand (Calendar Year)

Products			1973			1974			1975			1976			1977			1978		
			(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
HDPE		Domestic	899,649	15	79	890,000	-1	79	952,000	7	81	1,019,000	7	80	1,089,000	7	80	1,170,000	7	80
		Export	233,382	-20	21	230,000	-1	21	230,000	-	19	250,000	9	20	270,000	8	20	290,000	7	20
		TOTAL:	1,133,031	6	100	1,120,000	-1	100	1,182,000	6	100	1,269,000	7	100	1,359,000	7	100	1,460,000	7	100
LDPE		Domestic	450,664	47	75	477,400	6	76	532,700	12	76	595,400	12	77	665,800	12	78	745,400	12	80
		Export	151,893	-12	25	150,000	-1	24	165,000	10	24	180,000	9	23	185,000	3	22	185,000	-	20
		TOTAL:	602,577	26	100	627,400	4	100	697,700	11	100	775,400	11	100	850,800	9	100	930,400	9	100
PP		Domestic	576,005	17	80	591,000	3	80	667,000	13	81	734,000	10	82	802,000	9	83	871,000	9	84
		Export	146,814	4	20	147,000	-	20	153,000	4	19	158,000	3	18	162,000	3	17	167,000	3	16
		TOTAL:	722,819	14	100	738,000	2	100	820,000	11	100	892,000	9	100	964,000	8	100	1,038,000	8	100
PS	General use & impact resistant use	Domestic	387,730	20	86	415,660	7	86	470,390	13	83	526,070	12	84	589,840	12	86	660,950	12	87
		Export	62,000	-27	14	70,000	13	14	95,000	36	17	100,000	5	16	100,000	-	14	100,000	-	13
		TOTAL:	449,730	10	100	485,660	8	100	565,390	16	100	626,070	11	100	689,840	10	100	760,950	10	100
	For foaming	Domestic	141,000	33	100	147,800	5	99	163,200	10	99	180,400	11	99	199,900	11	99	221,500	11	99
		Export	-	-	-	2,000	-	1	2,200	10	1	2,400	9	1	2,600	8	1	2,900	12	1
		TOTAL:	141,000	32	100	149,800	6	100	165,400	10	100	182,800	11	100	202,500	11	100	224,400	11	100
	AS resin	Domestic	43,151	28	93	45,450	5	93	50,460	11	93	56,040	11	93	61,910	10	93	68,080	10	93
		Export	3,380	-27	7	3,400	-	7	3,740	10	7	4,110	10	7	4,530	10	7	4,980	10	7
		TOTAL:	46,531	21	100	48,850	5	100	54,200	11	100	60,150	11	100	66,400	10	100	73,060	10	100

Notes: (a) = Quantity
(b) = Increase rate
(c) = Composite ratio

Table AI-30. Eastern Europe

Plastics Production

	1972	1973	1975
USSR	2,035	2,295	3,533
East Germany	455	-	700
Romania	274	313	520-565
Czechoslovakia	297	356	500
Poland	200	336	428
Hungary	100	-	150
Bulgaria	110	130	140

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Table AI-31 shows the production capacities of the major five resins. The table clearly shows a low extent of production capacity.

Regarding the U.S.S.R., it has been stated by the Institute Fuer Ostmarktforschling (East European Market Research Institute) in Hamburg that the Russians produced approximately 1,560,000 tons in 1970, and further it is estimated that the production will grow to 4,322,000 tons by 1975.

Table AI-31. Plastic Production Capacity in Communist Bloc

10^3 t/y	LDPE	HDPE	PP	PS	PVC
East Germany	60				
Yugoslavia	50	(50)			18 (60)
Hungary	24				27 +(18)
Rumania	60				
USSR	144 +(240)	(200)	30		30
Poland	14		30		
Bulgaria	24			15	150
Czechoslovakia			30		100
China				30	

In ( ) : Either under production or under planning stage

Note: The figures in parentheses show either onstream, or contemplation stage.

The U.S.S.R. is plastics importing country at present. In view of the production target of 3,500,000 tons set forth for 1975, the country will have to import approximately 800,000 tons continually as the demand is still higher than the supply capacity.

The Japanese plastics industrial sphere estimates that the entire East European demand (including the U.S.S.R.) in 1975 will be as shown in Table AI-32. Here, the required imports are estimated after taking the production capacity in ER bloc into consideration.

Table AI-32 Demand & Required Imports for East European Block

(Unit: 10^3 tons)

	1975		1980	1990
	Demand	Import	Import	Import
PE	1,153	346	327	530
PVC	1,264	379	454	490
PP	190	57	58	100
PS	154	46	86	100
TOTAL:	2,761	828	925	1,220

2.2 Future Prospects of Exports from Major Exporters and their Influence on the Philippine Market

2.2.1 Future Aspect of Petrochemical Industry in the World

It has become quite difficult for the developed industrial countries to expand the scale of petrochemical industry because of the aggravating problems in obtaining raw materials, utilities, and lands for plant construction. The situation is further affected by sudden rise in the construction costs and the pollution problems.

Each country is intending to expand the domestic petrochemical industry to meet the demand increase including exports to limited to neighbouring countries. However, it has now become much more difficult than before to carry out the exportation of enourmous quantity of the demanded products even if the capacities were expanded.

On the contrary, the oil producing countries which are rich in natural gas and naphtha are in a position to develop the petrochemical industries. Generally, the domestic consumption of petrochemical products in these countries has not been high enough to warrant construction of the plants. If the plants were to be constructed, the petrochemical products would have to be export-oriented, and the export commodities would have to be destined mainly to those countries in which their own domestic petrochemical industries have not yet been established.

On the other hand, the new-comer countries in the petrochemical industry usually desire to carry out the production commensurate with the scale of the domestic consumption, while undertaking the so-called international sharing of the production of specialized items.

A further projections regarding the petrochemical industries in the Asian countries are listed briefly in Table AI-33.

2.2.2 International Competition of Petrochemical Products:

In order to compare the construction cost in the new-comer countries which are planning an embarkation on petrochemical industry, and that of the Philippines and Japan, calculations were made for the production cost of ethylene and LDPE as representative examples. Figures AI-9 and AI-10 show the computed results of the cost of ethylene and LDPE production in the year 1980 in Indonesia, Mideast, Singapore, the Philippines, and Japan.

The main prerequisite conditions for the production cost calculations are shown in Table AI-34. The sales price of ethylene has been calculated by incorporating an adequate profit at 10% return on fixed assets, and sales tax, after assuming 15% of IRR. The price of naphtha was assumed as US$222/metric ton in 1980 without the specific tax.

As shown in Figure AI-9, the ethylene production cost figures for Indonesia and Mideast, where natural gas is used as raw material, are lower than those of the countries in which naphtha is used. This result is not only due to a lower price of natural gas, but also to a considerably high deduction of

Table AI-33 New Projections for Petrochemical Industries (Olefins) in Asian Countries

(Unit: 10^3 tons)

	Ethylene	LDPE	HDPE	PVC	PP	PS	Start of Operation	Notes
Japan	1,500	380	220	470	310	250	1978	Capacities of down stream are estimated by UNICO
South Korea	350	100	70	150 1)	80	100 2)	1978	Yosu
Taiwan	230	90*	25*	24*	50	50 2)	1975	*Expansion
China	493	240	-	-	80	-	-	
Thailand	134	70	30	40 1)	30	-	1977	Suspended
Singapore	300	120	50	120 1)	60	0	1978	
Indonesia	300	120	50	100	70	0	1980	Preliminary
India	- 3)	93	8	45	25	16	- 1980	
Australia	150	22	48	-	-	-	-	
	25	-	-	-	28	-	-	
Iran	300	100	60	150 1)	50	100 2)	1977	Bandar Shalpur
Saudi Arabia	300 - 500	-	-	-	-	-	-	

Notes: 1) VCM
2) Styrene monomer
3) - not avairable

the by-products. Concerning the production cost of LDPE in these two countries, the level is lower than the other countries; however, the difference here is not as significant as in the case of ethylene production.

In the latter half of 1970's, the export from Japan will comprize the majority of petrochemical products supply in the Southeast Asian region because of export capacity which will amount to approximately 20% of the total production. Therefore, the Japanese export prices will remain as the "leader price" in this region.

The natural gas price is now evaluated much higher than fuel in the Mideast countries, thereby securing much higher profit for them in the future. It seems reasonable to presume that the export price of petrochemical products from the Mideast countries will be lower than the Japanese prices, and the former will be extremely competitive when the business stagnating.

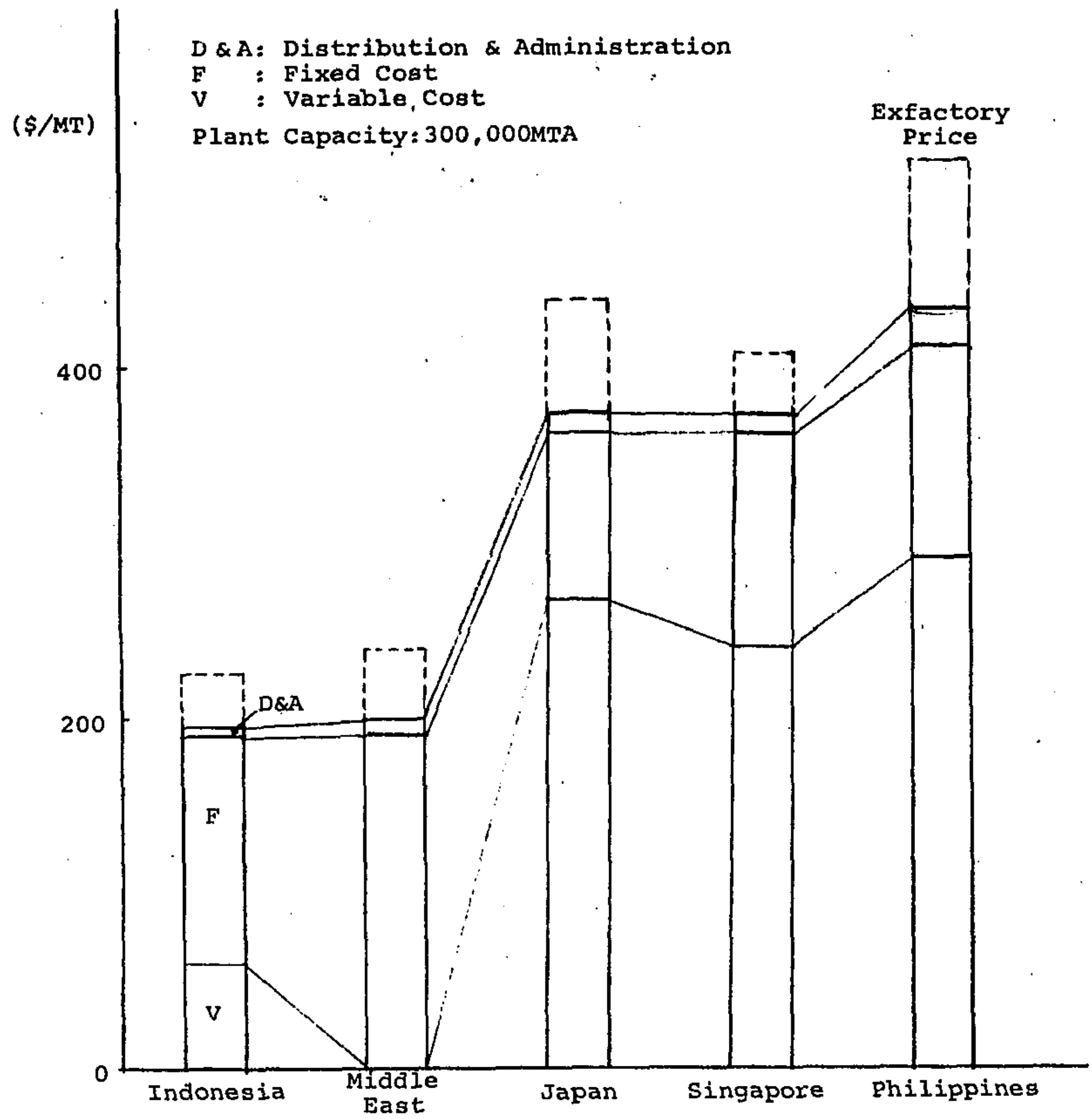


Figure AI-9 International Competitiveness of Production Cost in 1980, Ethylene

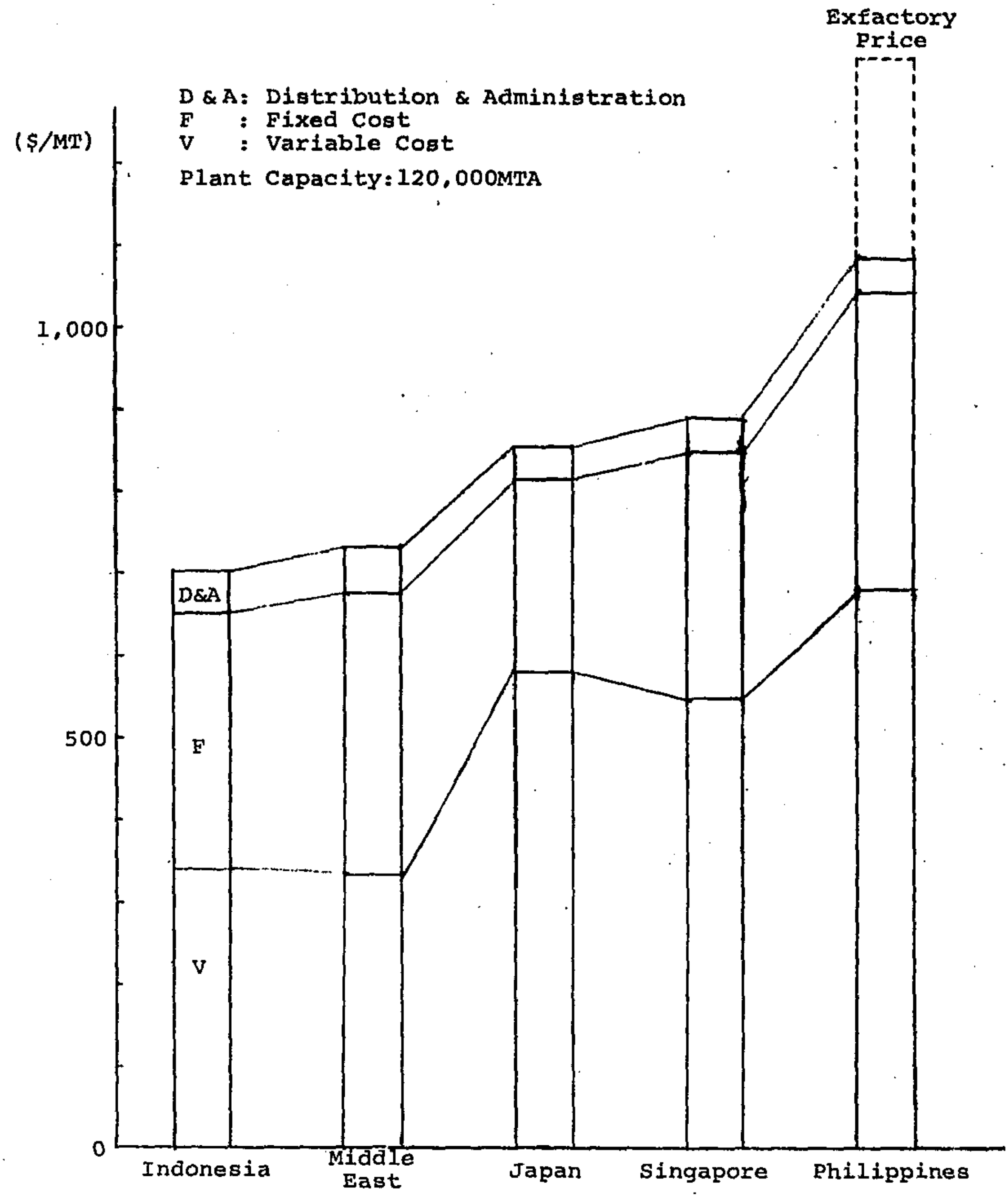


Figure AI-10 International Competitiveness of Production Cost in1980, LDPE

Table AI-34 Prerequisite Conditions for Comparison of Production Costs

	Indonesia	Middle East	Japan	Singapore	Philippine
Rate of Operation	85 %	80 %	95 %	90 %	90 %
Raw Material	Light Gas Condensate	Light Gas Condensate	Light Naphtha	Light Naphtha	Light Naphtha
Price of Raw Material* $/MT	70	28.8	185	168	222
Fuel Price* $/MMKcl	FG 60	FG 2.26	FO 9.52	FO 9.24	FO 16.8
Labour Cost* $/Year	2,500	4,500	10,500	2,900	3,920
Tax: Tax Holiday	5 years	5 years	- - -	1 - 5 years 0 % 6 - 8 years 4 % Over 8 years 40 %	***
Tax on Profit	45 %	55 %	53 - 54 %	40 %	35 %
Tax on Capital & Insurance	1.4 %	2.5 %	1.7 %	2 %	2 %
Interest:					
Long term loan	7.5 %	7.5 %	8 %	9 %	8.6**
Local loan	12 %	12 %	10 %	20 %	18 %
Project Life	10 years	10 years	9 years	10 years	15 years

* Estimated on the basis of 1980.

** Guarantee fee 1%/year is included.

*** Tax holiday on Sales Tax of average 50% and Tax Credit for expenses on investment.

3. Preliminary View on the Production Economics

3.1 Set up of Alternatives

In setting up alternatives for study, availability of raw materials, and nature and scale of market shall be taken into account.

As to the availability of the raw materials, the Government is contemplating to convert Filoil Refinery owned by PNOC to a refinery for raw materials production for petrochemical industries.

The Government requested a study on the availability of the raw materials in the following steps.

(1) Utilization of existing Filoil Refinery

(2) Debottlenecking of Filoil Refinery by adding a preflash column

(3) Introduction of the raw materials from other sources by either importing or domestic supply

Concerning the market, the complex is assumed to be oriented to the domestic market only because of its weakness in competitiveness against the products based on natural gas. The size of the domestic market is indicated by the Government. The study on the domestic market and on the proposed Filoil Refinery is requested to be reviewed and scrutinized by the Consultant.

However, the market size and nature, as well as the availability of the raw materials from the Filoil Refinery is scheduled to be also studied in detail, and is to be contunuously studied in the subsequent stage to this study. Therefore, these points cannot be clarified at the stage of orientation study.

This being the circumstance, the following assumptions were made for this study;

(1) Naphtha, gas oil and fuel oil can be fully delivered from the Filoil Refinery.

(2) As the market is not clarified at this stage, the study will be made by taking a certain range of capacity, so that the plant economy can be checked once the size of the market has been clarified.

On the other hand, the Government requested at the discussion for the orientation study a study on the following capacity ranges and raw materials for the ethylene plant:

1)	Plant capacity	150,000 MTA 200,000 MTA 250,000 MTA 300,000 MTA
2)	Raw materials	Naphtha Gas Oil Liquefied Petroleum Gas

Therefore, alternatives of ethylene plant have been set according to the requested capacity range and raw materials for the ethylene plant.

As to the down-flow products, the Government is placing a priority on certain capacities for olefin production in the seventh investment priorities plan.

The setting up of production schemes for these capacity ranges and market is scheduled to be scrutinized in the subsequent study. Only the production of LDPE will be reported in the orientation study. Therefore, the selection of alternatives for the LDPE plant will be made independently from the capacity of the ethylene plant.

In the seventh investment priority plan, the capacity of the LDPE plant is described as 115,000 MTA, and the study will be performed taking the following capacities centering around the capacity of 110,000 MTA of LDPE to check the economics of the plant when the market range is made clear.

LDPE plant	60,000 MTA
	80,000 MTA
	110,000 MTA
	140,000 MTA

As can be seen in the preceding description, the establishment of alternatives do not actually meet the situation of the Philippines. It would be necessary to set alternatives as a whole complex when the said assuption have been clarified in the course of the studies to be conducted at a stage subsequent to this orientation study.

3.2 Production of Ethylene from Different Materials

In this clause, an evaluation of raw material for ethylene production will be carried out. The influence of price of ethylene exerted on the production of Low Density Polyethylene (LDPE) will be separately studied in the clause which pertains to competitiveness with import (3.4 of this chapter).

Production cost calculations have been made for the raw material domestic naphtha, domestic gas oil, and imported LPG. The details of production cost are shown in Tables 4. in appendix I.

The order of advantage of raw materials is LPG, naphtha and then Gas Oil, in many cases in which these materials are indigenously available. Especially when by-products from an ethylene plant cannot be effectively utilized, as in the case of developing countries, this order of advantage is almost decisive. The underlying factor in defining this order is the difference in the yield from the raw materials.

When the ethylene yield is high, the construction cost, and consumption of utilities and raw material consumption will be low. Consequently, the production cost will be lower.

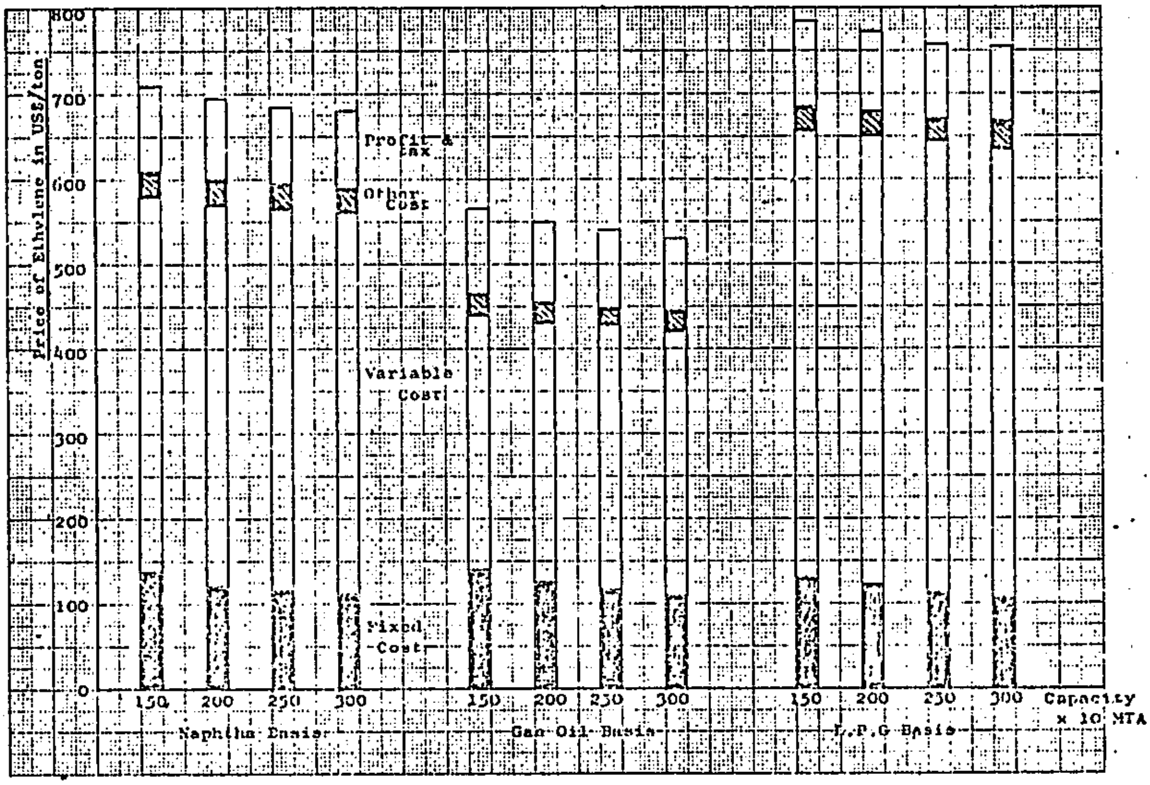
The results of calculations as shown in Fig. AI-11., nevertheless show that the order of advantage is gas oil, naphtha, and LPG, a reverse of the forgoing statement.

This may well be due to the provisions for taxes and prices for the raw materials particularly made in the Philippines.

As can be seen in the same figure, the variable costs take up the majority of the production cost. The variable costs, however, did not comprize such a remarkable portion in the production cost prior to the

Figure AI-11

Production Cost of Ethylene by different raw materials and different capacity



Note 1) The price of Raw Materials for the estimation as follows

Naphtha	US$ 274/t
Gas Oil	US$ 211/t
L.P.G	US$ 350/t

2) The details of Production Cost for Each 200,000 MTA Plant is shown in Table III.3.301 through III.3.303.

days of oil crisis.

Therefore, the price of raw materials greatly affects the economics of production plant.

The price of LPG, the raw material for ethylene production, is higher than that of other materials, as the transportation cost to Manila from abroad is high on its nature.

This being the fact, the employment of LPG as the raw material is not recommendable.

The prices of naphtha and gas oil used for the calculations are US$274/ton and 211/ton respectively, both of which includes the specific tax of US$57/ton and US$18/ton respectively as indicated in Table API-3 of Appendix I.

For a 200,000MTA ethylene plant, the production cost of ethylene is US$695/ton for naphtha and US$550/ton for gas oil. Thereby showing a considerable difference. (A plant with 200,000MTA capacity shall be used hereafter as an explanatory standard example.)

If the specific tax is excluded, the production cost for ethylene is US$520/ton by naphtha and US$490/ton by gas oil.

Here, the cost difference is not great.

In Japan and Europe, tax on naphtha is lower than the tax on gasoline. However, as stipulated in the National Internal Revenue Code, the tax on naphtha and gasoline is identical in the Philippines, so that the production cost of ethylene based on naphtha is considerably high.

Gas oil has more advangage not only in tax rate, but also in the low price level even before tax.

The price of naphtha is estimated at the gasoline price in order to ensure the same profitability for Filoil Refinery, as it may not be in a position to have gasoline for sale.

The price of such naphtha then will naturally be higher than the price of ordinary naphtha, as the former collects the profit comparable to that from gasoline.

On the other hand, the price of gas oil is estimated on the price level of diesel oil. Therefore, such a price is on a lower-than-normal level.

When utilizing the imported naphtha, the price is estimated to be US$230/ton. The production cost of ethylene is estimated to be US$560/ton which is on almost the same level as that of gas-oil-based ethylene. (This calculation is made by including the specific tax.)

Further, if the price of naphtha and gas oil is the same, the naphtha-based ethylene will be more advantageous than the gas-oil-based ethylene. The production cost difference here is about US$25 to US$75 per ton of ethylene, depending on the actual price of the raw materials.

These estimations which are not clear in Fig. AI-11 are evidently stipulated in Fig. AI-13 in 3.3 of this chapter.

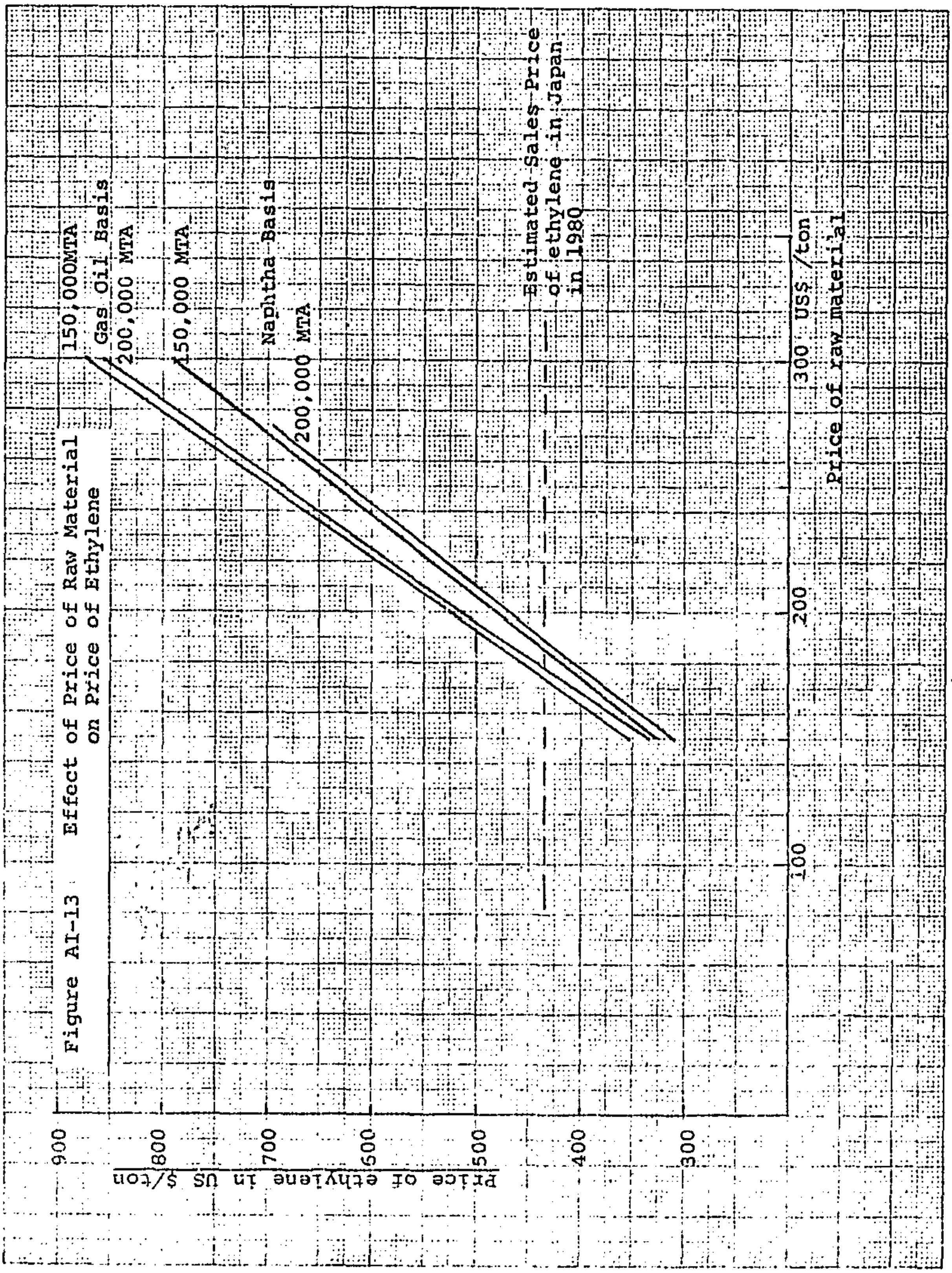


Figure AI-13 Effect of Price of Raw Material on Price of Ethylene

Therefore, at this stage in which no detailed study on Filoil Refinery is yet made without the clarification of the raw material availability and pricing policy, it is not possible to determine as to which raw material is more advantageous.

3.3 Production of Low Density Polyethylene

The production cost of low density polyethylene (LDPE) is estimated on the basis of plant capacity figures of 140,000MTA, 110,000MTA, and 80,000MTA.

The prices of ethylene range widely by the type, plant capacity and the employed raw material, however, they are taken as US$500, US$600 and US$700/ton.

The results of calculations on the production cost are summarized in Figure AI-12 . The details of production cost calculations for the cases of the above mentioned plant capacity and the ethylene price of US$600/ton are shown in 4-4 of Appendix I .

When compared with the price of imported LDPE in 1980 as estimated in Chapter 2 of Appendix III, the price of the LDPE in question is on an almost the same level as shown in Fig. II. 102.

This calculations indicate only the production cost of LDPE without reference to the scale of the domestic market. The relation between the scale of market and the sales price will be further scrutinized in the following part of this writing.

3.4 Preliminary View on Competitiveness

Examinations will be made in the following paragraphs here by taking low density polyethylene (LDPE) as the representative olefin product, regarding the competitiveness of the projected products with the imported products. Also examined here are the determination of the price for the raw materials for LDPE to be competitive with that of imported counterparts.

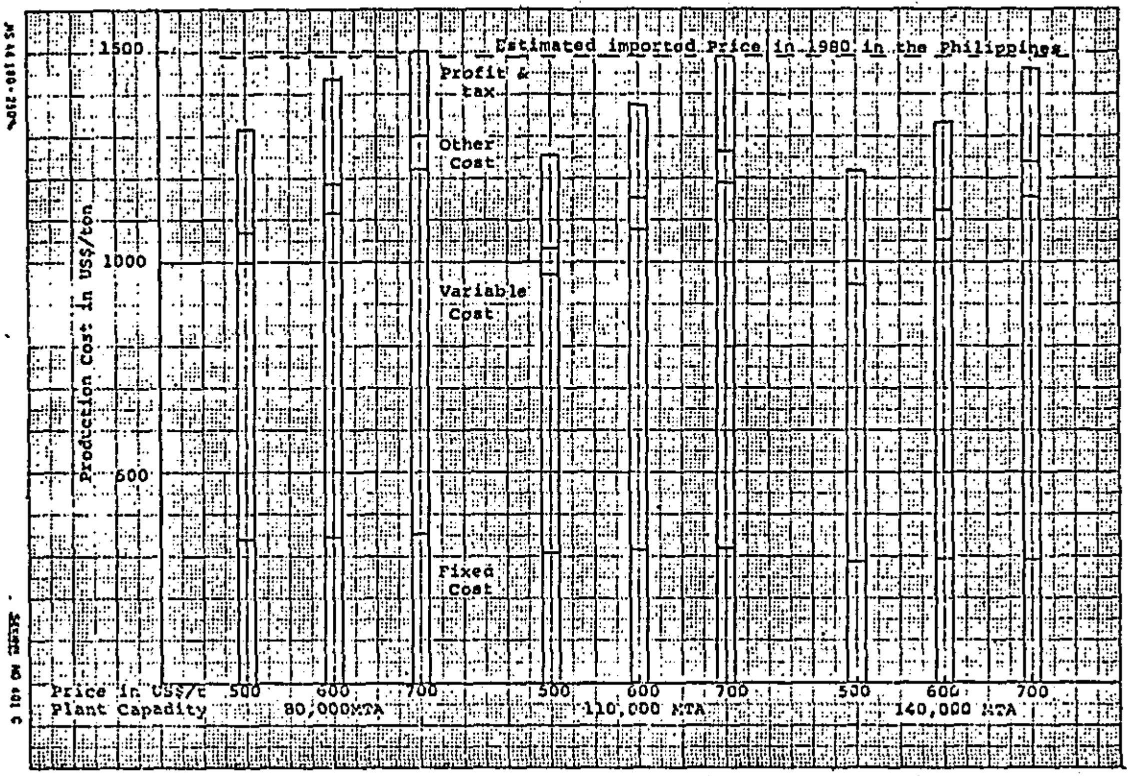
No decisive figure of the domestic market is obtainable at this orientation study stage. Therefore, the capacity of the LDPE plant has been set with a certain tolerance in range, and an assumption has been made on the relation between the domestic market and the product prices.

The price of imported LDPE, which includes ocean freight, insurance premium, a 30% import duty, etc., is estimated to be US$1490/ton in 1980 in the Philippines as explained in Chapter 2 of Appendix III.

However, the price may be different from what is estimated on the basis of demand/supply conditions. In order to partly cover such an event, a price level of US$1,190/ton, which is 20% lower than the estimated price has also been considered for study. The size of the market for the products and the prices of the products are deeply related. When the price of product goes up, the market will accordingly shrink. There is a certain correlation between these mutually opposing factors.

For the purpose of this study, an assumption is made that the scale of market for LDPE is 110,000MTA when the price of LDPE is at the level of US$1,190/ton; and further the scale of the market is 80,000MTA when the price is US$1,490/ton.

Figure AI-12 Production Cost of Low Density Polyethylene



Note ; Details of production cost for the case of 110,000 MTA capacity & ethylene price of 600 US$/ton is shown in table AIII.3.304

It is believed that this assumption is not far from the actual situation of the Philippines, a description of which is made in 2.1 of this part.

After the price of ethylene is estimated, the range of the prices for the raw materials has been settled, i.e., the plant capacity is taken as 150,000MTA for the production of 80,000MTA LDPE, and 200,000MTA for 110,000MTA LDPE.

Fig. AI-13 which shows the effects of the price of raw materials on that of ethylene, and the Fig. AI-14 which shows the effects of plant capacity and the price of ethylene on the price of LDPE are used for the estimation of the prices for ethylene and the raw materials.

When the price of LDPE in 1980 is at US$1,490/ton, the price of ethylene to be fed to an 80,000MTA LDPE plant will be less than US$645/ ton. Further, the price of raw materials will be US$234/ton for gas oil, and US$252/ton for naphtha.

The estimation procedure is shown in Figure AI-I5 .

When the price of LDPE is taken at US$1,190/ton, the market is assumed to be for 110,000MTA. The price of ethylene will then be US$450/ ton, and that of raw materials will be US$182/ton for gas oil and US$169/ ton for naphtha.

In view of the above-mentioned prices of raw materials, the tax imposed on naphtha should be decreased in the case of LDPE, the plant capacity of which is less than that planed by the Government.

In the case of 110,000MTA LDPE plant, even the price of naphtha itself should be decreased and tax exemption should be required.

For gas oil as the raw material, the same applies in the case of production at 110,000MTA.

This being the circumstance, the price of the supplied raw material such as naphtha or gas oil should be lowered by tax exemption, or by giving financial incentives to the raw materials suppliers or to the ethylene producers for the purpose of implementing a petrochemical industrialization in the Philippines.

Further, from the viewpoint of the prices of the raw materials, it seems that 80,000MTA of LDPE production is more profitable than 110,000MTA. The former scale does not call for market expansion efforts by reducing the price of LDPE.

However, in view of the national economy and the favourable effects of the LDPE production to the plastics processing industries in the Philippines, it seems worthwhile to keep the raw materials even lower either by tax exemption or duty exemption from crude oil which is a raw material for the petrochemical industry.

At the stage of this orientation study, only LDPE is taken as the representative olefin product.

The economics of other downstream production plants will also be studied when finally determining the price policy for the raw materials.

Figure AI-14 Effect of Price of Ethylene & Plant Capacity on Price of LDPE

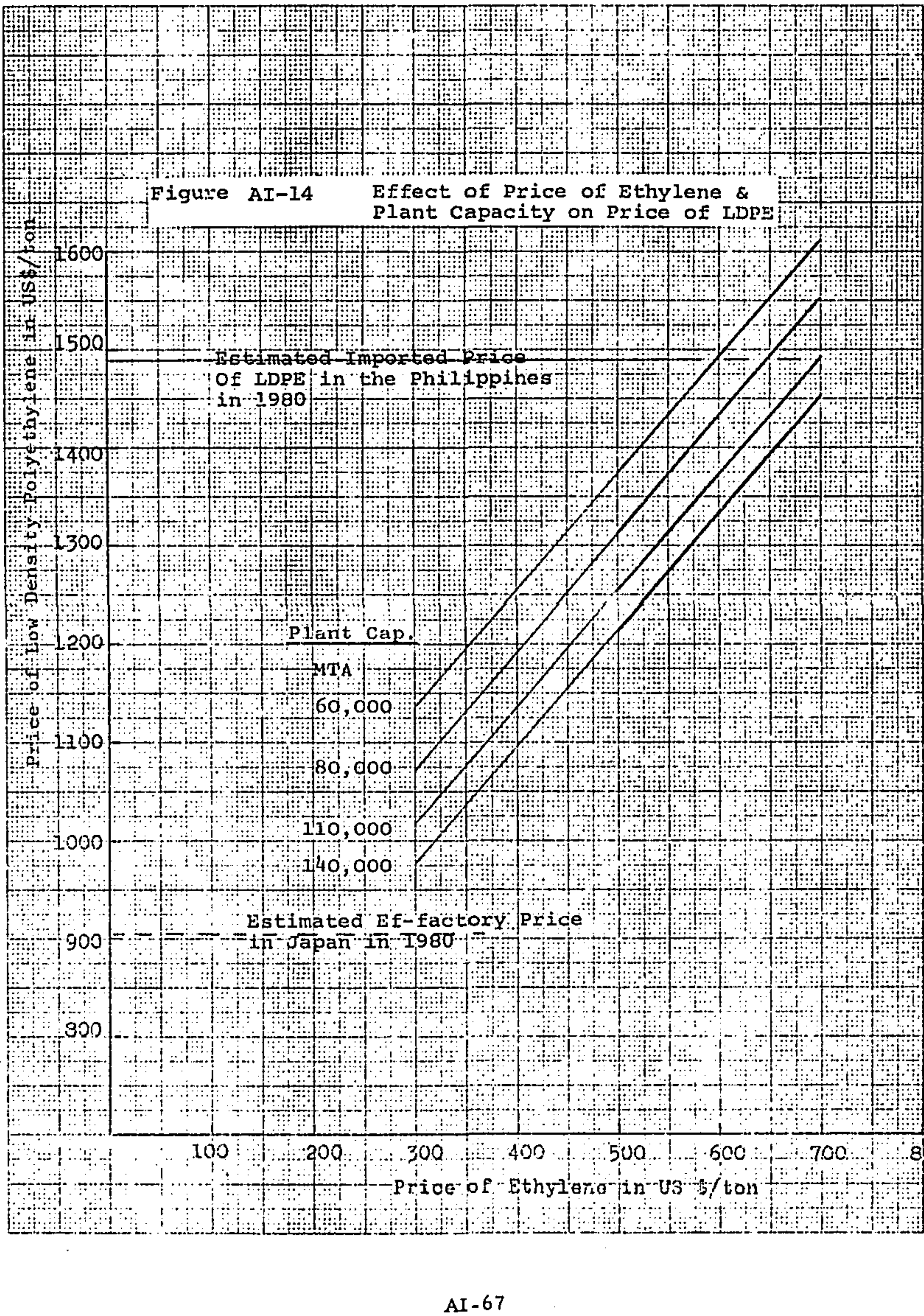
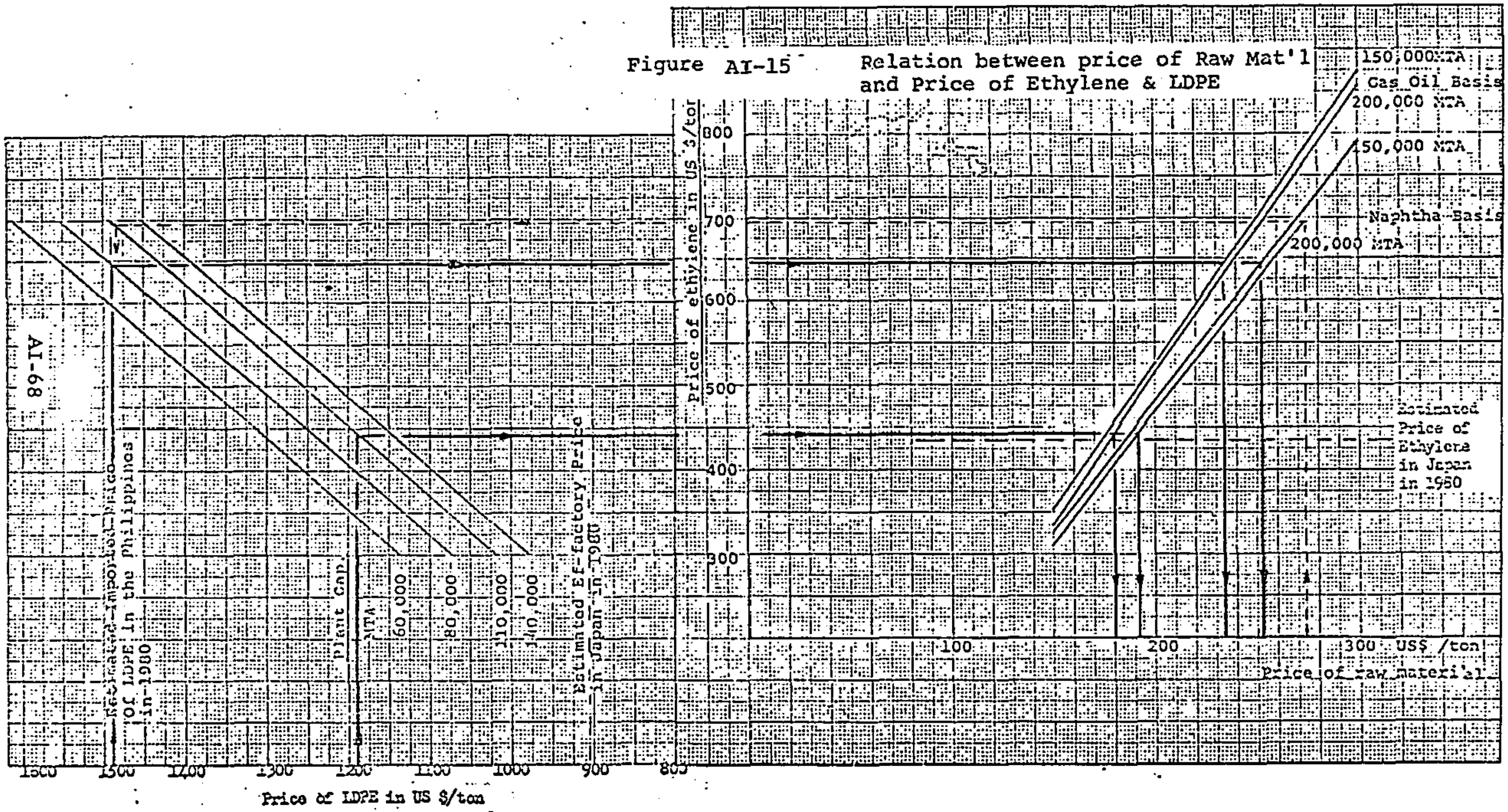


Figure AI-15 Relation between price of Raw Mat'l and Price of Ethylene & LDPE



3.5 Effects of Operational Rate

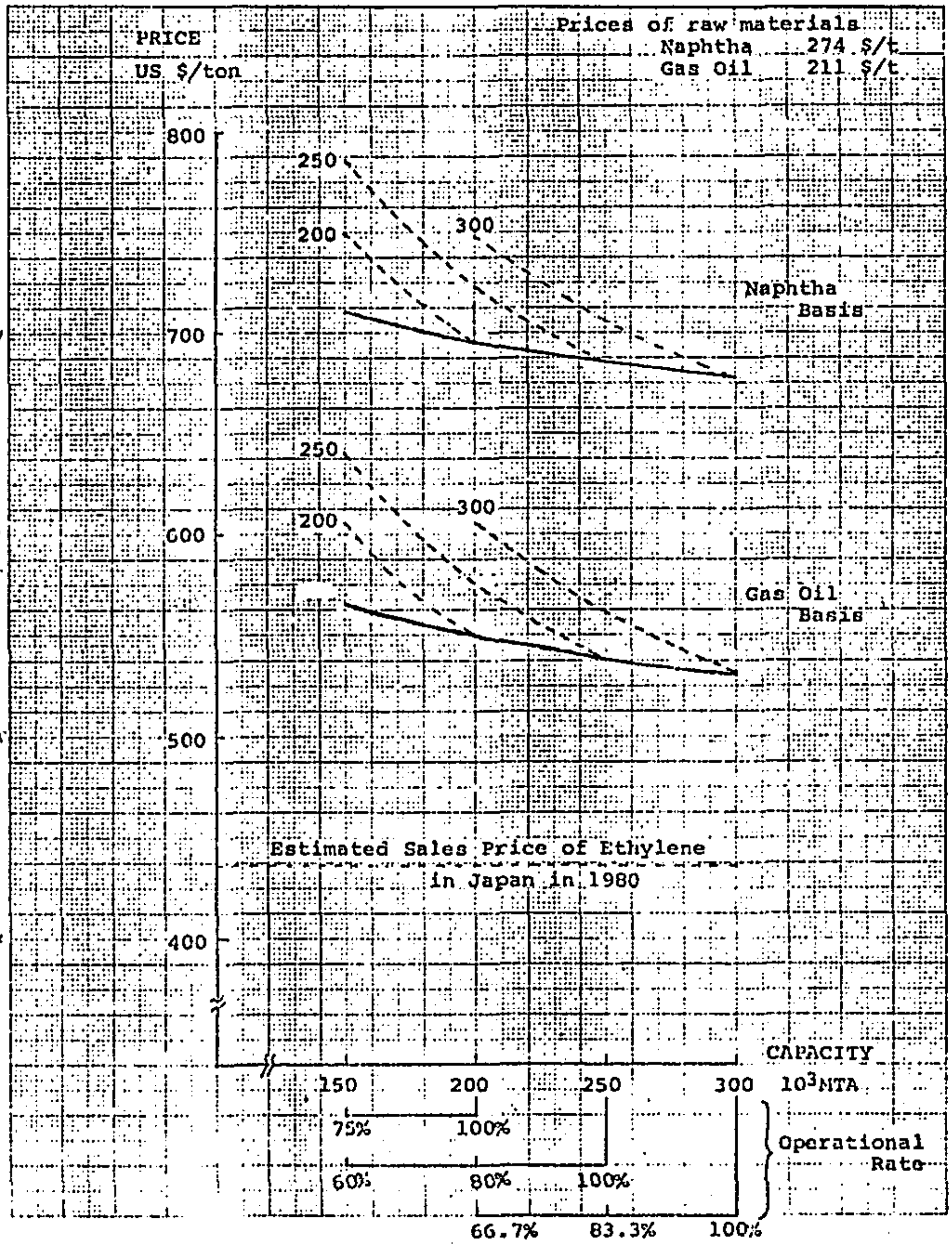
Generally speaking, it is not possible to keep a 100% operational rate in a plant. Fluctuations in the market or mechanical trouble in the plant will take place to affect the rate.

In some instances, a plant is constructed with a capacity to turn out products in a quantity much larger than the scale of the market. It is expected in such an instance that the market will grow to warrant the operation.

In order to check on this point, production on different operational rates has been studied. The results are shown in Fig. AI-16 for an ethylene plant, and in Fig. AI-17 for LDPE plant, having a 100,000 MTA capacity.

The operational rate of a plant is normally expected to be about of 90%. This factor will also be considered carefully when determining the incentives for raw materials, etc.

Figure AI-16
Effect of operational rate on price of Ethylene



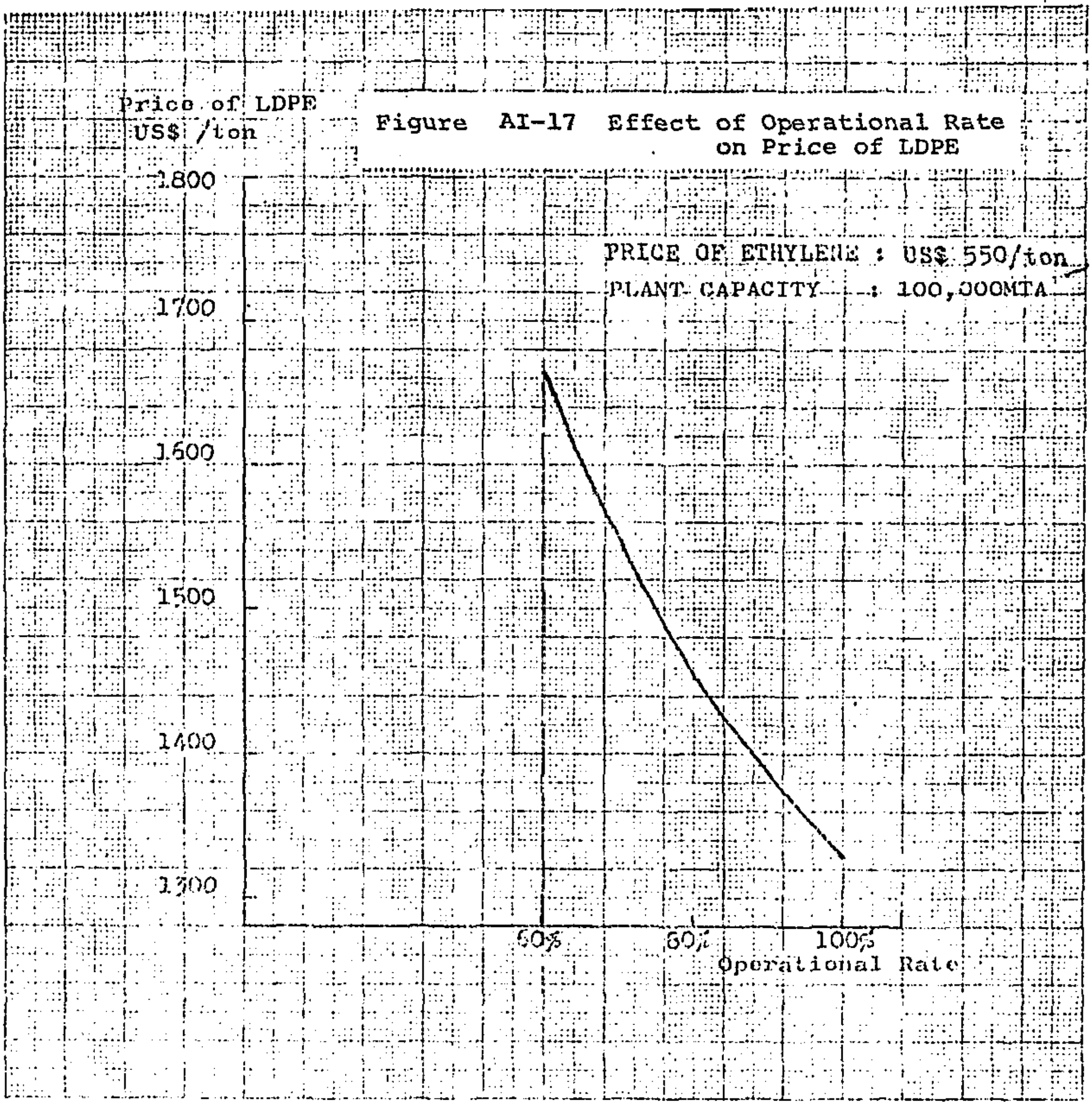


Figure AI-17 Effect of Operational Rate on Price of LDPE

ANNEX II

PRELIMINARY VIEW

OF

AROMATICS PRODUCTION

ANNEX II PRELIMINARY VIEW OF AROMATICS PRODUCTION

1. Preliminary View of Domestic Market Prospects in the Philippines

1.1 Introduction

Aromatics includes such compounds as benzene, toluene, xylene and their derivatives. The BTX are used for the production of synthetic fiber raw materials, phenol, styrene, and phthalic anhydride. In the Philippines, the demand for phenol and phthalic anhydride is low. Therefore, the aromatics are mainly consumed in the production of synthetic fibers and polystyrene.

However, in view of the synthetic fiber production in the Philippines in 1973 being less than 10,000 t/y, the demand for BTX is still very small. On the other hand, the demand for synthetic fiber is at least 30,000 t/y and the balance 20,000 t/y has been imported in the form of synthetic fiber filament yarn (FY) and staple fiber (SF). In the future, the demand for synthetic fiber will increase, and almost all the synthetic fiber for domestic consumption will be produced in the Philippines. At that time, the demand for BTX will increase and the necessary conditions for the establishment of the aromatics industry will be ready.

Therefore, forecasts will be made in the following paragraphs on the demand and production regarding synthetic fiber as a future market of aromatics industry.

1.2 Synthetic Fiber Consumption

1.2.1 Introduction

There are two sets of statistics which provide data concerning past synthetic fiber consumption in the Philippines, i.e., the "Foreign Trade Statistics of the Philippines" and the statistics prepared by the Food and Agriculture Organization (FAO).

However, these alone are not sufficient for the purpose of this study, as there are some defects in these compilations, that is to say, there are no available figures concerning material-wise consumption, e.g., consumption of polyester, nylon, etc.

This being the circumstance, past synthetic fiber consumption statistics have been prepared by summarizing Philippines-destined export statistics of eleven countries, i.e., Japan, U.S.A., Singapore, Hong Kong, Taiwan, Rep. of Korea, U.K., West Germany, France, Italy and the Netherlands. In the export statistics of these countries, synthetic fibers are being classified by materials. Thus, material-wise synthetic fiber import into the Philippines can be fairly correctly prepared.

In summarizing these foreign country export statistics, the blending ratios were estimated, and imports of blended fabrics were accordingly divided into material-wise synthetic fiber imports. When there is no description is available concerning the weight of the fabrics in the export statistics, average weight per square meter of Japanese synthetic fiber fabrics exported to Hong Kong has been used to convert the fabric export amount into weight.

1.2.2 Domestic Fiber Consumption

Table AII-1 shows the past synthetic fiber production in the Philippines. The production in 1973 was 2,600 t/y for nylon and 6,000 t/y for polyester, totalling 8,600 t/y. According to the "Foreign Trade Statistics of the Philippines", as shown in Table AII-2 , man-made fiber (synthetic fiber and regenerated fiber) was approximately 50,000 t/y in 1973.

However, as described above, man-made fibers have not been classified into synthetic and regenerated fibers, and therefore, the import amount of synthetic fiber or materials-wise import data cannot be obtained. According to the FAO statistics as shown in Table AII-3 , the total fiber consumption is 96,600 t/y, consisting of 39,200 t/y for synthetic fiber and 62,800 t/y for total man-made fiber.

Table AII-1 Production of Synthetic Fibers in the Philippines

	1969	1970	1971	1972	1973
Nylon FY	500	1,200	1,700	1,675	2,640
Polyester FY	-	-	500	1,954	2,310
Polyester SF	-	-	900	3,071	3,630
Total	500	1,200	3,100	6,700	8,580

Table AII-2 Import of Manmade Fiber into the Philippines

	1967	1968	1969	1970	1971	1972	1973
Synthetic Fiber	68	-	-	-	-	2	7,444
Regenerated Fiber	3,632	1,352	10,283	536	732	632	301
Other Manmade Fiber	21,970	39,448	29,685	37,116	51,619	49,960	42,266
Total	25,670	40,800	39,968	37,652	52,351	50,594	50,011

Source: Foreign Trade Statistics of the Philippines

Table AII-3 Total Fiber Consumption in the Philippines

		1967	1968	1969	1970	1971	1972
							(10^3 ton)
Synthetic Fiber	Import	11.4	18.1	23.7	20.0*	31.7*	29.9*
	Export	0.0	0.0	0.0	1.0	2.1	2.6
	Production	0.0	0.0	0.5	1.5	3.2	6.7
	Consumption	11.4	18.1	24.2	22.5	37.0	39.2
Regenerated Fiber	Import	21.3	22.3	25.9	20.3	23.7	23.4
	Export	0	0	0	0.1	0.1	0.2
	Production	0	0	0	0	0	0
	Consumption	21.3	22.3	25.9	20.4	23.8	23.6
Manmade Fiber Total	Import	32.7	40.4	49.6	40.3	55.4	53.3
	Export	0.0	0.0	0.0	1.1	2.2	2.8
	Production	0.0	0.0	0.5	1.5	3.2	6.7
	Consumption	32.7	40.4	50.1	42.9	60.8	62.8
Total Fiber	Import	55.3	51.1	59.6	42.8	56.3	54.3
	Export	0.5	1.6	1.5	1.7	2.4	3.3
	Production and Consumption of Fibers	49.7	37.8	38.2	36.4	36.4	39.0
	Consumption	104.5	87.3	96.3	80.9	95.1	96.6

Source: FAO

Note: * FAO estimate

Table AII-4 shows the import data prepared by the eleven countries export statistics. The material-wise synthetic fiber import into the Philippines is shown in Table AII-4 . According to these statistics, import of synthetic fiber is 34,689 t/y which consists of polyester (14,357 t/y), nylon (12,977 t/y) and others (7,355 t/y). The share of polyester and nylon fibers are almost the same and the two fibers dominate the synthetic fiber consumption.

Table AII-4 Manmade Fiber Consumption in the Philippines

(ton)

	1967	1968	1969	1970	1971	1972	1973
Nylon	2,627	5,639	7,278	6,086	11,331	10,807	12,977
Polyester	3,100	4,744	5,658	7,642	12,545	12,261	14,357
Acrylic	852	1,675	1,818	1,361	1,969	3,151	4,044
Other Synthetic	1,452	1,930	1,410	1,858	3,533	2,029	3,311
Synthetic Fiber Total	8,031	13,988	16,164	16,947	29,378	28,248	34,689
Regenerated Fiber	20,373	23,552	24,667	22,649	23,806	22,965	23,530
Other Manmade Fiber	2,344	4,857	5,193	4,664	7,819	5,758	6,487
Total Manmade Fiber	30,748	42,397	46,024	44,260	61,003	56,971	64,706

Source: Export Statistics of the Foreign Countries

Table AII-5 shows the summarized data of three different sources of statistics. The last three lines of the Table AII-5 show the import amount into the Philippines derived from three different sources of statistics. There are slight fluctuations among the three statistics, but the variations are within tolerance.

Table AII-5 Manmade Fiber Consumption and Import in the Philippines

(ton)

	1967	1968	1969	1970	1971	1972	1973
FAO (Consumption)	32,700	40,400	50,100	42,900	60,800	62,800	-
Production	-	-	500	1,200	3,400	6,700	8,580
FAO(Consumption) - Production	32,700	40,400	49,600	41,700	57,400	56,100	-
Import*1 (Foreign Country's Export Statistics)	30,748	42,397	45,524	43,060	57,603	50,271 *2	56,126 *2
Import (Philippines' Import Statistics)	25,670	40,800	39,968	37,652	52,351	50,594	50,011

Sources: FAO
Export Statistics of the Foreign Countries
Foreign Trade Statistics of the Philippines

Notes: *1 Import from Japan, USA, Singapore, Hong Kong, Taiwan, Korea, Rep. of and six European Countries.
*2 Import from Hong Kong, Taiwan, Korea, Rep. of and Singapore is estimated the same that of in 1971.

Therefore, any of the three sources of statistics can be used to conduct the study, however, in this report the eleven countries export statistics are used instead, because the reliability of these statistics is high, and further included material-wise import data. The synthetic fiber consumption in the Philippines has been regarded as the sum of the export amount from the eleven countries and the production amount in the Philippines. As shown in Table AII-6 , the synthetic fiber consumption in the Philippines in 1972 is 31,000 t/y.

The share of synthetic fiber in the total fiber consumption, as shown in Table AII-6 , increased from 8.3% in 1967 to 32.1% in 1972. Further, as shown in Figures AII-1 and AII-2 , the share by materials from 1967 to 1973 remained almost constant, that is, the share of polyester and nylon, each showing 40%.

Table AII-6 Past Trend of the Share of Synthetic Fibers

(ton)

		1967	1968	1969	1970	1971	1972
Import of Synthetic Fibers	(t/y)	8,694	15,798	17,681	17,660	30,058	24,335
Production of Synthetic Fibers	(t/y)	-	-	500	1,200	3,100	6,700
Consumption of Synthetic Fibers	(t/y)	8,694	15,798	18,181	18,860	33,158	31,035
Consumption of Total Fibers (FAO)	(t/y)	104,500	87,300	96,300	80,900	95,100	96,600
Share of Syntheric Fibers	(%)	8.3	18.1	18.9	23.3	34.9	32.1

Regarding the form-wise synthetic fiber consumption, as shown in Figure AII-3 , the share of synthetic fiber FY and SF gradually increased from 50% in 1967 to 80% in 1973. This means that the textile processing facilities in the Philippines have been substantiated to produce dyed and finished fabrics, if only the synthetic FY and SF are imported. This means also that, if the synthetic fiber producing facilities expansion is carried out, the Philippines would be able to produce dyed and finished synthetic fiber fabrics to fulfil total domestic consumption from synthetic fiber raw materials such as purified terephthalic acid (p-TPA), dimethylterephthalate, and caprolactam. Until then, the Philippines must either import or produce these synthetic fiber raw materials.

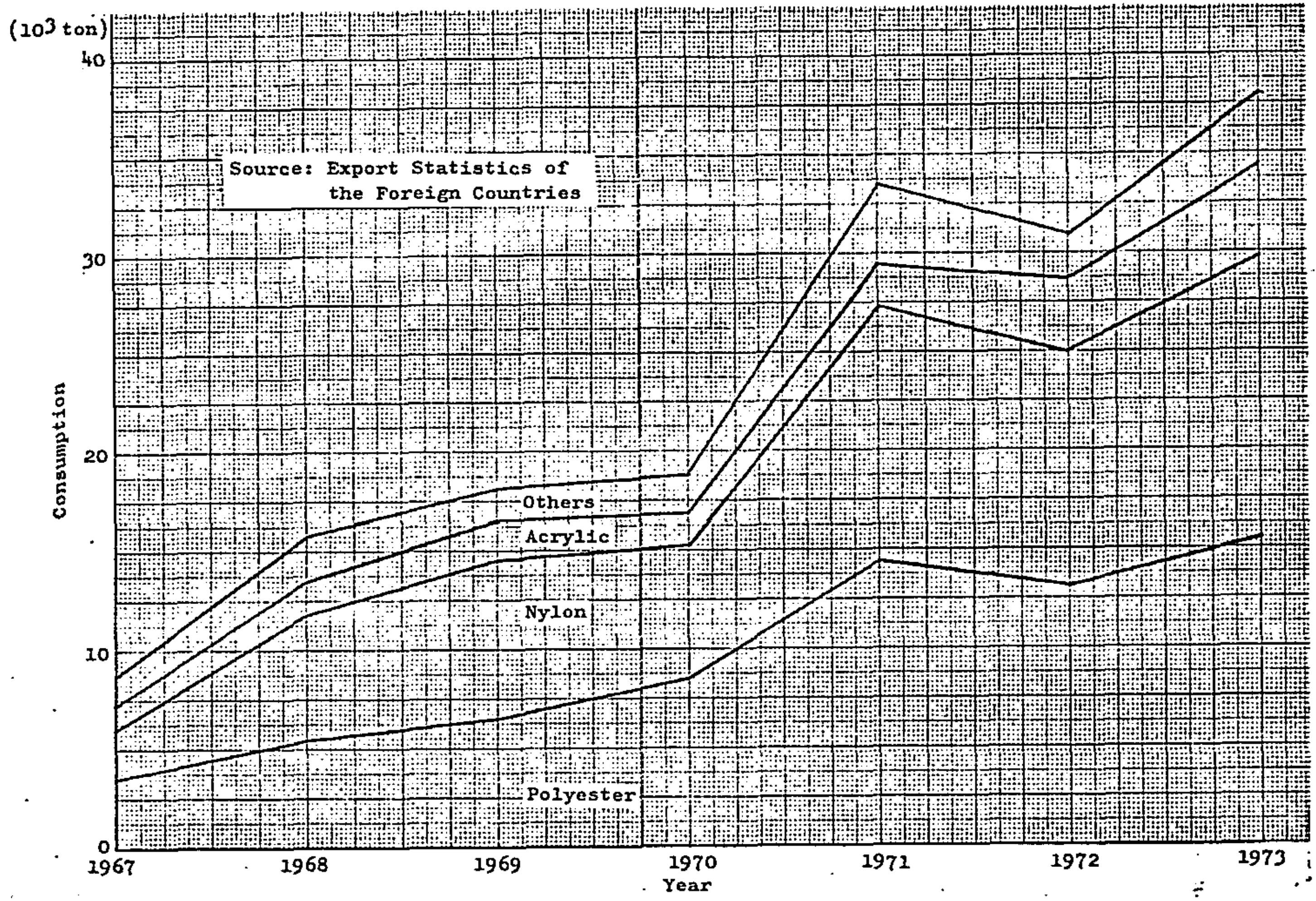


Figure AII-1 Form-Wise Synthetic Fiber Consumption in the Philippines

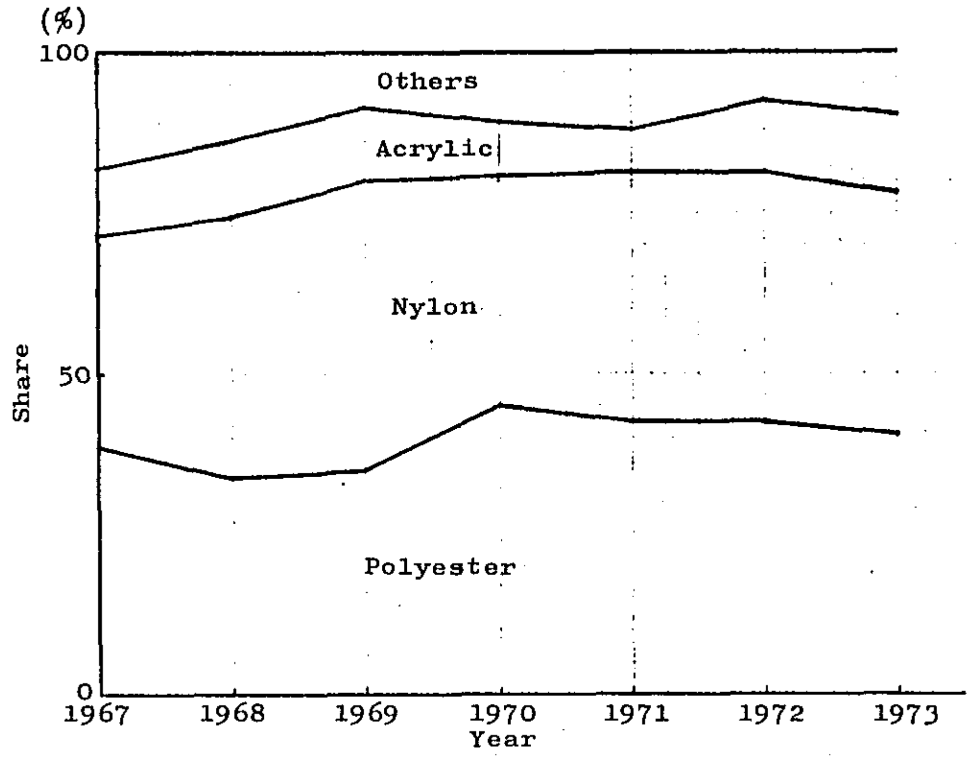


Figure AII-2

Material-Wise Consumption of Synthetic Fibers in the Philippines

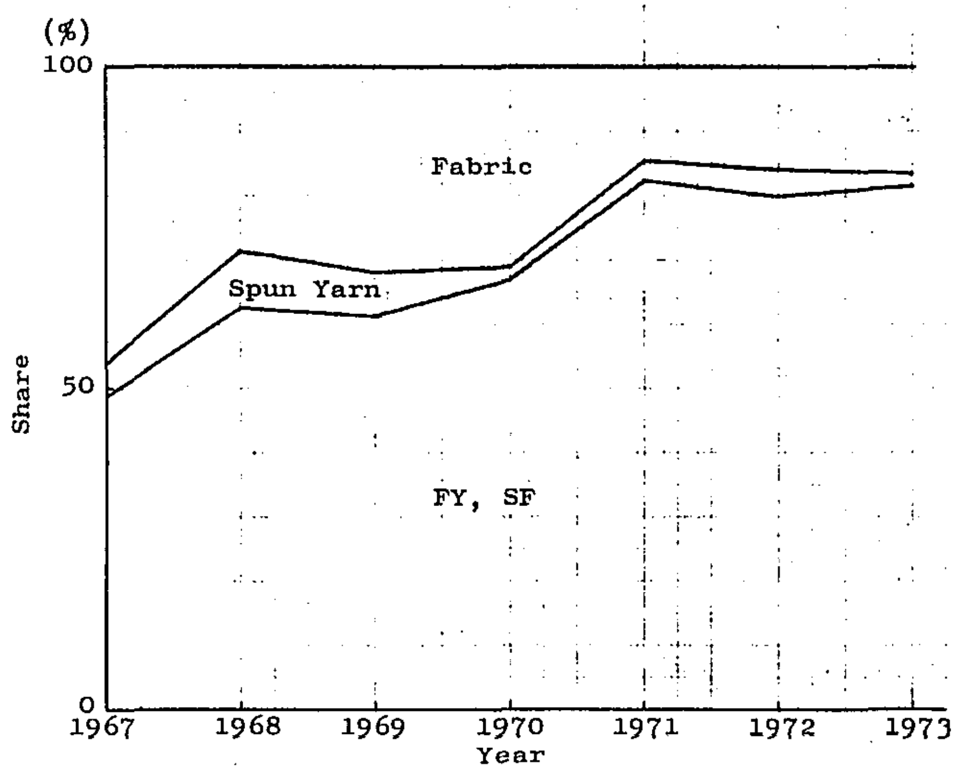


Figure AII-3

Form-Wise Consumption of Synthetic Fibers in the Philippines

1.3 Forecast on Domestic Synthetic Fiber Demand

1.3.1 Total Fiber Demand

Forecast on the total fiber consumption is shown in Table AII-7. The forecast method is described hereunder. It is generally known that there is a relation between GNP per capita and per capita total fiber consumption. Figure AII-4 shows the relations in developing countries of less than US$500 GNP per capita in 1971.

Regression formula is as follows:

$$\log y = - 1.2175 + 0.7019 \log x \quad (r = 0.73)$$

x: per capita GNP in US$/y

y: per capita total fiber consumption kg/y

Further, Figure AII-5 shows the relation between GNP per capita and per capita total fiber consumption in Southeast Asian Countries. The relation shown in Figure AII-5 can be expressed by the above regression formula with approximation.

Table AII-7 Forecast on Total Domestic Fiber Demand

(ton)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Population (Thousand)	37,919	39,040	40,219	41,457	42,759	44,007	45,315	46,686	48,915	50,569
Growth of GNP Per Capita	1	1.038	1.077	1.118	1.161	1.205	1.251	1.298	1.348	1.399
Per Capita Total Fiber Consumption (kg/y)	2.50	2.57	2.64	2.71	2.79	2.87	2.95	3.03	3.11	3.20
Total Fiber Consumption (t/y)	95,100*	96,600*	110,000	112,000	119,000	126,000	134,000	141,000	152,000	162,000
Synthetic Fiber Consumption (t/y)	29,378*	28,248*	34,689*	42,100	47,500	52,400	57,400	61,600	67,600	72,900

* Actual Figure

Table AII-7 Forecast on Total Domestic Fiber Demand

(ton)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Population (Thousand)	37,919	39,040	40,219	41,457	42,759	44,007	45,315	46,686	48,915	50,569
Growth of GNP Per Capita	1	1.038	1.077	1.118	1.161	1.205	1.251	1.298	1.348	1.399
Per Capita Total Fiber Consumption (kg/y)	2.50	2.57	2.64	2.71	2.79	2.87	2.95	3.03	3.11	3.20
Total Fiber Consumption (t/y)	95,100*	96,600*	110,000	112,000	119,000	126,000	134,000	141,000	152,000	162,000
Synthetic Fiber Consumption (t/y)	29,378*	28,248*	34,689*	42,100	47,500	52,400	57,400	61,600	67,600	72,900

* Actual Figure

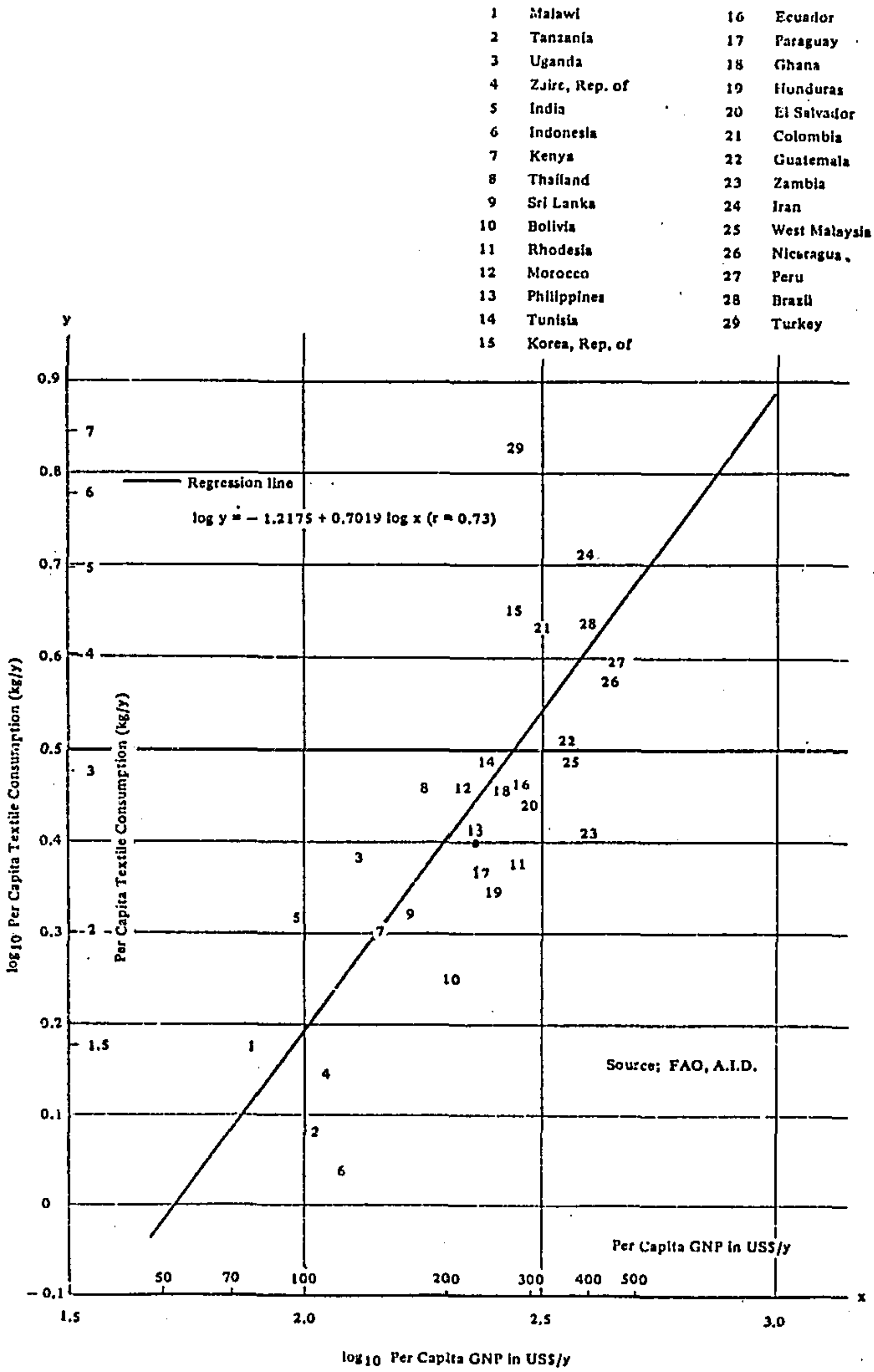


Figure AII-4 Relationship between Per Capita Textile Consumption and Per Capita GNP in Developing Countries (1971)

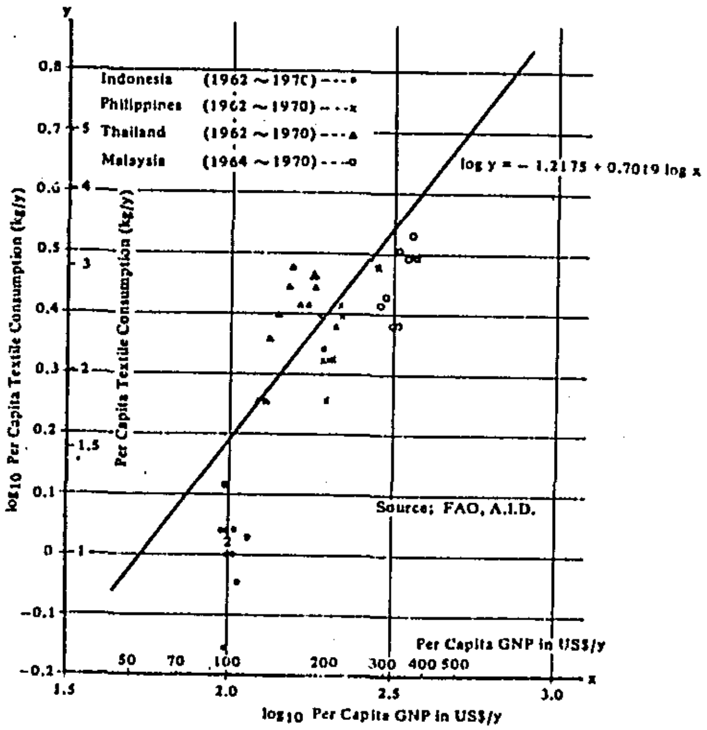


Figure AII-5 Relationship between Per Capita Textile Consumption and Per Capita GNP in Southeast Asian Countries

As shown in Figure AII-5 , the Philippines is plotted below the regression formula. This signifies that the Philippines' per capita total fiber consumption is smaller than that of average per capita total fiber consumption of the same GNP per capita countries. In the future, per capita total fiber consumption will increase along with the enhancement of per capita GNP. Although several cases can be considered regarding the mode of the increase in per capita total fiber consumption, it is assumed here that the per capita total fiber consumption will increase in parallel with the regression line.

The growth rate of GNP per capita is estimated at 3.8%/y, which is the target figure of the Four Year Development Plan of the Philippines which started in 1972/1973. GNP per capita in 1971 is estimated at US$338/y at the exchange rate of Pesos 3.93/US$ in 1967. Per capita total fiber consumption in 1980 is estimated at 3.2 kg/y as shown in Figure AII-6 . For 1980, the population of the Philippines is estimated at 50,569,000, therefore total fiber consumption will increase to 162,000 t/y.

1.3.2 Share of Synthetic Fiber

As shown in Table AII-6 , the share of synthetic fiber in total fiber demand in the Philippines is 32.1% in 1972. Forecast of the future share of synthetic fiber has been formulated as follows.

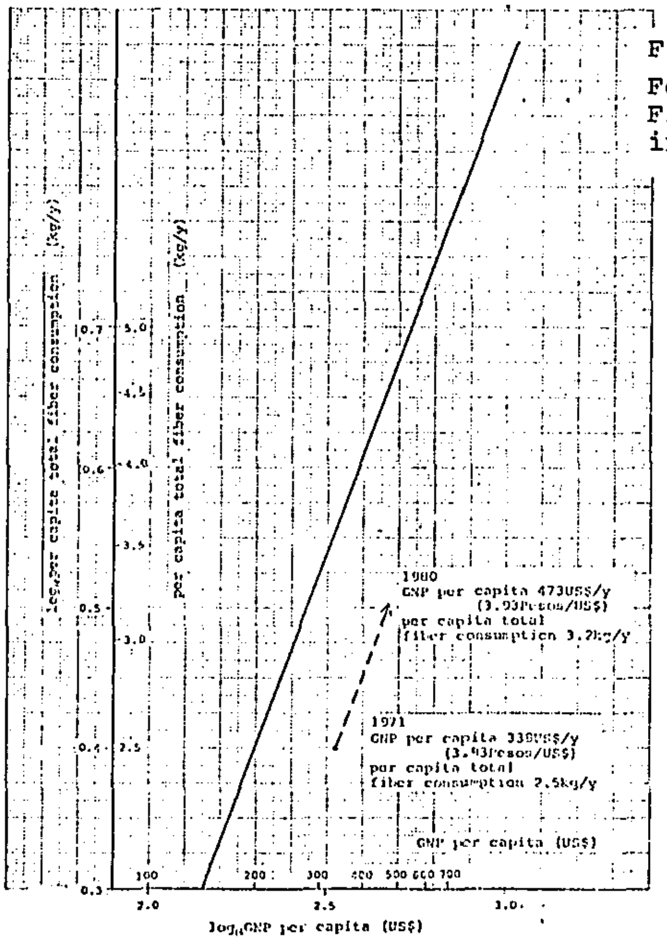


Figure AII-6
Forecast on Total Fiber Consumption in the Philippines

The past trend of the share of synthetic fiber in developed countries is shown in Figure AII-7 . In the case of U.S.A. and West Germany, the share of synthetic fiber increased to about 40% in 1971 and 1972. The share of synthetic fiber production in the total fiber production in the world increased from 26% in 1972 to 29% in 1973. Concerning the future share of synthetic fiber, several forecasts have been announced. The forecast figures are as follows.

Dr. R. Kleber	(Hoechst)	38.2% in 1980
"Textile Mitteilunger"		37.7% in 1980
Mr. Greene	(Monsanto)	46.9% in 1985

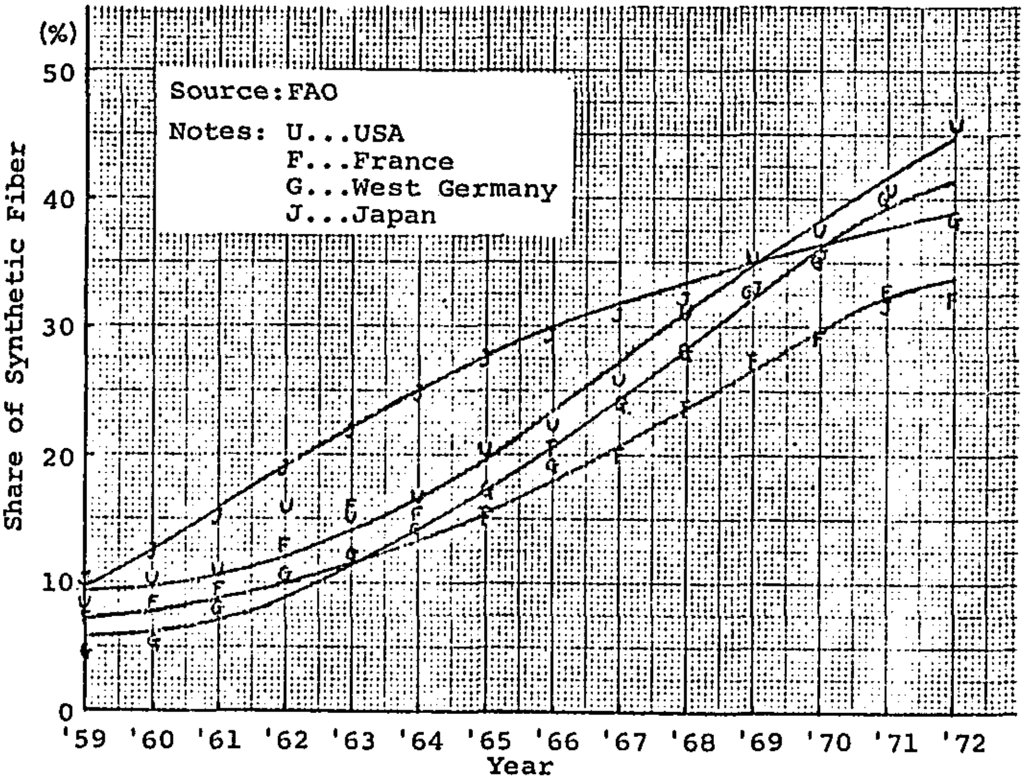


Figure AII-7 The Past Trend of the Share of Synthetic Fiber in Developed Countries

As has been described above, the share of synthetic fiber will continue to increase. The reasons for the increase are as follows:

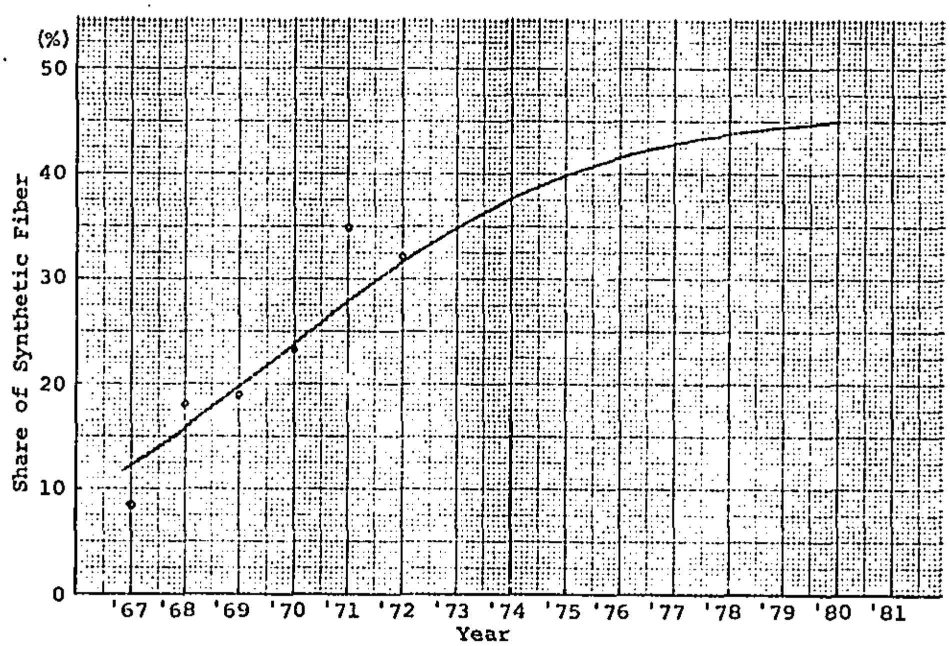
(1) Achievement of increase in production of cotton seems to be difficult in relation to the food production.

(2) Regenerated fiber is not economically competitive with synthetic fiber, and further, the production of rayon and rayon pulp will cause environmental problems. Therefore, the world production of regenerated fiber remained constant at 3,500,000 t/y from 1968 to 1972, and it is expected that the production will rather decrease in the future.

As has been mentioned in the above paragraphs, the major part of the increase in the world fiber demand must rely on the production of synthetic fiber. Therefore, the share of synthetic fiber will continue to increase.

In the Philippines, cotton and regenerated fiber have not been produced. However, the plantation of cotton and the production of regenerated fiber are being planned. If these plans are embodied, the products will substitute imports. Therefore, it will not contribute to the increase in the total fiber consumption. The major part of the increase in the total fiber demand must therefore be supplied by the production of synthetic fiber.

Taking the above described reasons into consideration, the share of synthetic fiber in 1980 is forecast to be 45%. Figure AII-8 shows a logistic regression line of the share of synthetic fiber obtained by the forecast figure of 45%,and on the past trend. The synthetic fiber domestic demand in the Philippines will increase to 72,900 t/y in 1980.



Fugure AII-8 Forecast on the Share of Synthetic Fiber in the Philippines

1.3.3 Material-Wise Synthetic Fiber Demand

The past trend of material-wise synthetic fiber consumption in the Philippines is shown in Figure AII-2 . The share of polyester and nylon is both 40%, acrylics 10%, and others 10%. The ratio of the share of each material is somewhat different from that in Southeast Asian Countries: the share of nylon in the Philippines is larger than that of Southeast Asian Countries.

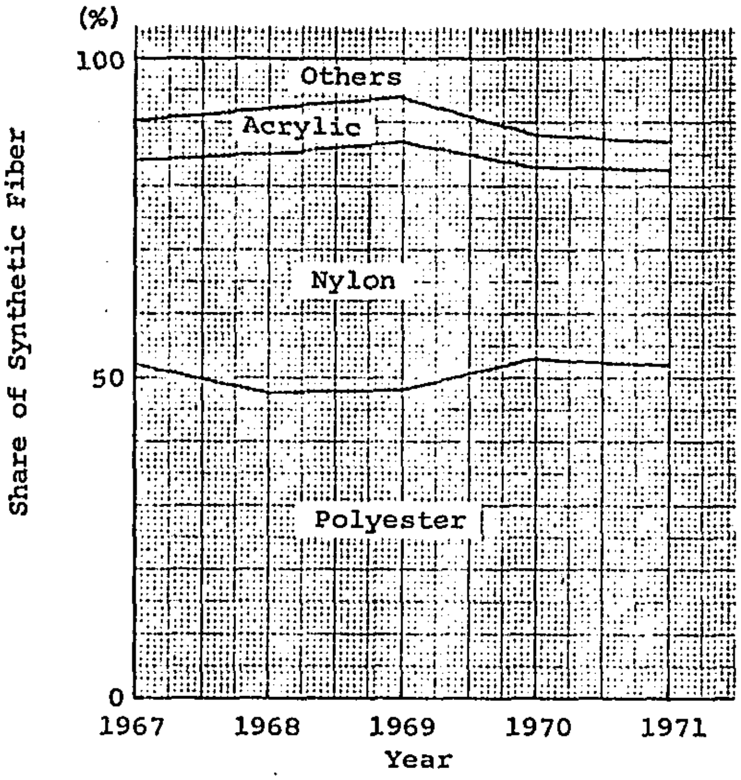


Figure AII-9 Material-Wise Share of Synthetic Fiber Consumption in the Philippines, Malaysia, Thailand and Indonesia

As shown in Figure AII-9 , the material-wise share of synthetic fiber consumption in total of the Philippines, Malaysia, Thailand, and Indonesia is 50% for polyester, 35% for nylon, 5% for acrylic, and 10% for others.

Due to the following reasons, the share of polyester will increase in the future.

(1) Polyester can be used both in FY and SF forms, and also has the characteristics suitable for textile use.

(2) On the contrary, nylon is mostly consumed in the form of FY. Nylon is mainly for industrial use and for making carpet, and the share of the textile-use portion is decreasing.

(3) p-TPA/DMT, the raw materials for polyester, can be produced less costly than caprolactam, the raw material for nylon.

(4) Synthetic fiber demand in the Philippines is mostly for textile use, and the demand for industrial use or carpet use is still small. Therefore, polyester is more suitable than nylon for the Philippines' market.

Taking the points described in the above paragraphs into consideration, the material-wise share of synthetic fiber demand is forecast to be 65% for polyester, 25% for nylon, and 10% for acrylic.

Table AII-8 and Figure AII-10 show the material-wise synthetic fiber demand forecast by 1980.

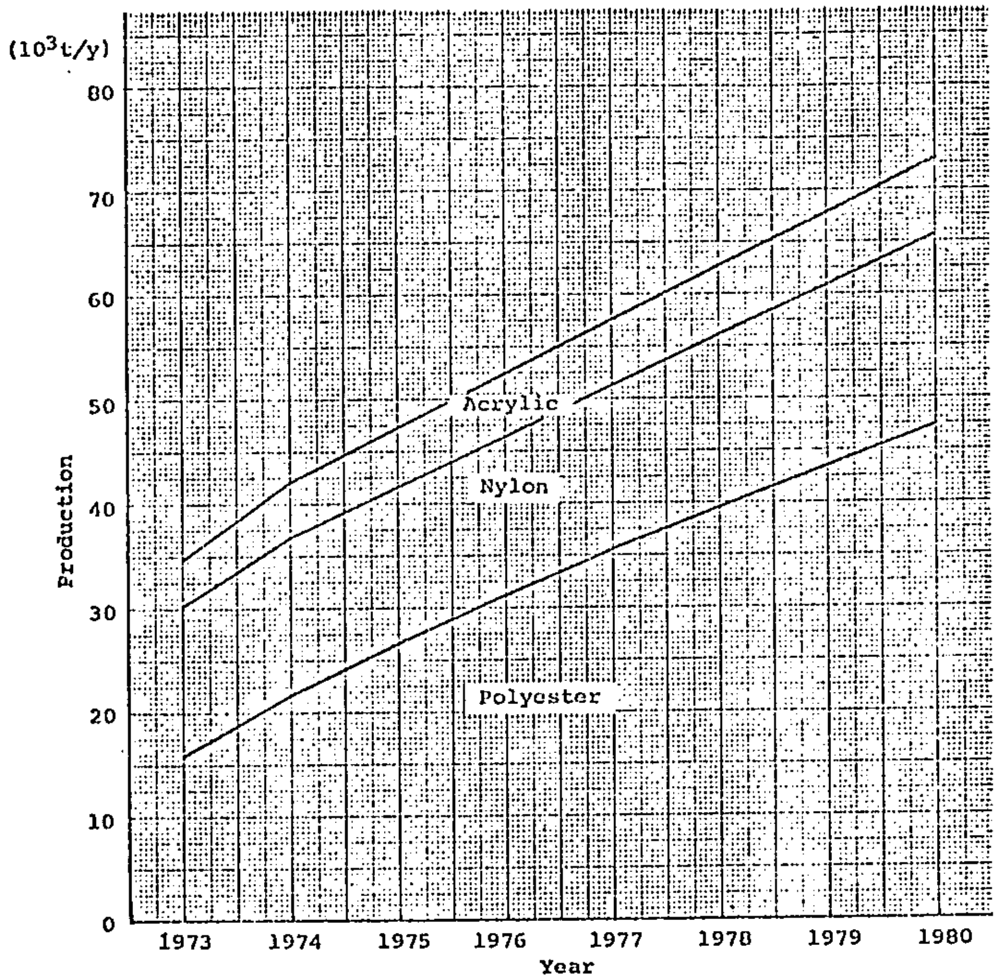


Figure AII-10 Forecast on Synthetic Fiber Demand in the Philippines

Table AII-8 . Forecast on Synthetic Fiber Demand in the Philippines

(ton)

	1973	1974	1975	1976	1977	1978	1979	1980
Polyester	15,872*	21,700	26,600	31,200	35,600	38,800	43,300	47,400
Nylon	14,346*	15,100	15,200	15,200	15,500	16,000	17,200	18,200
Acrylic	4,471*	5,300	5,700	6,000	6,300	6,800	7,100	7,300
Total	34,689*	42,100	47,500	52,400	57,400	61,600	67,600	72,900

* Synthetic Fiber "Other' Synthetic in the Table AII -4"are allocated to Polyester,

1.3.4 Demand for Synthetic Fiber Raw Materials

Regarding the production of the synthetic fiber in the Philippines, there are a number of plans for producing synthetic fiber. The total plant capacity including existing capacity and plant expansion plans on the governmental approval application and planing stages, amounts to 40,000 to 60,000 t/y for polyester and 14,000 to 20,000 t/y for nylon. Therefore, if these plans are embodied, the most part of the forecast synthetic fiber demand would be fulfilled by the domestic production.

Therefore, all the domestic synthetic fiber demand can be regarded as the demand for synthetic fiber raw materials.

1.4 Export of Textile Manufactures

1.4.1 Present Status

The Philippines is exporting synthetic fiber products mainly to the U.S.A.; however about 50% of the export is made on a consignment basis. It is fairly difficult to forecast the future export amount from the Philippines, as the future export amount is determined not only by the export promotion policies of the Government of the Philippines, but also by the international competitiveness of the Philippine textile industry. Therefore, in this study the forecast on export amount has been briefly formulated. It is necessary to conduct another study to investigate into appropriate measures for promoting textile industry towards export-oriented industry.

Imports of man-made fiber manufactures into the U.S.A. from Southeast Asian Countries is shown in Table AII-9 . The export from the Philippines has increased year by year; however, the share of the Philippines in Southeast Asian Countries is only 6% in 1973.

1.4.2 Prospect on Future Export

If the U.S.A.'s import from Southeast Asian Countries remained about 2 x 10^9 equivalent square yards per year, and if the share of the Philippines should increase to 12% by 1980, two-fold of the present share, the Philippines' man-made fiber manufactures export to the U.S.A. would be 2.4 x 10^8 equivalent square yards.

If the weight per square yard of the fabrics is assumed to be 117g, the export amount will be 28,000 t/y.

Table AII-9 U.S. Import of Manmade Fiber Manufactures from Southeast Asian Countries

(10^3 equivalent square yards)

	1970	1971	1972	1973	1972.6 -1973.5	1973.6 -1974.5
Philippines	37,757	43,091	60,484	84,457	66,261	88,354
Thailand	2	47	14,585	45,230	34,821	40,809
Malaysia	2,658	1,510	3,790	2,664	3,742	2,590
Singapore	3,059	7,281	46,954	117,644	103,223	99,084
Indonesia	22	27	58	1,771	323	2,275
Korea	254,120	408,469	415,603	316,952	390,220	255,484
Hong Kong	189,416	247,411	253,614	203,670	232,501	168,429
Taiwan	351,140	592,231	465,817	397,146	402,776	377,355
Japan	782,211	1,401,170	943,008	650,368	843,376	473,072
Total	1,620,385	2,701,237	2,203,913	1,819,902	2,077,243	1,507,452

Source: U.S. General Imports of Manmade Fiber Manufactures

The present export from the Philippines is carried out in the form of garments, and in the future, the main export goods of man-made fiber manufactures is expected to be also garments, as the garment manufacturing receives high added value. Here, it is assumed that one-half of the garment export is made on the basis of the imported fabrics, and the rest is on the basis of the domestic fabrics.

Further, it is assumed that 60% of the materials employed to make garments are polyester, 25% nylon, and 10% acrylic. On the basis of these assumptions, synthetic fiber export from the Philippines would be 8,400 t/y, the breakdown of which being 5,000 t/y for polyester, 2,000 t/y for nylon, and 800 t/y for acrylic.

The reasons for assuming export as described above are as follows.

(1) At present, the Philippines export garments mainly to the U.S.A., however, in the future the efforts will be exerted to export garments to other developed countries. Nevertheless, in spite of such efforts, the export to the U.S.A. will still dominate the major share of the Philippines' export. The reason is that the labor cost in the U.S.A. is on the highest level in developed countries, and that the U.S.A. will continue to import garments from developing countries.

(2) To foster the synthetic fiber industry as an export-oriented industry will take a long time. The Philippine textile industry has been a domestic-market-oriented industry, and it has been protected from the influence of international market. Therefore, the quality of the Philippine textile goods is not adequate, and price is comparatively high.

In order to foster textile industry as an export-oriented operation, efforts must be exerted to develop the textile processing industry, to improve the product quality, and to rationalize the textile industry.

As the export is carried out in the form of garments, it is necessary to promote synthetic fiber FY and SF production, spinning, weaving, knitting, dyeing, finishing, and sewing industries. However, it will be difficult to foster these industries within a short period, in view of the involvement of a series of different processes forming a long line and also the complexity of the numerous enterprises concerned.

When a country wants to foster an export-oriented textile industry, it is generally practised to import good quality fabrics from abroad as the first step, and then establish a garment industry. Thereafter, the country normally takes measures to foster dyeing, knitting, weaving, and spinning industries in this order. Therefore, it will take a long time to establish an export-oriented textile industry. Until the industry is established, good quality fabrics must be imported for carrying out garment export.

(3) There are numerous competitors in the realm of international market. In general, a developing country aims to develop the textile production into an export-oriented industry. Because the textile industry involves within itself a number of industries as described earlier, the development of this particular industrial sector provides ample employment opportunities.

For this reason, Rep. of Korea, Hong Kong and Taiwan have already established export oriented textile industry in Southeast Asia, and other countries are aiming to also achieve the establishment.

In the presence of international competition with these nations, the Philippines must take appropriate policies and exert efficient efforts to establish an export-oriented textile industry. Therefore, a detailed study should be conducted in this respect.

1.5 Future Demand for Synthetic Fiber Raw Materials

On the basis of the above-described synthetic fiber demand forecast in domestic and export market, the demand for synthetic fiber raw materials is estimated to be 50,600 t/y (as p-TPA) for p-TPA/DMT, 22,000 t/y for caprolactam, and 8,100 t/y for acrylonitrile (Table AII-10). The above-mentioned demand for synthetic fiber raw materials is in general a latent demand, and it does not become real demand until the synthetic fiber production is actually carried out.

Table AII-10 Demand Forecast on Synthetic Fiber and Its Raw Materials in 1980

(t/y)

	Fiber			Raw Materials		
	Domestic	Export	Total			
Polyester	47,000	5,000	52,000	p-TPA/DMT	50,600	(as p-TPA)
Nylon	18,000	2,000	20,000	Caprolactam	22,000	
Acrylic	7,300	800	8,100	Acrylonitrile	8,100	

However, as has been described above, there are production plans of 40,000 to 60,000 t/y for polyester and 15,000 to 16,000 t/y for nylon, so that the demand for p-TPA/DMT and caprolactam are considered to be real demand. As far as acrylonitrile is concerned, the demand cannot be regarded as real demand, as the demand is smaller than p-TPA/DMT or caprolactam and further there is no plan to produce acrylic fiber in the Philippines.

2. Future Outlook of International Market of Synthetic Fiber Raw Materials and the Influence on the Philippines

2.1 Introduction

Synthetic fiber raw materials have never been in short supply before the oil crisis. The reasons are as follows:

(1) The use of synthetic fiber raw materials is limited almost to the production of synthetic fiber. Therefore, plant expansion for synthetic fiber raw materials production is carried out along with the expansion of the synthetic fiber producing plant.

(2) The distribution channel is highly stratified, and the linkage of the supplier and the consumer is almost fixed.

(3) Synthetic fiber manufacturers are participating in the production of monomer and basic raw materials. Therefore, the supply/demand relationship within the group will necessarily assume a direction towards equilibrium. It is considered therefore that the distribution in the market of the floating commodities will definitely be a temporary phenomenon which manifests itself at the time when the demand balance inside the group is upset.

Therefore, it is highly difficult for these raw materials for synthetic fiber to find the outlet for supply/demand market other than fiber industry, and the balance between supply and demand is mainly controlled by export and import.

Another feature of the synthetic fiber raw materials industry is that the industry rely its raw materials mostly on aromatics. Monomers of the nylon and polyester, that are the monomers of the two of the three major synthetic fibers, such as p-TPA/DMT, caprolactam, hexamethylene diamine, and adipic acid, are all aromatics derivatives. Only two exceptions are acrylonitrile and ethyleneglycol. As the demand for acrylic fiber is small, nylon and polyester are the major synthetic fibers in the Philippines. Thus, the feedstocks for synthetic fiber raw materials industry in the Philippines are mostly aromatics.

2.2 Present Status of Synthetic Fiber Raw Materials Market

Due to the oil crisis of 1973, short supply of synthetic fiber raw materials became serious, thereby harming synthetic fiber production. However, the situation has suddenly changed in such a manner that the demand for synthetic fiber has decreased to result in over supply of synthetic fiber raw materials.

This was caused by the increase in stocks of textile products in every processing stage due to the apparent consumption, and by the decrease in real demand due to serious inflation.

However, the price of synthetic fiber raw materials on one hand has been steadily increasing due to the crude oil price hike, and the price of synthetic fiber has been decreasing significantly on the other.

The Japanese synthetic fiber producers are reducing operation to about 20% to 50%. This is a phenomenon emerged not only in Japan, but also in Europe and the U.S.A. In these countries, since September 1974, the prices of synthetic fiber have been decreasing, so that synthetic fiber producers have been reducing operation.

2.3 Future Outlook of the Market of Synthetic Fiber Raw Materials

Synthetic fiber raw materials are not polymers but monomers. Therefore the difference in producing processes or the difference in producers do not result in significant difference in the characteristics or the properties of the monomers. It is not necessary to provide technical services at the time of synthetic fiber raw material sales unlike in the case of polymers such as polyolefins. Transportation of synthetic fiber raw materials is easier than polymer. Therefore, in this sense, synthetic fiber raw materials are more of international commodities than polymers are.

However, as has been described in the previous chapter, synthetic fiber raw materials, especially monomers, have no use other than as raw materials for synthetic fiber production. Therefore, they are not international commodities in the strict sense of the term, as the trade of synthetic fiber raw materials is not carried out freely.

One of the most important points in reviewing the future supply/demand situation is the influence of inflation caused by the oil crisis. It has been said that the growth of the fiber demand will decrease along with the progress of stagnation of the economy. Especially in developing countries, due to the increase in food expenses, it is forecast that the growth of the fiber demand will decrease along with the fall in textile expenses.

On the other hand, the world synthetic fiber production plans are scheduled to meet the expected demand increase in synthetic fiber which was projected before the days of oil crisis. If all these plans are embodied, synthetic fiber raw materials supply would be evidently in excess. However, due to the recession, it seems that some plans for producing synthetic fiber raw materials will be postponed. Now that some of the synthetic fiber production plans will be postponed and with world-wide decrease in synthetic fiber demand forthcoming, synthetic fiber raw materials will not be in short supply for some years to come.

Future outlook on the supply/demand situation of synthetic fiber raw materials is described below.

<u>Developed Countries</u>

The foremost problem pertains to a question as to whether the demand for synthetic fiber will recover or not. If the demand for synthetic fiber decreases in developed countries which are the major consumers, the demand for synthetic fiber raw materials will decrease seriously and eventually will result in world-wide over-supply of synthetic fiber raw materials.

If the demand for synthetic fiber recovers, developed countries will not export synthetic fiber raw materials, especially monomers, any more, and will make efforts to maintain self-sufficiency.

Developing Countries (Non-Oil-Producing Countries)

Due to the increase in food expenses caused by inflation, textile expenses will decrease, and will eventually result in the decrease in synthetic fiber demand. With the decrease in synthetic fiber demand, some plans for producing synthetic fiber will be compelled to be postponed. Therefore, plans for producing synthetic fiber raw materials will be postponed until the synthetic fiber production plans become feasible.

The synthetic fiber raw materials which will be produced in non-oil-producing developing countries, will be mainly consumed domestically and will not be destined for export, as these countries always have a danger of suffering from restriction in steady import of raw materials such as crude oil, naphtha, p-xylene or benzene. In general, at the initial stage of the synthetic fiber raw materials production, p-xylene, benzene or cyclohexane is imported as the raw materials for producing p-TPA/DMT and caprolactam, as the domestic market size is always too small to carry out the production with naphtha as the starting raw material.

Developing Countries (Oil Producing Countries)

The production of petrochemical products has been planned in oil producing countries to achieve industrialization and to increase the value added to the resources instead of carrying out crude oil export. The production of synthetic fiber raw materials has also been planned by these nations, however, the main products in this case were not such monomers as p-TPA/DMT or caprolactam, but were the raw materials for monomers, such as BTX, p-xylene or cyclohexane.

The reason for producing BTX, p-xylene or cyclohexane instead of monomers, in oil producing countries are as follows.

(1) Minimum economic size of facilities to produce BTX and p-xylene is comparatively large. Therefore, it is not appropriate for non-oil-producing countries of small market to produce these raw materials.

(2) When these raw materials are produced, several by-products are obtained. However, the demand for the by-products is small in developing countries, so that they will have to be exported at international price.

(3) If the capacity of synthetic fiber production reaches the minimum economic size, every country will produce monomers by importing p-xylene, benzene or cyclohexane.

(4) Therefore, it is better for oil-producing-countries not to produce monomers, but to produce international commodities such as BTX, p-xylene or cyclohexane.

2.4 Synthetic Fiber Raw Materials in Southeast Asia

The largest synthetic fiber producing country in Southeast Asia is Japan. A number of synthetic fiber producing companies in Southeast Asia are somehow related to Japanese enterprises.

Japan's share figures of synthetic fiber and synthetic fiber raw materials producing capacity in Southeast Asia are as follows.

Synthetic Fiber	80%	1,533.6	10^3t/y in 1973
Caprolactam	100%	469	" "
p-TPA/DMT	94%	775	" "

As shown above, Japan has the dominating majority of the share. In the future, Japanese share will decrease year after year; however Japan will still keep the majority of the share for some time to come.

Therefore, supply/demand situation of synthetic fiber raw materials in Southeast Asia will be highly influenced by the Japanese synthetic fiber industry. However, the share of the oil producing countries in BTX, p-xylene and cyclohexane market will increase by the end of 1970's.

2.5 Influence on the Philippine Synthetic Fiber Industry

The Philippines will increase synthetic fiber production, even if some delay in start-up of new plant may happen. Along with the increase in synthetic fiber production, the Philippines will import monomers instead of synthetic fiber FY and SF.

The following are the measures taken by the Government of the Philippines for the procurement of synthetic fiber raw materials.

(1) Raw Materials for Polyester

In the next two or three years, the demand for raw materials for polyester will not attain a level of minimum economic size of polyester monomers production. During this period, the Philippines will be able to import p-TPA/DMT easily. However, the demand for p-TPA/DMT will increase to about 50,000 t/y by the end of the 1970's, a figure which warrants the minimum economic size for producing p-TPA/DMT in the Philippines. Therefore, it may be feasible to produce p-TPA/DMT by importing p-xylene as the raw materials.

Two processes are considered to produce p-TPA/DMT, one is to import p-xylene and the other is to produce BTX from naphtha. The selection between the two must be finalized by taking into consideration the availability of naphtha or p-xylene and the utilization potential of product benzene and toluene.

(2) Raw Materials for Nylon

For the production of caprolactam, much larger investment is required than in the case of the p-TPA/DMT production. Further, when producing caprolactam, a large amount of ammonia and sulfuric acid is required, and a large amount of ammonium sulfate is by-produced. Therefore, production cost of caprolactam is higher than that of p-TPA/DMT.

As synthetic fiber, the share of nylon for textile use is being taken over by polyester. Therefore, caprolactam expansion plans are less in number than that for p-TPA/DMT, and it is estimated that caprolactam supply will tend to be less than p-TPA/DMT.

Demand for caprolactam in the Philippines is estimated at about 20,000 t/y in 1980. This amount is not considered to be ample to produce caprolactam economically from imported or domestically produced benzene. On the other hand, the import of caprolactam will become more difficult than that of p-TPA/DMT. Therefore, it may become necessary for the Philippines to investigate into the feasibility of caprolactam production in collaboration with the neighboring countries.

3. Preliminary View of Production Economics

3.1 Set-up of Alternatives for Study

The production scheme for the preliminary production economics study is established in view of the following:

(1) Scope of application and domestic markets of the products

(2) Availability and type of raw materials

(3) Process routes

Together with the scrutinization mentioned-above, it is particularly necessary to pay a careful attention to the establishment of a basis for fostering the textile industry. In the textile industry the final products have a higher extent of added value than in the case of the outputs of other industrial sectors. Therefore, by means of preparing an industry from which economical and stable self-supply of synthetic fiber raw materials can be obtained, it is possible to have an amply potential export possibilities in the future.

3.1.1 Scope of Application and Domestic Market

The representative products derived from aromatics are shown in Table AII-11 and production of these products in the Philippines may become possible in the near future. The major aromatics products required at the initial stage of the petrochemical industry are the raw materials for synthetic fiber, thus the aromatics complex is to be planned to supply them.

Table AII-11 Major Scope of Aromatics Application

Aromatics	Application: Major Intermediate	Major Final Products	
Benzene	Styrene Cyclohexane	Polystyrene, Phenol SBR, Caprolactam Solvents	
Toluene	-	Solvent	
Mixed Xylene (C_8 Aroma)	P-Xylene	P-TPA, DMT	Polyester
	O-Xylene	Phthalic Anhydride DOP	Plasticizer
	M-Xylene	-	
	Ethyl benzene	-	
C_9^+ Aroma	-	-	

The object of this orientation study is to identify the feasibility of the aromatics complex on the basis of the naphtha feed, especially taking into account the optimal allocation of limited hydrocarbon raw materials in the Philippines. Further, the final products to be studied may be limited not only by raw materials, but also by the size of the domestic market demand. However, they are one of the most essential products, and they may hold the highest potential in respect to the added value among aromatics products in the Philippines. Therefore, in spite of the other possibilities of producing raw materials for plasticizers or synthetic detergents, (i.e., o-xylene, phthalic anhydride, DOP, alkylbenzene, etc.) the final products aspired for in this orientation study are selected. They are caprolactam for nylon, and purified terephthalic acid and dimethyl terephthalate for polyester. The intermediate products of the aromatics complex are, therefore, limited only to cyclohexanne, p-xylene, and their intermediates, i.e., benzene, mixed xylene, etc.

The plant capacity scale has been established as follows on an assumption of operation commencement in 1979, after taking into consideration such factors as the minimum economic scale of the plants, at least 60% to 80% level of operational rate at the time of plant operation commencement and the results of the preliminary domestic demand forecasts in the Philippines as stated in Chapter 1.

Nylon raw material:	caprolactam	30,000 t/y
Polyester raw material:	p-TPA	70,000 t/y
	or DMT	77,000 t/y

At the time of establishing the above plant scales, the export possibility of the products should be duly taken into consideration as well, however, no such export demand factor has been incorporated in this study. Therefore, further detailed studies will be necessary in this respect.

In this case, polyester fiber can be produced from either p-PTA or DMT. However, in the orientation study, it was assumed that the polyester fiber demand will be fulfilled by means of the production of only one type of raw materials, i.e., by either p-TPA on DMT, for the purpose of sympifying the orientation study. However, as it is very likely that both p-PTA and DMT will be used as the raw materials for polyester in the future as in the case of other countries, it is necessary to conduct a thorough study in the future regarding the simultaneous production of p-PTA and DMT at the time of producing polyester raw materials.

3.1.2 Availability and Types of Raw Materials

There are two possible sources of raw materials for the production of aromatics such as benzenes and xylenes; namely, the reformate through the aromatization of straight-run naphtha, and pyrolysis gasoline by-produced with the production of ethylene through thermal cracking of naphtha or gas oil. The typical analyses of the reformate and the pyrolysis gasoline are shown in Table AII-12.

When the reformate and the pyrolysis gasoline are compared for their benzene content, the pyrolysis gasoline is more suitable for the extraction of benzene than the reformate. On the contrary, the comparison of mixed xylene content in each material show the quantitative advantage of the reformate to the pyrolysis gasoline. Further, the

Table AII-12 Analysis of Major Raw Material for Aromatics Production

	Reformate		Pyrolysis Gasoline	
Process	Hydrotreating & Reforming		Thermal Cracking (Ethylene Plant)	
Type of Feed	Broad Range Naphtha (a)	Narrow Range Naphtha (b)	Full Range Naphtha	Atm. Gas Oil
Objective of Operation	Benzene, Xylene	Xylene	Olefin	Olefin
Property of Feed	Kuwait Naphtha SP.GR(API)0.727(63.1) IBP/EP 180/302°F PONA 71.9/0/20.1/8.0	Kuwait Naphtha SP.GR 0.74(59.4API) IBP/EP °F 230/307	Kuwait Naphtha SP.GR(API)0.731(62)° Dist. C_5-400°F PONA 68/0/22/10 Sulfur. 0.15 wt Max	Kuwait Atm. Gas Oil Spar(API) 0.844(36.1)° TBP 400-650°F wt% Hydrogen 13.1 Sulfur 0.25 wt% Max
Analysis				
Benzene	7.4 wt %	1.2 wt %	23.3 wt %	32.8 wt %
Toluene	14.4	15.0	17.2	15.8
Mixed-Xylene	22.3	34.5	12.4	11.8
C_9 Aroma	9.5	15.8		

Table AII-13 <u>Yield of Aromatics to Feed</u>

	Reformate		Pyrolysis Gasoline	
	Broad Range Naphtha (a)	Narrow Range Naphtha (b)	Full Range Naphtha	Atm. Gas, Oil
Yield of Reformate, pyrolysis Gasoline to Naphtha, Gas Oil	75.5 wt %	85.2 wt %	24.9 wt %	18.5 wt %
Yield of B.T.X to Naphtha, Gas Oil *				
Benzene	5.6 wt %	1.0 wt %	5.8 wt %	6.1 wt %
Toluene	11.0	12.5	4.2	2.9
Mixed-Xylene	16.1	28.2	3.0	2.1

* Note: Efficiency of extraction process unit is included.

Table AII-14 <u>Typical Analysis of Mixed Xylene</u>

Components	Mixed Xylene in Reformate	Mixed Xylene in Pyrolysis Gasoline
	Vol %	Vol %
P-Xylene	18	12
m-Xylene	44	29
O-Xylene	20	14
Ethylbenzene	18	45

analysis of the mixed xylene shown in Table AII-14 implies the qualitative advantage of the mixed xylene from the reformate for the production of p-xylene which is the raw material for p-TPA/DMT.

Ethylbenzene is a harmful component for the separation of the p-xylene, or for the isomerization of o-xylene or m-xylene. However, ethylbenzene content is very high in the mixed-xylene extracted from pyrolysis gasoline.

Generally speaking, pyrolysis gasoline is not commercially used for the production of p-xylene, unless adequate treatments are effected for the removal of ethylbenzene. Therefore, p-xylene is mainly produced from the mixed xylene in the reformate. However, the content of the mixed xylene in the reformate varies depending not only on the property, i.e., P.O.N.A. analysis etc., but also on the cut range of naphtha. Recent research and development of the aromatization through the reforming of naphtha revealed that a narrower cut range of feed is essential for the effective production of aromatics.

In order to produce a specifie type of an aromatic compound, it is desirable to use a fraction having a narrow distillation range. Table AII-12 and AII-13 show the relationship between the specifications of naphtha, and the compositions and yield of the obtained aromatics.

However, the case of (a) naphtha is adopted for the evaluation of production economy.

3.1.3 Process Routes

Basically, there are two lines of industrialization for the production of aromatics and synthetic fiber raw materials. One is to build synthetic fiber raw material plants such as caprolactam or p-TPA /DMT plants on the basis of the imported intermediates such as cyclohexane and p-xylene and p-xylene. (Backward integration)

The other line is to build a total aromatics complex on the basis of the reformate produced by the aromatization of naphtha. (Forward Integration).

In the first case, there is no choice other than the production of P-TPA and DMT.

However, in the case of the second line, a number of process routes can be applied in accordance with the property of raw materials and the demand for aromatics. For the evaluation of production economy, especially in view of the optimum allocation of hydrocarbon raw materials, the following are presumed for the selection of process routes:

(1) It is presumed that the olefin complex will be constructed in 1979. Therefore, the benzene necessary for the production of caprolactam will be amply produced by then by means of extraction from pyrolysis gasoline and reformates.

(2) Therefore, the aromatics complex for the production of basic aromatics such as benzene, xylene etc. should be designed to supply enough p-xylene for the production of p-TPA/DMT.

(3) No product except cyclohexane, p-xylene is presumed to be produced in aromatics complex.

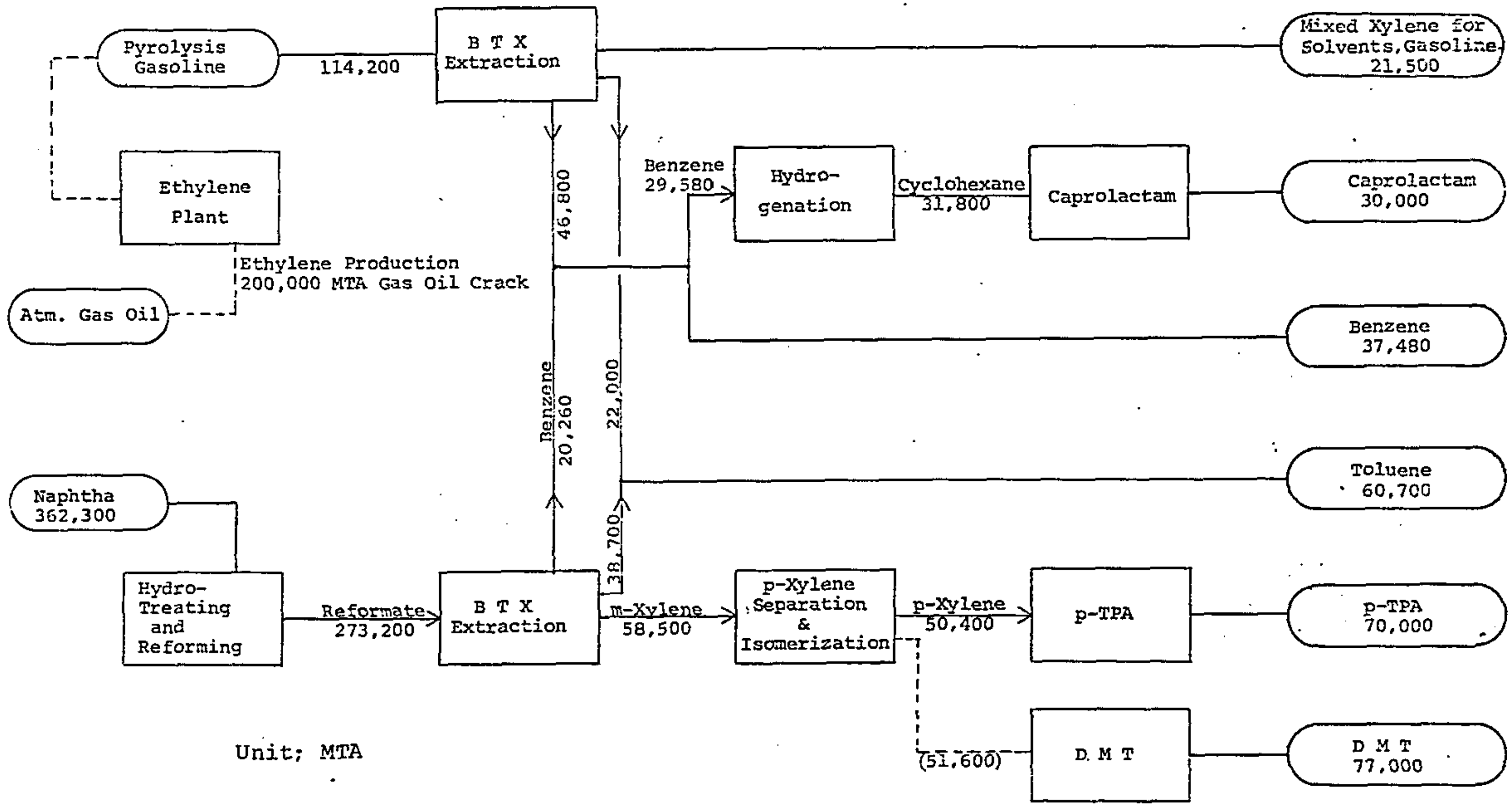


Figure AII-11 Production Scheme for Caprolactam,p-TPA/DMA Based on Domestic Raw Materials

(4) The disproportionating or transalkylation of toluene and/or C_9 aromatics process is not considered for the purpose of simplification of the study at the orientation stage.

Therefore, a tentative scheme and material balance as shown in Fig AII-11 can be obtained, in accordance with the assumption and the discussion stated in 3.1.1 to 3.1.3 for the production of aromatics and synthetic fibre raw materials.

3.2 Production Economics on Different Raw Material Sources

There are two lines of processes for the production of synthetic fibre raw materials depending on the sources of basic raw materials, i.e., naphtha and pyrolysis gasoline supplied domestically or the importated intermediates, such as p-xylene and cyclohexane.

Production economics was evaluated by the production cost in 1980 on an assumption that the operational rate is 100%, and the time of start up of the plants is in mid-1979.

3.2.1 Production of Synthetic Fiber Raw Material Based on Imported Intermediates

(1) Production of Caprolactam

The production economics of caprolactam was studied on the basis of the imported cyclohexane, ammonia and domestic sulfuric acid. The prices used herein which were calculated on the basis of the procedure are specified in Appendix II.

The price of cyclohexane is estimated as the price of importation from Japan, on the basis of the cost-push calculation of the FOB price with a yearly inflation rate of 7% excluding the cost of depreciation. The price of ammonia is estimated as the imported price from Indonesia, assumed on the cost-plus-adequate-profit basis in the plants to be newly constructed on natural gas feed basis.

The price of sulfuric acid is estimated as the domestic production based on the pyrite and not on the smelter acid. The price of ammonium sulfate is estimated as the imported price from Japan.

The export price of the Japanese ammonium sulfate was estimated by multiplying the past average price ratio between urea and ammonium sulfate with the projection price of urea. Therefore, no projection on the basis of the urea price on the basis of the present ammonium sulfate price in the Philippines has been conducted.

This is because of the fact that the ammonium sulfate price largely depends on the urea price and on the supply/demand position of fertilizers. Therefore, it has been deemed inadequate to forecast the future price of ammonium sulfate on the basis of the presently prevailing price level in the Philippines which is abnormally high due to the supply shortage of fertilizers.

The results of production cost calculation is shown in 5.1 in Appendix II. The price of domestically produced caprolactam is slightly higher than the estimated imported price from Japan.

Table AII-15

Prices of Caprolactam & Raw Materials Based on Imported Cyclohexane

Cyclohexane	591 $/MT
Ammonia	305
Sulfuric Acid	76
Ammonium Sulfate	171* (179)
Produced Caprolactam	1,661
Imported Caprolactam	1,646

Note: * indicates the price excl. sales tax, and values in ( ) are the price incl. sales tax.

Taking into account that the extent of domestic market in 1980 will not reach the level of production capacity of the minimum economic scale of the plant adopted as the basis for the production cost calculations, it is necessary to reduce the operational rate according to the domestic market, or to export the remaining products at an extremely low price level, e.g., the same price as the FOB price in Japan. This leads to an increase of the production cost or a decrease of the average sales price.

In view of the above points, it is deemed that the commercial operation commencement in mid-1979 is not optimum.

(2) Production of p-TPA/DMT

The economics of purified terephthalic acid (p-TPA) for polyester fiber raw materials has been studied on the basis of the price of p-xylene, auxiliary raw materials and acetic acid imported from Japan.

Also, the production economics of dimethyl terephthalate (DMT) of a 77,000 MTA plant capacity for the production of the same amount of polyester fiber as the p-TPA has been studied on the basis of the price of p-xylene and methanol imported from Japan. The results of the preliminary market survey are shown in Table AII-8, and production economics are shown in 5.2 and 5.3 in Appendix II for p-TPA and DMT respectively.

Table AII-16

Prices of p-TPA/DMT, Raw Materials Based on Imported p-Xylene, Methanol, Acetic Acid

p-Xylene	720 $/MT
Methanol	442
Acetic Acid	610
Produced p-TPA	1,184
Produced DMT	1,357
Imported p-TPA/DMT	1,546

Even by taking into account the demerits of reduction in the operational rate, or the exportation at a low price level in the early stages of operation, there still remains the possibility of establishing the production of p-TPA/DMT in the early 1980's.

One of the reasons is that not only the quantity, but also the rate of growth of demand for polyester fiber raw material is larger than that of caprolactam.

However, it is difficult to obtain definite figures in an estimation of the demand of raw material for synthetic fiber for two reasons. One is that the actual demand for raw material originates only from the existing polymerization plants which produce chips for staple or filament yarn, not from the potential demand for the textile final products. Accordingly, it is necessary, for a precise estimation of synthetic fiber raw material, not only to estimate the demand for textile products, but also to scrutinize the trends, possibilities and the plans for production of staple and filament yarn from polymerized chips in the Philippines, in view of the competition with the importation of staple, filament yarn and polymerized chips. The second problem is that the demand for textile products includes the demand for export in the form of garment.

The textile industry is labour intensive, so that there exists the possibility to develop an export-oriented textile industry in the future in the Philippines, in spite of the fact that only a small amount of garments is being exported at present.

However, the future situation of the textile industry will be influenced by many factors unknown at present, such as the development policy of the Philippine Government, behavior of the entrepreneures, etc.

Therefore, it is better to take up further studies on the textile industry development for the final conclusion of synthetic fiber raw material production.

3.2.2 Production of Aromatics for the Synthetic Fiber Raw Materials from Domestic Materials

There are two domestic resources for the production of aromatics, i.e., pyrolysis gasoline by-produced with ethylene in the olefin plant and naphtha or its reformate from the refinery. As stated in 3.1, only benzene, basic raw material for caprolactam, can sufficiently be produced effectively from the pyrolysis gasoline.

Therefore, the production of p-xylene should be carried out from aromatized naphtha or reformate. The prices of naphtha and pyrolysis gasoline are presumed to be as follows for the production economics study:

Price of Naphtha

1) Imported Naphtha without Import Duty and Specific Tax

$166/MT @1980

2) Domestic Supply Naphtha without Specific Tax

$217/MT @1980

3) Domestic Supply Naphtha with Specific Tax

$274/MT @1980

Price of Pyrolysis Gasoline

1) By-produced Pyrolysis Gasoline without Sales Tax

$222/MT @1980

2) By-produced Pyrolysis Gasoline with Sales Tax

$222/0.96 = $231/MT

(1) Production of Benzene from Pyrolysis Gasoline

For by-produced gasoline with the 200,000 MTA ethylene from atmospheric gas oil, the production cost based on the price of pyrolysis gasoline $222/MT is shown in 5.4 in Appendix II.

Table AII-17

Prices of Benzene and By-Products
<u>Extracted from Pyrolysis Gasoline</u>

Pyrolysis Gasoline	222 $/MT	(231)
Toluene	233	
Mixed Xylene	233	Ethylbenzene rich
Raffinate & C_9+	233	
Benzene	379	

Note: * indicates the price excl. sales tax, and values in ( ) are the price incl. Sales tax.

An extraction unit only is required for the separation of benzene, toluene, and mixed xylene from raffinate, so the production cost is very low, even if the prices for the credit of by-produced toluene, and mixed xylene are assumed to be the same as the price of extra gasoline without the specific tax.

(2) Production of p-xylene from Naphtha

The only resource for the production of p-xylene is generally mixed xylene separated from reformate because of the low ethylbenzene content which is suitable for separation and isomerization.

Therefore, the necessary production units are hydrotreating and reforming of naphtha, B.T.X. extraction, and p-xylene separation and isomerization units. The production capacity and material balance of the aromatic complex for the production of p-xylene corresponding to the production of 70,000 MTA p-TPA are shown in Figure AII-11.

Production costs of the p-xylene and its intermediates, mixed xylene and reformate are shown in 5.5 through 5.7 in Appendix II which are based on $274/MT as the price of naphtha including the specific tax.

For the production cost calculation, the credited price of benzene is assumed to be the same as the imported price from Japan, and also the price of toluene is set at the level of the price of extra gasoline without sales tax.

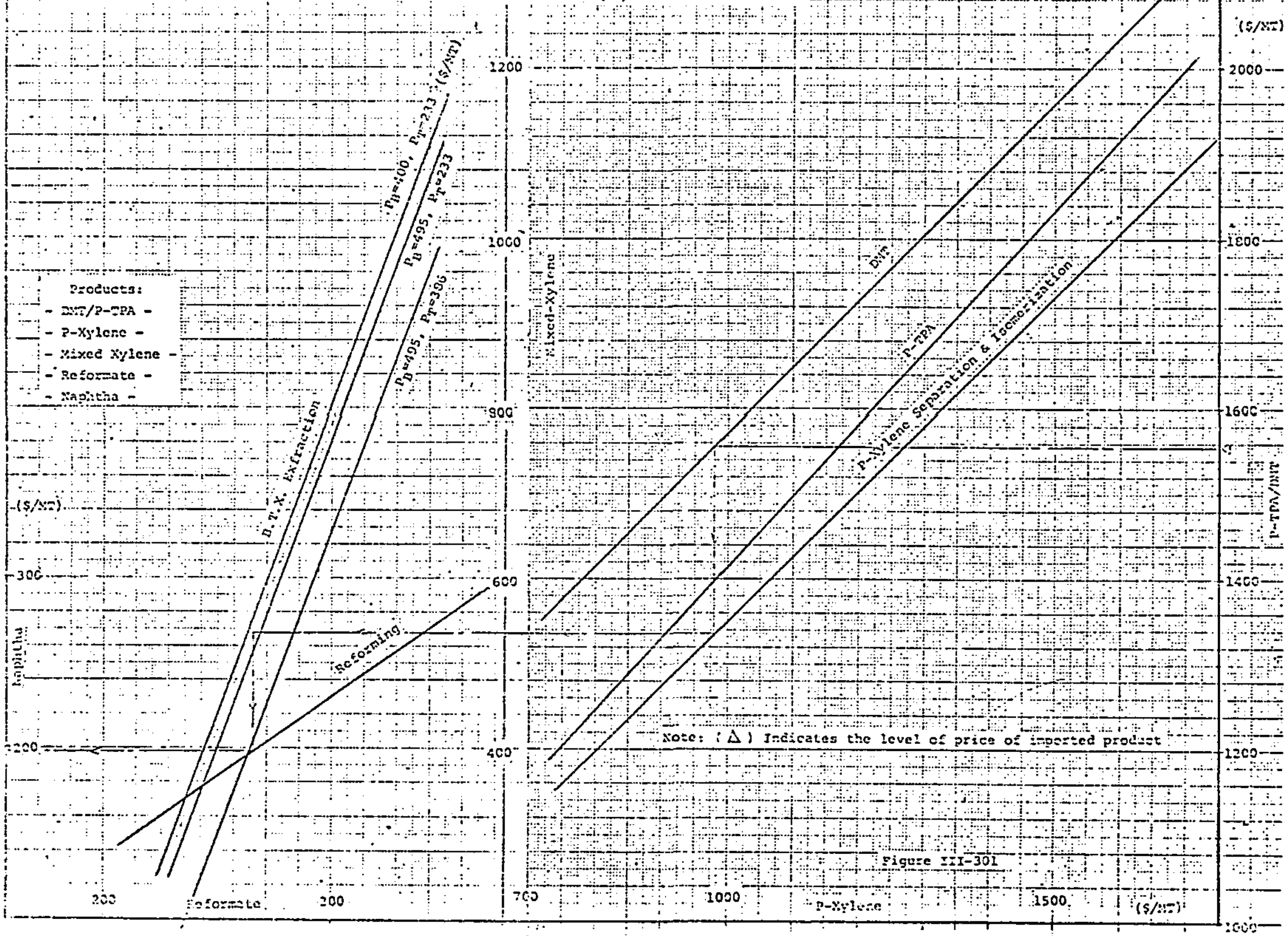
Table AII-18

Price of Aromatics and Raw Materials of Domestic Supply Based on the Price of Naphtha with the Specific Tax

Naphtha	$274/MT
Reformate	$364/MT
Mixed Xylene	$1,140/MT
Benzene	$495/MT
p-Xylene	$1,723/MT

The production costs calculated on the above basis are too high in comparison with the imported prices. Thus it seems that there is no possibility of aromatics production on the basis of the same level of the price of naphtha as gasoline with specific tax. In order to investigate into the effects of the price of naphtha on the production costs and exfactory prices of aromatics and synthetic fiber raw materials, case studies were performed and the results are shown as monograph "Effects of the price of raw material on exfactory price of products (1)" in Figure AII-12.

Figure AII-12 Effect of the Price of Raw Material on Exfactory Price of Product (1)



Calculations by applying the monograph show that the allowable price of naphtha is approximately $172/MT for the production of p-xylene competitive with the imported price of $721/MT, and configuration of prices of intermediates and other products are shown in Table AII-19.

Table AII-19

Prices of Aromatics and Raw Materials for the Production of p-Xylene Competitive Against Imports

Naphtha	$172/MT
Reformate	$214/MT
Mixed Xylene	$334/MT
Benzene	$470/MT
p-Xylene	$721/MT

(3) Production of Cyclohexane from Benzene Produced Domestically

The major portion of benzene will be produced by extracting it from pyrolysis gasoline. Benzene can also be by-produced through the extraction from reformate. Therefore, the exfactory price of benzene is difficult to evaluate because of the difference of production cost due to the production lines or different raw materials. A further difficulty is the by-production of benzene with the mixed xylene, the price of benzene depending on the price of mixed xylene. Further the production cost of benzene from pyrolysis gasoline varies on the plant capacity. Therefore, the plant capacity of olefin production affects the production cost of benzene.

Taking the above indefinite situation into consideration, the price of benzene for the evaluation of p-xylene and cyclohexane production should be determined taking into account the imported price ($495/MT) production cost produced from pyrolysis gasoline ($379/MT), and the allowable price for the competitive production of caprolactam ($470/MT). For the basis of study, an imported price of $495/MT is assumed as the price of benzene. In this case, the exfactory price of cyclohexane is slightly higher than the imported price.
(Cf. Table AII-20.)

Table AII-20

Prices of Caprolactam Based on Domestic Cyclohexane

Benzene	$495/MT
Cyclohexane	604
Caprolactam	1,680

The results of case studies were shown as monograph "Effect of the price of raw material on exfactory price of products (2)" in Figure AII-13.

3.2.3 Production of Synthetic Fiber Raw Materials from Domestic Materials

(1) The production of caprolactam from domestic cyclohexane.

The production economics of caprolactam based on domestic cyclohexane, sulfuric acid and imported ammonia was studied and "The effects of the price of raw material (cyclohexane) on exfactory price of products (caprolactam)" is shown in the same Figure AII-13 as the monograph of benzene, cyclohexane price relations. If the price of cyclohexane is assumed to be the same as the imported one, the exfactory price of caprolactam is slightly higher than the price of imported caprolactam. (Cf. Table AII-20. Calculated from monograph, the allowable price of cyclohexane is $580/MT for the production of caprolactam competitive against imports, and the corresponding price of benzene is approximately $470/MT. (Cf. Table AII-21.)

Table AII-21

Prices of Benzene and Cyclohexane for the Production of Caprolactam Competitive against Imports

Benzene	$470/MT
Cyclohexane	580
Caprolactam	1,646

If the price of benzene extracted from pyrolysis gasoline ($379/MT) is assumed to be the feed for the production of cyclohexane, the exfactory price of caprolactam and cyclohexane are $1,534/MT and $480/MT respectively. Cf. Table AII-22.

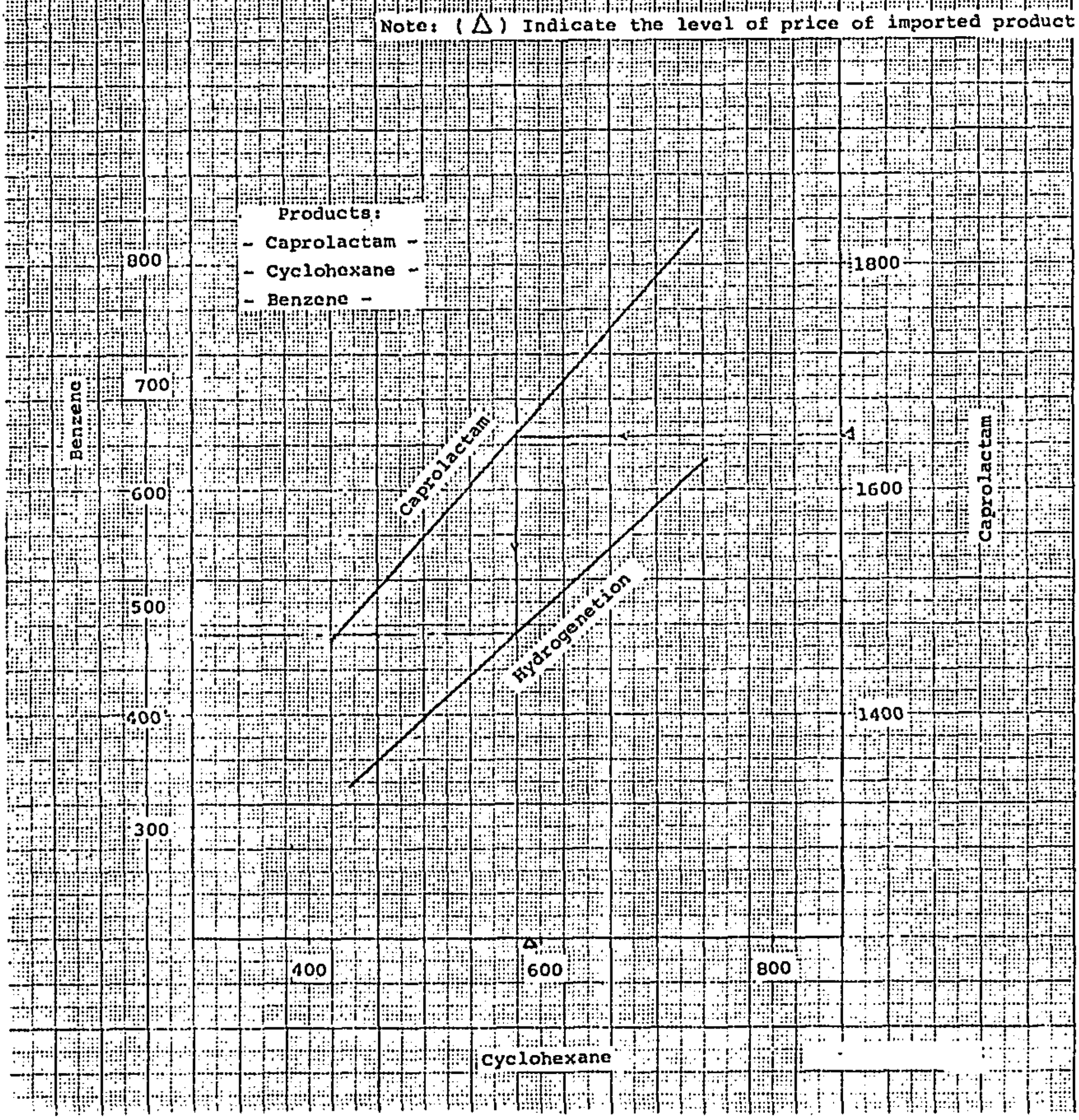
Table AII-22

Prices of Caprolactam and Cyclohexane Based on the Price of Benzene Extracted from Pyrolysis Gasoline

Pyrolysis Gasoline	$222/MT
Benzene	379
Cyclohexane	480
Caprolactam	1,534

Therefore, the production of caprolactam on the basis of domestic benzene rather than on imported intermediates is more possible, if the olefin complex is to be realized.

Figure AII-13 Effect of the Price of Raw Material on Exfactory Price of Products (2)



(2) Production of p-TPA/DMT from Domestic p-Xylene

The production of purified terephthalic acid of dimethyl terephthalate based on the domestic p-xylene and imported sub raw materials, acetic acid and methanol, respectively, was studied and the results are shown in the same Figure AII-12 as the monograph for the mixed xylene, p-xylene price relation. The exfactory prices of p-TPA/DMT produced with the capacity of 70,000 MTA and 77,000 MTA respectively are shown in Table AII-23.

Table AII-23

The Price of p-TPA/DMT of Domestic Production
Based on the Price of Naphtha with the Specific Tax.

		Remarks
Naphtha	$274/MT	With the specific tax and import duty on crude oil
p-Xylene	$1,723/MT	Cf. Table AII-18 & 5.7 in Appendix II
p-TPA	$2,014/MT	
DMT	$2,130/MT	

In comparison with the imported p-TPA/DMT, it seems likely that there is no possibility of production based on the price of naphtha with the specific tax. For the preliminary estimation of the allowable price of p-xylene for the production of raw materials of polyester fiber competitive against imports, the monograph in figure AII-12 is used. The results of configuration of prices for aromatics and naphtha are shown in Table AII-24.

Table AII-24

The Prices of Aromatic Intermediates
and Naphtha for the Production of
p-TPA/DMT Competitive Against Imports

		Remarks
Naphtha	US$198/MT	
Reformate	US$254/MT	
Mixed Xylene	US$535/MT	
Benzene	US$470/MT	The allowable prices for caprolactam production
p-Xylene	US$980/MT	
DMT*	US$1,548/MT	

*Note: DMT is a selected representative of p-TPA/DMT for the evaluation of the price of naphtha, because its production cost is higher than p-TPA.

The results obtained here are, of course, on the assumption of a 100% operational rate, and all the products would be sold in the domestic market. However, as discussed in the case of caprolactam, at least during the early years of the start of operation, it is necessary to reduce the operational rate or to export at a lower price level than the domestic market price. Therefore, the price of naphtha calculated here is regarded as the maximum allowable price. However, the improvement of the feasibility of the establishment of the aromatics complex based on the domestic raw materials for the synthetic fiber raw materials will be given by the scrutinization in the optimal selection of cut range of naphtha for reforming, and optimum combination with refinery for receiving the supply of reformate.

The difference in the cut range of feeding naphtha causes an essential change in the products pattern of B.T.X. Therefore, it will also cause a great change in the necessary amount of naphtha for the production of specific aromatic products.

As is evident from the yield of B.T.X. shown in 3.1.2, Table AII-13, the required amount of broad range naphtha (within the distillation range of IBP/EP 180/302°F) is 362,300 MTA. On the other hand, the required amount of the narrow range naphtha (within the distillation range of IBP/EP 230/307°F) is approximately 181,000 MTA which is approximately 1/2 of the required amount of the broad range naphtha.

Another improvement in the feasibility of the aromatics project will be obtained by the integration of the production of high-octane gasoline and reformate for the production of raw materials for aromatics products by commonly utilizing the hydrotreating and reforming units by separating the feeds and products through a block operation. With a successful combination of refinery and aromatics complex, and if the price of reformate can be the same as the price of extra gasoline, the prices for aromatics shown in Table AII-25 will be obtainable.

Table AII-25

The Prices of Aromatics Based on the Price of Reformate Same as Extra Gasoline

Reformate	US$233/MT
Mixed Xylene	US$442/MT
Benzene	US$470/MT
p-Xylene	US$860/MT

ANNEX III

PRELIMINARY VIEW
OF
NITROGENOUS FERTILIZER
PRODUCTION

ANNEX III PRELIMINARY VIEW OF NITROGENOUS FERTILIZER PRODUCTION

1. Preliminary View on Domestic Market

1.1 General Outlook of Agriculture in the Philippines

The Philippines virtually has a character of an agricultural country. Further, the national economy of the country in the recent years has been compelled to largely depend on the improvement and development of the domestic agricultural production. Owing to the industrialization policy undertaken by the Government since the independence, the relative importance of agriculture in the gross national income has since been gradually reducing. Nevertheless, the rate of agriculture still takes up approximately 30% of the gross national production. Approximately 60% of the total labour force is engaging in agriculture.

In particular, the Philippines is characterized as being one of the countries of the highest population growth rate. The population is increasing at a rate higher than 3% per year, which exceeds by far the annual growth rate of rice production. At present in the Philippines, the "Masagana 99 Rice Production Program" is being staged. Through this program, intense efforts are being exerted on the improvements in paddy cultivation, the character of which is still heavily underdeveloped. The details of this program will be described in a later part of this writing.

The agriculture in the Philippines may be categorized into two sectors; the "food crop sector" to supply to the domestic market and involving underdeveloped production technique, and the "commercial crop sector" for producing export commodities and having a comparatively high level of production technique. The crop which represent the former category are rice and corn, while coconut and sugar cane represent the latter.

The crop area and production figures of the major crops over the past decade since 1963 are as shown in Tables AIII-1 and AIII-2, in which it is shown that rice (palay) and corn together comprize approximately 60% of the total crop area.

Rice is consumed by 80% of the total population as the main diet. Rice therefore is the most important crop and is mainly produced in Central Luzon, Southern Tagalog, Cagayan Valley, and Western Visayas regions, which altogether take up approximately 62% of the total national rice production. The crop area over the past ten years has been slightly over 3 million hectare without much significant change in the coverage, while the per hectare production has been somewhat improved from 1.25 ton (rough rice)/ha in 1963 to 1.42 ton/ha in 1973. However, when compared with international standard, or even with other Asian countries, the productivity is still on a far lower level.

Corn is consumed by 20% of the population as the main diet. This crop is being produced mainly in Southern Mindanao. This region alone covers approximately 38% of the total national corn production.

Although the crop area is progressing along a trend of increase, Eastern Visayas region alone has been displaying a trend of decrease in the crop area. Visayas region has a number of people who consume corn as daily diet; however, the productivity of the corn in

Table AIII - 1 Crop Area of Selected Crops from 1963 to 1973

(10^3 ha)

	1963	1968	1970	1971	1972	1973
(Food Crops)	(5,977)	(6,401)	(6,406)	(6,345)	(6,561)	(6,345)
Palay	3,161	3,304	3,113	3,112	3,246	3,112
Corn	1,950	2,248	2,420	2,392	2,432	2,325
Fruits	395	398	402	380	404	408
Root Crops	264	250	252	246	258	266
Vegetables	124	101	113	108	111	115
Other Food Crops	83	100	106	107	110	119
(Commercial Crops)	(1,957)	(2,405)	(2,540)	(2,752)	(2,821)	(2,868)
Coconut	1,392	1,800	1,884	2,048	2,126	2,133
Sugar Cane	259	318	366	442	441	455
Abaca	182	171	173	155	145	163
Tabacco	97	94	87	76	78	84
Other Commercial Crops	27	22	30	31	31	33

Source: B. A. Econ., Dept. of Agriculture and Natural Resources

Table AIII - 2 Production of Selected Crops from 1963 to 1973

(10^3 ton)

	1963	1968	1970	1971	1972	1973
(Food Crops)	(7,974)	(9,294)	(10,670)	(10,774)	(10,629)	(9,890)
Palay	3,967	4,561	5,234	5,343	5,100	4,415
Corn	1,273	1,619	2,008	2,005	2,013	1,831
Fruits	1,068	1,449	1,640	1,726	1,808	1,867
Root Crops	1,360	1,305	1,316	1,221	1,218	1,220
Vegetables	214	251	333	328	329	371
Other Food Crops	92	109	139	151	161	186
(Commercial Crops)	(3,795)	(3,943)	(4,531)	(4,848)	(4,562)	(5,202)
Coconut	1,556	1,593	1,726	1,679	1,813	1,797
Sugar Cane	2,030	2,161	2,595	2,980	2,554	3,191
Abaca	128	104	123	105	111	119
Tobacco	67	65	61	56	56	65
Other Commercial Crops	14	20	26	28	28	30

Source: B. A. Econ., Dept. of Agriculture and Natural Resources this region is approximately 1/2 of that in Mindanao. It has been reported that at present, the supply of corn is dependent on shipments from Mindanao.

Like in the case of rice, the national average productivity of corn is still extremely low. The average is much lower not only than the world average, but also than the average productivity achieved in neighbouring Asian countries.

Table AIII-3 shows a comparison of the rice and corn productivity of the Philippines with those of the neighbouring countries.

Coconut is the third largest crop by area following only rice and corn. Tables AIII-1 and AIII-2 evidently show that the coconut crop area has been rapidly expanding over the past 10 years supported by favourable international oil and fat raw material market situation. Coconuts are cultivated throughout the nation except Northern and Central Luzon, however, as in the case of sugar cane which will be described later, there is a large difference in the productivity between the plantation and small holders. Therefore, in order to improve the national average of coconut production, the production technique improvement on the part of small holders seems imperative.

The crop area for sugar cane is far smaller than that for the above-mentioned three major crops, however, in terms of the benefits per unit area, sugar cane displays a rate higher than any other crops. Therefore, the productivity is also higher than that of other crops, thereby showing a level close to the international standard. The cropping of coconut is centering on Western Visayas which covers approximately 60% of the total sugar cane crop area of the country. Central Luzon follows Western Visayas by showing approximately 16%.

The sugar production in the Philippines has been growing with the background of the favourable provisions on the basis of the sugar quota of the United States so far; however, no great expansion in the export seems possible in the future. It is therefore forecast that production expansion commensurate with the growth of the domestic consumption will be achieved.

1.2 Masagana 99* Rice Production Program

As has been mentioned earlier, the productivity of rice, which is the major agricultural product of the Philippines, is on an extremely low level, and further the annual growth rate in rice production is far lower than the annual population increase. In addition to these drawbacks, the flood in 1972 and drought in early 1973 severely affected the rice production of the country. Particularly, rice shortage immediately before the cropping in 1973 was serious.

In order to cope with the above-mentioned situation, the Government of the Philippines commenced the Masagana 99 Rice Production Program* in the wet season of 1973 (Phase I). The farmers under the Program are provided with production credit up to the maximum of P900/ha. Of this amount, P500 is earmarked for the procurement of agricultural input items such as fertilizers, agricultural chemicals, etc., while the remaining P400 for seed, irrigation fee, labour, etc.

*The term 'Masagana 99" signifies an aspiration for achieving a target of paddy yield of 99 cavan (1 cavan approximately corresponds to 44 kg) which is the average yield of the participant regions to the program.

Table AIII - 3 Per Hectare Yield of Paddy and Corn in Selected Countries

(ton/ha)

	Paddy			Corn		
	1970	1971	1972	1970	1971	1972
World	2.30	2.30	2.25	2.44	2.74	2.79
Philippines	1.72	1.57	1.49	0.84	0.83	0.80
Indonesia	2.36	2.41	2.44	0.96	1.01	1.01
Thailand	1.97	1.99	1.82	2.60	2.26	1.34
W. Malaysia	2.72	2.91	2.90	3.74	2.16	2.12
Japan	5.63	5.24	5.85	2.75	2.50	2.90

Source: Production Year Book 1972, FAO

Table AIII - 4 Comparison of HYV Area between Philippines and Indonesia

	Paddy Crops Area (10^3 ha)	HYV Area (10^3 ha)	%
Philippines	3,246	1,827	56.3
(Central Luzon)	(671)	(417)	(62.2)
Indonesia	7,979	1,432	17.9
(Java)	(4,371)	(1,031)	(23.6)

Sources: Philippines - Bureau of Agr. Econ. 1972

Indonesia - Bimas Control Body 1972

The target for the dry season of 1974/1975 (Phase IV) was 579.4 thousand hectare, the breakdown of which is as shown below:

	Area (ha)	Yield (cavans/ha)
Irrigated	546.7	85
Rain-fed	32.7	65
	579.4	84

The Masagana 99 Program seems to be analogous to the Bimas Program of Indonesia; however, when compared with the Bimas Program, the Masagana 99 Program is still new, so that a certain length of time will be necessary until full effects are achieved.

Table AIII-4 shows a comparison of the extension rate of the high yielding varieties (HYV) in Indonesia and in the Philippines. The table clearly suggests that the extension rate of HYV in the Philippines is extremely high. Nevertheless, it is highly notable that, as has been discussed earlier (Table AIII-3), the rice productivity in the Philippines is extremely low.

This implies that the improvement in the productivity of rice cannot be materialized by merely introducing high yielding varieties, and that harmonizstion of overall yield improvement technology including fertilizer application is imperative for the attainment of the purpose. In this sense, it is strongly expected that the Masagana 99 Program, which is a "package deal" of the yield improvement technology will truly contribute to the enhancement of the productivity.

According to a projection formulated by FAO*, it is expected that a demand of 5.2 million tons of rice (7.65 million tons in terms of paddy) will be generated by 1980. Thus, in order to satisfy the self-sufficiency in supply of rice, the present (1973) average yield of 1.42 ton/ha will have to be improved to 2.46 ton/ha if no expansion in crop area is to be made.

It is strongly hoped that the Masagana 99 Program will not fail because of possible difficulties in meeting with the required financial capacity for providing subsidy and credit, securing of required amount of fertilizers, etc.

*Agricultural Commodity Projections, 1970-80; FAO.

1.3 Present Status of Fertilizer Consumption

Fig. AIII-1 shows the consumption trend of nitrogenous fertilizers covering past 14 years. Table AIII-5 shows the actual ton-basis stipulation of type-wise fertilizer consumption records in the years 1972 and 1973. Table AIII-6 shows the nutrient-basis stipulation of the data shown in the above table.

According to Fig. AIII-1, the growth in fertilizer consumption in the Philippines has been uneven in trend, and the consumption growth up to 1968 shows an extreme stagnation, while a rapid growth is recorded for the period from 1969 onwards. Thus, the average annual growth rate for the period of 1960/74 is 9%.

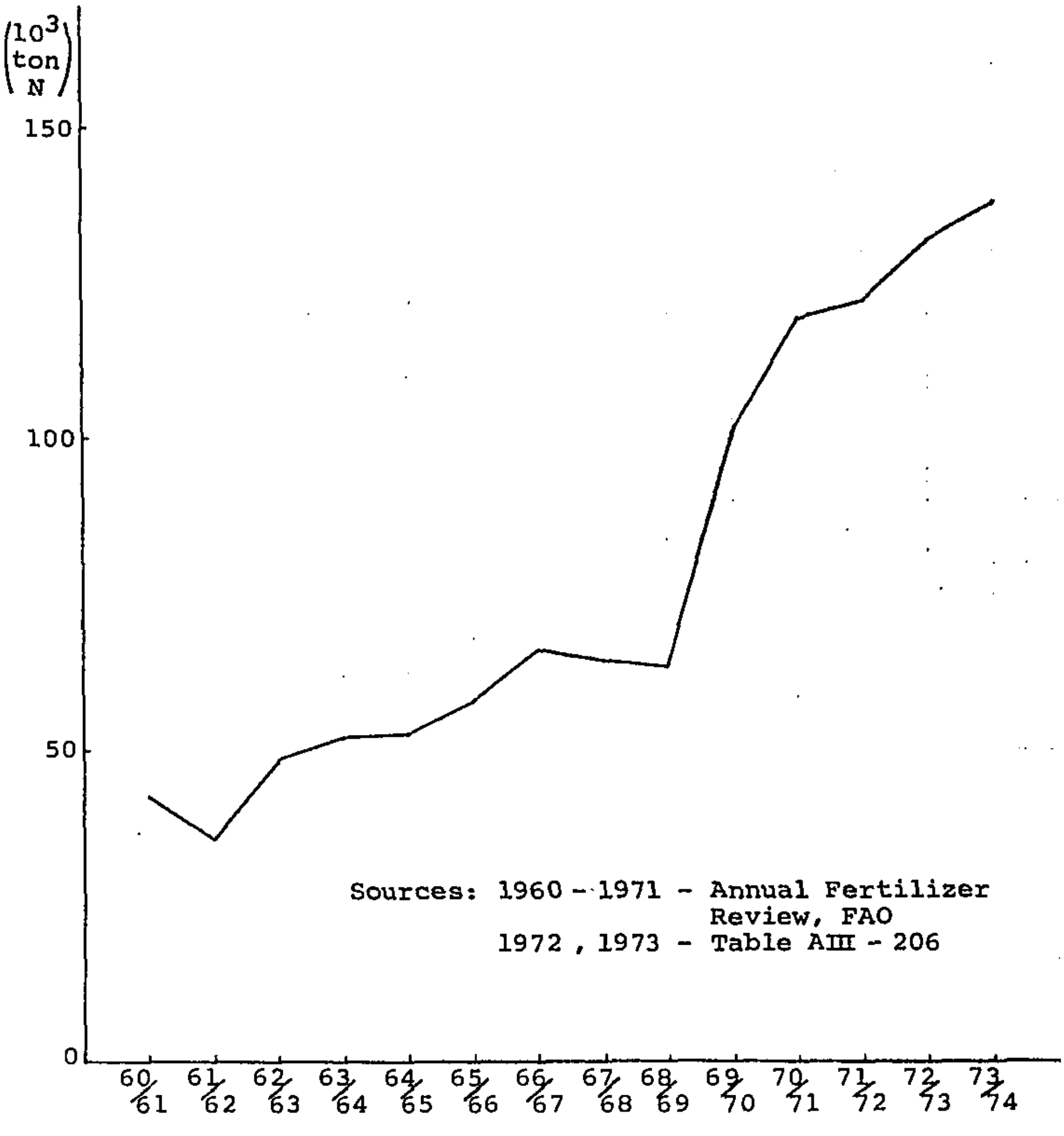


Figure AIII - 1 Consumption of Nitrogenous Fertilizer from 1960 to 1973

According to Table AIII-5, the recent growth in fertilizer consumption seems to be due mainly to the consumption growth in the food crop sector. By the Presidential Decree of autumn, 1972, a dual-price system was enacted for fertilizers for the purpose of giving favourable provisions for food crop production. As a result, the food crop sector (rice, corn, etc.) has been entitiled to obtain fertilizers on a level lower than the cost price, while the commercial crop sector (sugar cane, coconuts, etc.) has been compelled to purchase fertilizers on a comparatively high price level. This policy must have greatly encouraged the fertilizer consumption in the food crop sector.

Expecially in 1973, the farm gate price of paddy was more than P30/cavan which made the fertilizer prices comparatively low for the rice producing farmers. However, the hike in the fertilizer prices in the international market did not allow unlimited supply of low-cost fertilizers to the rice farmers.

Table AIII-7 shows the change took place in the recent years in the fertilizer prices in the Pholippines. Particularly during 1974, fertilizer price revisions were made several times, until finally the urea for food crop sector attained a high price level of P111/15kg. When compared with the governmental support price of P40/50kg. of paddy, the above-mentioned fertilizer price seems to be rather discouraging for the fertilizer consumption to further grow.

The type-wise breakdown of nitrogenous fertilizers is shown in Table AIII-6, which indicates more than 50% of the total is comprized by urea, while the remaining 50% shared almost equally by ammonium sulfate and compound fertilizers. However, in view of a crop wise analysis, the consumption of ammonium sulfate in the commercial crop sector is considerably high.

1.4 Future Prospect of Fertilizer Consumption

Several institutes or individual analysts have so far conducted fertilizer demand forecast for the Philippines. Of these, the USAID/TVA report entitled "The Fertilizer Industry in the Philippines (1971)" is a forecast which is based on a detailed analysis. In this report, nutrient-wise and crop-wise demand forecasts are formulated by covering a period from 1971 to 1975 by taking the year 1970 as the base year. Further, by exterpolating the obtained figures, the calculations of the data covering the year 1980 are also conducted. (Table AIII-8)

However, the actual results of consumption up to 1973 (Table AIII-5) is considerably lower than these USAID/TVA forecast figures, thereby implying that the low degree of fertilizer availability and high extent of prices in the international market during this period affected the growth in consumption. In other words, the actual consumption registered figures which are far from the requirements because of the difficulties felt on the part of the suppliers. By referring to the fertilizer application rate used in this USAID/TVA report, the present nitrogenous fertilizer consumpiton is shown in Table AIII-9 in terms of a crop-wise breakdown. The table implies that rice (palay) takes up approximately one-half of the total consumption of the fertilizers. If an assumption is made that the total fertilized area of palay coincides with the subject area envisaged in the Masagna 99 Program, it is necessary that the actual figures be slightly lower than those stipulated in this table. (700 thousand hectare for wet season, 350 thousand hectare during dry season.)

Table AIII - 5 Typewise and Sectorwise Fertilizer Consumption in 1972 and 1973

(tons)

	1972			1973		
	Food Crops	Commercial Crops	Total	Food Crops	Commercial Crops	Total
Urea	75,000	105,000	180,000	71,500	87,300	158,800
Ammonium Sulfate	40,000	80,000	120,000	66,881	101,019	167,900
T S P	-	8,000	8,000	-	-	-
KCl	-	64,000	64,000 (K_2SO_4 2,000)	-	57,100	57,100
18 - 46 - 0	-	45,000	45,000	5,000	41,800	46,800
16 - 20 - 0	20,000	20,000	40,000	34,512	20,538	55,050
14 - 14 - 14	22,000	23,000	45,000	30,703	21,222	51,925
12 - 24 - 12	10,000	5,000	15,000	7,400	1,100	8,500
12 - 12 - 12	8,000	2,000	10,000	23,143	1,672	24,815
10 - 5 - 20	-	3,000	3,000	4,092	6,398	10,490
Total	175,000	355,000	530,000	243,231	338,149	581,380

Source: FIA

Table AIII - 6 Typewise and Sectorwise N Consumption

($N\ 10^3$ ton)

	1972				1973			
	Food Crops	Commercial Crops	Total	(%)	Food Crops	Commercial Crops	Total	(%)
Urea	34.5	48.3	82.8	(63)	32.9	40.2	73.1	(53)
Ammonium Sulfate	8.4	16.8	25.0	(19)	14.1	21.2	35.3	(26)
Compound	8.5	15.6	24.1	(18)	14.8	14.7	29.5	(21)
Total	51.4	80.7	131.9	(100)	61.8	76.1	137.9	(100)

Source: Table AIII - 205

Table AIII - 7 Price of Urea

(Peso/50 kg Bag)

		Food Crops	Commercial Crops
May	1973	27.10 - 29.00	34.75 - 37.85
Nov.	"	27.10 - 29.00	49.20 - 53.95
Feb.	1974	63.95 - 67.55	86.40 - 90.00
April	"	63.95 - 67.55	115.00 - 118.60
Aug.	"	63.95 - 67.55	166.70 - 170.30
Nov.	"	111.00 - 114.60	166.70 - 170.30

Source: FIA

Table AIII - 8 Fertilizer Demand Projection by USAID/TVA

(Nutrient ton)

	N	P_2O_5	K_2O
1971	127,883	41,742	53,836
1972	138,799	45,466	57,881
1973	149,340	49,172	61,740
1974	160,707	52,984	65,766
1975	171,972	56,846	69,796
1980	238,000	85,000	100,000

Source: The Fertilizer Industry in the Philippines, USAID/TVA

Table AIII - 9 Estimated N Consumption in 1973

	Crops Area (10^3 ha)	% Fertilized	Fertilized Area (10^3 ha)	N Dosage (kg/ha)	Consumption (N ton)
Palay	3,112	44	1,369	50	68,450
Corn	2,325	38	884	25	22,100
Sugar Cane	455	80	356	80	28,480
Coconut	2,133	1.4	30	20	600
Other Crops	1,188	25	297	50	14,850
Total	9,213	32	2,936	46	134,480

Also, the corn and sugar cane fertilized area percentage of 38 and 80 seems to be too high for corn and too low for sugar cane in view of the respective average yield figures achieved at present.

Table AIII-10 shows an estimate on the nitrogenous fertilizer consumption in the year 1980 taking the figures shown in Table AIII-9 as the bases. Regarding the two commercial crops and other crops shown in this table, the stipulated figures seem to be reasonable, however, the figures for palay and corn, the estimates seem to be considerably optimistic.

Regarding palay, it is difficult to presume that fertilizer application approximately corresponding to the recommendation is actually conducted in approximately 70% of the total crop area. The total irrigated palay area in the Philippines at present is approximately 800 thousand hectare, which signifies that the area figure will be 1.6 million hectare if the whole area is double-cropped. If the fertilized area in the rain-fed condition during the wet season is assumed to be 200 thousand to 400 thousand hectare, the maximum of the fertilizer application area will be 1.8 to 2.0 million hectare.

Also, if it is assumed that the average yield of the fertilized area is 2.72 ton/ha for rice (4.00 ton/ha for paddy), the rice production from the fertilized area total of 2,208 thousand hectare is approximately 6,000 thousand tons. If this production figure is divided by the estimated figure of rice-fed population in the year 1980 (approximately 80% of the total population, i.e., 43,000 thousand), the per capita figure is obtained as approximately 140 kg. This implies a slight extent of over-production.

In view of the above-mentioned points, it is reasonably estimated here that the maximum fertilized area for palay in the year 1980 will be 2,000 thousand hectare.

According to the projection compiled by FOA, no increase is forecast in terms of per capita demand of corn in the Philippines, thereby implying that the future demand increase will be made commensurate with the population increase. If the population increase rate is assumed to be at 3.4% per year, the demand for corn in the year 1980 will be 2,314 thousand tons. In order to obtain this amount of production, it would be sufficient to have 771, 661, or 578 thousand hectare of crop area on an assumption that the yield of fertilized area is taken at 3, 3.5, or 4 hectare respectively. Therefore, as has been mentioned earlier, the fertilized area stipulated in Table AIII-8 is already suggesting an over-estimation. Even when the corn demand for animal feed use is taken into account, it seems inadequate to estimate a fertilizer area figure of more than 1 million hectare.

In the light of the above-mentioned points, the palay and corn portion of the figures shown in Table AIII-10 have been recalculated to obtain conservative figures as shown in Table AIII-11. However, it must be noted that the calculations of demand described in the foregoing paragraphs do not take into account the situation presenting difficulty in securing sufficient quantity of fertilizers, abnormally high international price of fertilizers, and other constraints caused on the part of the fertilizer suppliers.

If the tight market situation of the fertilizer as is prevailing at present is to continue for the future, the fertilizer consumption in the year 1980 will be on a level much lower than estimated above.

Table AIII - 10 N Demand Projection in 1980

	Crops Area (10^3 ha)	% Fertilized	Fertilized Area (10^3 ha)	N Dosage (kg/ha)	Consumption (N ton)
Palay	3,200	69	2,208	80	176,640
Corn	2,400	63	1,512	40	60,480
Sugar Cane	450	91	410	120	49,200
Coconut	2,800	4	112	40	4,480
Other Crops	1,100	29	319	80	25,520
Total	9,950	46	4,561	69	316,320

Table AIII - 11 Modified N Demand Projection in 1980

	Fertilized Area (10^3 ha)	N Dosage (kg/ha)	Demand (N ton)
Palay	2,000	80	160,000
Corn	1,000	40	40,000
Sugar Cane	410	120	49,200
Coconut	112	40	4,480
Other Crops	319	80	25,520
Total	3,841	73	279,200

2. Preliminary View of International Market and the Influence on the Philippine Market

2.1 Introduction

During the period from 1960 to 1965, the nitrogenous fertilizer market of the world showed a comparatively stable trend. However, food shortage prevailed during the same period in certain areas of the world, and an acute increase in the population in developing countries led some people to believe that global food crisis is inevitable. This further gave rise to the necessity of fertilizer production increase in order to prevent such a catastrophe.

The improvement in the production technique for fertilizer incidentally made it possible in the meantime to construct large-scale low-cost plants by employing centrifugal compressors. This being the circumstance, a large plant construction "rush" took place worldwide during the period from 1965 to 1972.

Thus, the fertilizer market position turned all of a sudden into "oversupply". The international market price of fertilizers constantly showed a downtrend during the same period until at last the price level almost reached the production cost figures. Therefore, the fertilizer manufacturers of the world naturally lost incentive in the plant facilities expansion.

From this point onwards, the fertilizer plant construction trend began to show a stagnation. The abnormal climate conditions took place in various areas of the world in 1972 resulted in a large extent of food production decrease. The stock of foods suddenly disappeared and the food prices kept increasing. Because of this, the demand for fertilizers also increased suddenly from 1973 onward, so that the world fertilizer supply/demand balance showed another swing from oversupply to shortage.

The fertilizer prices have been showing uptrend every month until today. Due to the fact that the completion of fertilizer plant construction requires three to four years from the commencement of the work, it has been a common opinion amongst the knowledgeable people of the world that fertilizer short supply condition will persist at least for another three years. Although it is believed that the shortage of fertilizer at present comprises merely 2 to 3% of the total demand, the prices of fertilizers show a level which is six to eight times as high as the bottom price level quoted in 1971.

Therefore, even if the extent of shortage seems to be small, the effects thereof are serious. Thus, both fertilizer producing and consuming countries alike again showed a strong intention for constructing fertilizer plants. For constructing a fertilizer plant, raw materials, technology and vast amount of fund must be made available. In spite of such requirements, it has become evident that a considerable instances of fertilizer new plant construction will be conducted during the forthcoming three to four years. The present international fertilizer market situation is tight with an abnormally high price level prevailing. However, by the time this project is completed, i.e., around 1980, it seems that a vast change will have been taken place in the supply/demand balance and in prices of fertilizers.

In this chapter, by placing emphasis on the period after 1980, forecasts will be made on the world nitrogen balance, Southeast Asian nitrogen balance, flow of trades within the balance, position assumed by urea, and future fertilizer prices. Studies will be made here regarding the effects of the above-mentioned factors on the economy of the Philippines. Countermeasures to be undertaken by the Philippine Government will also be studied in this chapter.

2.2 International Market

2.2.1 Future Prospects of World Demand and Supply:

The trend of ammonia production scale increase in the developed areas of the world started in 1965,and came to a tentative end in 1971. During this period, the production capacity increased by 25.7 million N tons; however, consumption increase by only 15.3 million N tons. Therefore, as shown in Table AIII-12, the operational rate was accordingly reduced to 60%, and price also showed a sudden drop. (Refer to Table AIII-19) Thus, the fertilizer producers lost new construction or expansion incentive. In the meantime, small-scaled old plants began to be scrapped one after another. In other words, a serious recession took place in the world fertilizer industry.

The globally poor yield of agricultural products in 1972 due to abnormal weather occured while the situation of the fertilizer industry was extremely deteriorated as described above. From 1973 onwards, the fertilizer demand suddenly increased owing to the urgent necessity for food production increase. However, the supply or the operational rate of production facilities failed to grow under the effects of the oil crisis which took place in the autumn of 1973. This being the case, the stocked fertilizer altogether went to the market. From 1974 onwards, the fertilizer prices kept increasing because of the clear manifestation of long-term and global fertilizer shortage, repeated price increase for crude oil, and progress of inflation. The present fertilizer price level is six times as high as the lowest level record in 1971.

Such a situation naturally gave incentive for fertilizer production plant construction to both fertilizer exporting and importing countries. At present, a number of construction projects have been and being announced in various parts of the world. According to TVA's statistics, the total capacity figure of the fertilizer production plants which are being constructed or projected to be constructed amounts to 34,139,000 N tons which corresponds to 54.7% of the existing production capacity as of end of 1973. In other words, the secondary fertilizer plant construction boom seems to be forthcoming.

It is highly difficult to formulate a forecast on the nitrogenous fertilizer supply/demand in the world. However, the following points may at least be stated. In view of the presently prevailing food shortage and population increase, the fertilizer demand trend will not be far away from the demand forecasts announced so far by TVA, UNIDO, and by other organizations. On the other hand, the increase in the plant construction project will not acutely appear for at least three years to come, because of the fact that normal new construction of a plant will require three to four years until completion. The operational rate will decrease rather than increase because of the increment in the number of new plants in the meantime. This being the case, it can be stated that for another three years i.e., until 1976, fertilizer short supply will continue. From 1977 onwards, when a number of newly constructed plants start operation, the balance will turn towards an obvious ease. The demand and supply balance formulated by TVA shown in Table AIII-12 indicates that the short supply condition will persist until 1977. Then, from 1978 onwards, a number of new plants will go into full production operation, thereby again inviting surplus capacity and consequential oversupply of fertilizers. the Consultants fully agree with such a general outlook towards the future of fertilizer market trend.

Table AIII-12 World N Demand and Supply Forecast

N 10^3 tons

	Capacity	Operation Rate	Production	Demand	Balance
1965	27,767	62.2%	17,275	16,357	918
66	31,869	62.5	19,911	18,842	1,069
67	37,973	58.8	22,327	21,778	549
68	40,504	63.2	25,591	23,938	1,653
69	45,424	62.6	28,431	26,618	1,813
70	50,340	60.0	30,196	28,653	1,543
71	53,490	60.8	32,534	31,720	814
72	58,195	60.4	35,129	33,700	1,429
73	62,646	56.8	35,600	36,476	-876
74	67,100	56.9	38,200	39,189	-989
75	72,100	56.7	40,900	41,975	-1,075
76	77,200	56.5	43,600	44,828	-1,228
77	86,400	54.7	47,300	47,750	-450
78	93,100	55.0	51,200	50,742	458
79	95,000	57.4	54,500	53,802	698
80	96,700	58.2	56,300	56,931	-631

Source: TVA, Aug., 1974 and April, 1974

Regarding the year 1980, TVA forecasts a turn towards production capacity shortage and short supply. It seems that this forecast has been formulated on the basis of conservative calculations because of the difficulties met in forecasting plant construction projects to be announced in the future. The TVA forecast states an operational rate of 58.2% for 1980; however, a rate higher than this should be available by then in view of past records of world's fertilizer industry. If the operational rate is taken as 60% for the year 1980, the TVA balance forecast for the same year must be changed to oversupply by 1,089,000 N tons. According to Table IV 8, the trend of price fall under over-supply condition is not necessarily acute, and 5 years elapsed until the price hit the lowest level. Therefore, Consultants maintain that short supply will not emerge for at least two to three years after 1980, as shown on Figure AIII-2.

2.2.2 Future Prospects of World Nitrogen Trade:

Table AIII-13 shows the region-wise distribution of the present world nitrogen trade (import and export). The major export regions are West Europe, Japan, East Europe and North America. The major import regions are Asia other than Japan, Latin America and Africa. The USSR, China, India, the USA and Canada are the countries in which the number of presently announced fertilizer plant construction projects is high. Table AIII-14 shows the results of capacity increase forecasts at the present stage in the major exporting regions. The capacity increase is overwhelmingly high in East Europe centering around the USSR, followed by North America and West Europe. Japan shows almost no increment. Table AIII-15 shows the demand increase forecast of nitrogen in the export regions.

From these two tables, it can be estimated that the major export regions in the year 1980 will be East Europe centering around the USSR, followed by Japan. In the case of North America and West Europe, the demand will also increase while the capacity grows, thereby reducing the export surplus.

Table AIII-13 Regional N Export and Import Balance, 1972

N 10^3 tons

	North Amer.	West Europe	East Europe	Japan	Latin Amer.	Africa	Other Asia	Oceania	World Total
Export	1,373	2,632	1,141	1,274	243	38	228	26	6,955
Import	794	1,300	392	0	872	590	2,961	21	6,930
Balance	579	1,332	749	1,274	-629	-552	-2,733	5	25

Source: TVA, April 1974.

Table AIII-14 Estimates of N Production Capacity Increase in Export Regions

(from 1973 to 1980)

N 10^3 tons

	North America	West Europe	East Europe	Japan	A Total	B World Total	A/B
1973	13,477	13,951	13,422	3,781	44,631	56,113	79.5%
1980	19,993	16,863	26,171	3,800	66,827	97,258	68.7%
Increase	6,516	2,912	12,749	19	22,196	41,145	

Source: UNICO Estimate, Sept. 1974.

Table AIII-15 Estimates of N Demand Increase in Export Regions (from 1973 to 1980)

N 10^3 tons

	North America	West Europe	East Europe	Japan	A Total	B World Total	A/B
1973	8,503	7,104	9,298	922	25,827	36,476	69.9%
1980	11,894	9,481	15,643	921	37,939	56,931	66.6%
Increase	3,391	2,377	6,345	-1	12,112	20,455	

Source: TVA April, 1974.

Particularly in the case of the USA, it is possible that the country becomes an importer depending on the agricultural production situation. It is forecast that Persian Gulf countries will grow into new exporters.

Along with the plant construction advancement in the presently import regions such as Asia other than Japan, Latin America, and Africa, these countries will definitely show a vast decrease in the trading rate as against the total production in the year 1980.

Table AIII-16 N Consumption, Production and Balance Forecast

N 000 tons

		71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4	84/5	85/6
Burma,	Capacity	66	66	66	66	66	66	66	66	66	166	166	166	166	166	166
	Consumption	28	37	47	57	65	74	81	88	94	100	106	112	118	124	130
	Production	49	47	50	50	50	50	50	50	50	114	122	130	130	130	130
	Balance	21	10	3	-7	-15	-24	-31	-38	-44	14	16	18	12	6	0
Indonesia,	Capacity	49	87	118	157	286	286	286	956	1,226	1,226	1,226	1,226	1,226	1,226	1,226
	Consumption	258	305	344	383	422	461	499	538	577	615	653	692	730	774	821
	Production	46	59	81	108	214	241	249	633	812	863	914	914	914	914	914
	Balance	-212	-246	-263	-275	-208	-220	-250	95	235	248	261	222	184	140	93
Khmer,	Capacity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Consumption	2	2	3	4	5	7	8	10	12	13	14	15	16	17	17
	Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Balance	-2	-2	-3	-4	-5	-7	-8	-10	-12	-13	-14	-15	-16	-17	-17
Laos,	Capacity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Consumption	0.1	0.1	0.2	0.3	0.4	0.6	0.9	1	1	2	2	3	4	4	5
	Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Balance	-0.1	-0.1	-0.2	-0.3	-0.4	-0.6	-0.9	-1	-1	-2	-2	-3	-4	-4	-5
Malaysia,	Capacity	41	41	41	41	41	41	41	41	41	311	311	311	311	311	311
	Consumption	63	72	74	80	86	90	95	100	105	110	113	115	118	120	123
	Production	35	36	36	36	36	36	36	36	36	214	230	245	245	245	245
	Balance	-28	-36	-38	-44	-50	-54	-59	-64	-69	104	117	130	127	125	122
Philippine,	Capacity	117	117	117	117	117	117	117	117	117	387	387	387	387	387	387
	Consumption	122	135	150	170	191	211	232	252	273	294	314	334	355	375	396
	Production	46	53	58	64	70	70	70	70	70	186	205	225	244	244	244
	Balance	-76	-82	-92	-106	-121	-141	-162	-182	-203	-108	-109	-109	-111	-131	-152
Singapore,	Capacity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Consumption	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Balance	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Source: UNICO, 1974

Table AIII-16 N Consumption, Production and Balance Forecast (Continued)

N 000 tons

		71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4	84/5	85/6
	Capacity	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Thailand,	Consumption	51	69	68	68	68	76	85	93	101	110	116	123	130	137	143
	Production	5	4	6	8	10	11	11	11	11	11	11	11	11	11	11
	Balance	-46	-65	-62	-60	-58	-65	-74	-82	-90	-99	-105	-112	-119	-126	-132
	Capacity	0	0	0	0	0	0	0	0	162	162	162	162	162	162	162
Vietnum DR,	Consumption	31	47	55	63	71	78	84	89	94	97	100	103	105	106	107
	Production	0	0	0	0	0	0	0	0	113	121	129	137	145	145	145
	Balance	-31	-47	-55	-63	-71	-78	-84	-89	19	24	29	34	40	39	38
	Capacity	0	0	0	0	0	0	0	0	0	270	270	270	270	270	270
Vietnum R,	Consumption	98	100	111	123	135	148	161	174	187	200	213	226	239	252	265
	Production	0	0	0	0	0	0	0	0	0	187	200	214	227	241	241
	Balance	-98	-100	-111	-123	-135	-148	-161	-174	-187	-13	-13	-12	-12	-11	-24
	Capacity	300	338	369	408	537	537	537	1,207	1,639	2,549	2,549	2,549	2,549	2,549	2,549
Total,	Consumption	654	768	853	949	1,044	1,146	1,246	1,346	1,445	1,542	1,632	1,724	1,816	1,910	2,008
	Production	131	199	231	266	380	408	416	800	1,092	1,696	1,811	1,876	1,916	1,930	1,930
	Balance	-473	-569	-622	-683	-664	-738	-830	-546	-353	154	179	152	100	20	-78

Note: The above production figures have been computed on the prerequisite of following new construction;

Pusri III,	Indonesia	(NH_3 1000 T/D) by 1977,	Burma	(400 T/D) by 1979
East Kalimantan,	"	(" 1500 ") " "	Philippine	(1000 ") " "
West Java	"	(" 1000 ") by 1978,	South Vietnum	(1000 ") " "
North Vietnum		(" 600 ") " "	Malaysia	(1000 ") " "

Source: UNICO, 1974

2.2.3 Nitrogen Demand and Supply Balance in Southeast Asia:

Including the Philippines, all the countries in the Southeast Asian area are so-called agricultural countries. The fertilizer consumption in this area has been growing over the past six years at a rate as high as average 18% per year. In spite of this, the number of fertilizer manufacturing plants in this area is few and those existing are all small in scale. Therefore, until today, this area has been an import region into which a considerable extent of fertilizer has been supplied from outside. Of these countries, Indonesia, Malaysia, and Burma have natural gas resources. A number of fertilizer plant construction projects are being established or contemplated in these countries.

Table AIII-16 shows the demand and supply balance forecast of fertilizers compiled by the Consultants by incorporating the Southeast Asian projects as well. For the major consumer countries in the table (the Philippines, Thailand, Malaysia, Indonesia, and Burma), the Consultant has already conducted through on-site surveys prior to the compilation of the figures.

The Consultant maintains that supply shortage will take place within the region by 1979/80 period, thereby necessitaing partial importation. However, if all the presently publicized plant construction projects should be implemented on schedule, self-sufficiency status will be attained for the period after 1980/81.

The forecast shown in Table AIII-16 assumes that one 1,000 ton NH_3 plant will be constructed inside the Philippines. In view of the fact that fertilizer is the most important input for food production increase, the Consultant believes that this forecast is adequate.

2.2.4 Type of Fertilizer in World Production:

There are several types of nitrogenous fertilizers, and different countries choose different types in accordance with the type of available raw materials, extent of production cost, and nature of crops to which the fertilizer is applied. The popular types of nitrogenous fertilizers are; urea, ammonium sulphate, and ammonium nitrate. Of these, the production of urea in particular has lately been showing increase year after year. At present, urea is the foremost type in production and trade quantity amongst various types of nitrogenous fertilizers. This trend of urea growth will be intensified every year in the future. Table AIII-17 shows a TVA statistics regarding the increment rate of urea production in the world. The present rate of urea conprized in the total nitrogenous fertilizer production is 30%; however, it is forecast that the rate will grow to 36% by the year 1978. The urea production rate is particularly high in the Asian Region where it is expected that the rate will be as high as 67%. This is due to the lower production cost of urea and the suitability to paddy field application.

Table AIII-17 Portion of Urea Production in N Capacity

N 000 tons

	Asia			Other Region			World Total		
	Total N Capacity	Urea Capacity	%	Total N Capacity	Urea Capacity	%	Total N Capacity	Urea Capacity	%
1967	6,396	2,438	38	31,577	4,682	15	37,973	7,120	19
1970	8,964	3,795	42	41,376	8,248	20	50,340	12,043	24
1973	13,901	6,825	49	48,745	11,848	24	62,646	18,673	30
1975	16,112	8,655	54	55,662	14,329	26	71,774	22,983	32
1978	18,652	12,526	67	58,955	15,772	27	77,607	28,298	36

Source: TVA April, 1974

2.3 Future Price Tendency in International Market

The trade prices fluctuate in accordance wirh the supply and demand in free competitive trade. Fertilizer is no exception to this rule. Because of the fact that fertilizer is an indispensable input for food production increase, the effects of demand and supply balance reflect especially strongly onto the price trend.

Table AIII-18 shows the nitrogen demand and supply balance in the world since 1964, along with the export price (FOB Japan) of urea as a representative commodity of nitrogenous fertilizer. Fig. AIII-2 illustrates the data of Table AIII-18. The following points may be derived from this figure:

(1) The fluctuation of fertilizer price is basically geared to the trend of demand and supply balance.

(2) The price will show a gradual downtrend if oversupply continues.

(3) A sudden and vast price increase will take place immediately after the emergence of short supply conditions.

The present price level of urea on an FOB basis in the world varies according to the origin. Japanese urea is quoted at around US$300/t, while $350 and $400 approximately are being priced for West Europe and East Europ urea respectively. The East European commodity is dealt with on spot sales basis, and importing countries in Asia basically rely on imports from Japan.

The present prices of urea mentioned above are six to eight times as high as the lowest price quote during 1971. On the other hand, the estimated fertilizer shortage during the year 1974 is merely 2.6% of the total estimated production. In other words, the price level is abnormally high, although the extent of shortage in supply is not necessarily great.

It is highly difficult to estimate the future trend of fertilizers in the future. In this respect, the Consultant's opinions are as follows:

(1) Short supply conditions will persist for approximately three years. The price will slightly increase in proportion to the extent of shortage. In view of the already abnormal present level, no vast price increase is likely. Thus, the price will maintain a plateau for some three years to come.

(2) By 1977, a number of newly constructed plants will be placed onstream, and they will go into full production during 1978 when some oversupply may take place. Therefore, the fertilizer price will soften around 1978, and then will show a gradual fall.

(3) The expected oversupply from 1978 onwards will not be as vast as the one emerged during the last half of 1960s decade; however, the condition may persist for at least four to five years because of operational rate improvements, etc. Therefore, the price will show a gradual decrease; however, the level will never reach the production cost. An eventual stability of price level will be attained at a production-cost-plus-adequate-profit (marginal price) level.

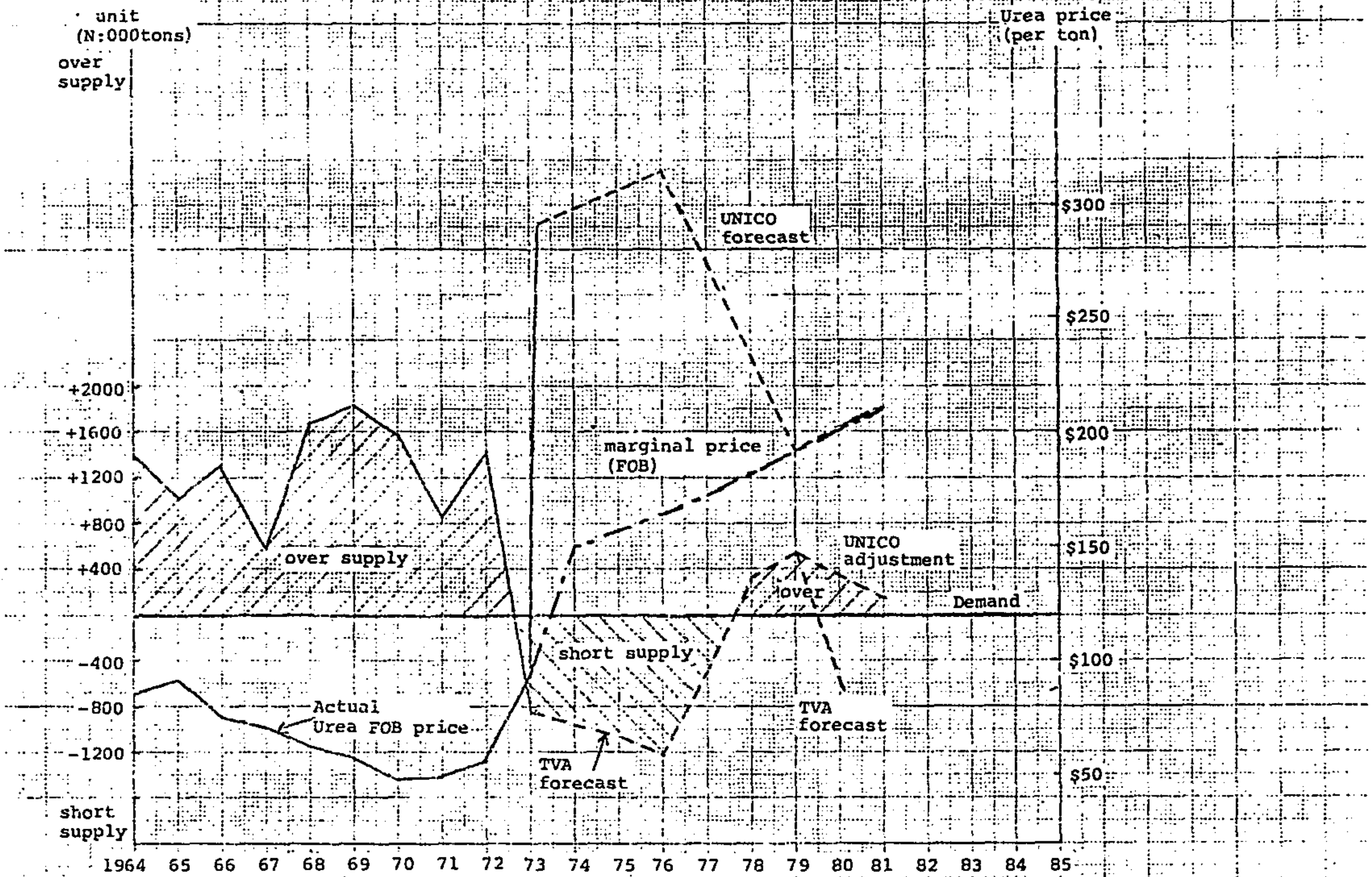
Table AIII-18 Relation between N Demand and Supply Balance and Urea Export Price (FOB Japan)

	Demand	Supply	Balance	Urea price
	N 10^3 tons	N 10^3 tons	N 10^3 tons	$/ton
1964	15,420	16,830	+ 1,410	86.32
65	16,276	17,275	+ 999	91.65
66	18,560	19,911	+ 1,351	77.83
67	21,778	22,327	+ 549	71.52
68	23,938	25,591	+ 1,653	64.86
69	26,618	28,431	+ 1,813	59.71
70	28,653	30,196	+ 1,543	49.56
71	31,720	32,534	+ 814	49.86
72	33,700	35,129	+ 1,429	56.82
73	36,000	35,600	- 400	93.14
74	39,200	38,200	- 1,000	July 127.24 Aug. 210.00 Sept. 293.00
75	42,000	40,900	- 1,100	
76	44,800	43,600	- 1,200	
77	47,800	47,300	- 500	
78	50,700	51,200	+ 500	
79	53,800	54,500	+ 700	
80	56,900	56,300	- 600	

Source: Demand & supply balance from TVA Aug, 1974
Urea FOB price from JUASIA

Figure AIII-2

Relation between N Demand and Supply Balance in the World and Urea Export Price (FOB Japan)



Note: N Demand & Supply Balance are taken from TVA Forecast, Aug 74 ---- forecast
Urea FOB Price by JUASIA

(4) The Consultant forecasts the future FOB Japan price of urea as follows, while assuming a 7% annual inflation factor.

1976	US$330.00
1980	US$200.00
1982	US$220.00

Table AIII-19 shows the comparison of ammonium sulphate price with that of urea over a period of recent 14 years on an export price FOB Japan basis. The average rate of ammonium sulphate price as against urea is 49.1%.

The nutrient content in ammonium sulphate is 46% of that in urea. Therefore, per nutrient transportation cost will be higher in the case of ammonium sulphate than urea. Nevertheless, the handiness in application at each farmer, suitability particularly for special crops such as sugar cane, and the higher effectiveness in alkali soil are the advantages of ammonium sulphate over urea. The Consultant therefore maintains that the future price of ammonium slphate can be calculated on 49% of estimated urea price.

Table AIII-19 Export Price of Urea and Ammonium Sulphate (FOB Japan)

Unit: $/ton

	Urea	Ammonium Sulphate	AS/Urea Price Ratio
1960/1	85.55	40.71	47.6%
61/2	76.85	38.16	49.7
62/3	72.62	36.81	50.7
63/4	75.26	37.94	50.4
64/5	86.32	47.07	54.5
65/6	91.65	47.52	51.8
66/7	77.83	38.64	49.6
67/8	71.52	34.34	48.0
68/9	64.86	31.88	49.2
69/70	59.71	30.02	50.3
70/1	49.56	24.38	49.2
71/2	49.86	20.53	41.2
72/3	56.82	25.98	45.7
73/4	93.14	46.29	49.7
74, July	127.24	57.92	
" Aug.	210.00		
" Sept.	293.00		
14 years' average			49.1%

Source: JUASIA

2.4 Influence of Future Prospects of World Market on the Philippines

The Philippines is an agriculturally based country and has a comparatively large number of population. Self- sufficiency in supply of food seems to have been attained at one time in the past; however, a large amount of food importation is being carried out. Fertilizer application has recently been popularized vastly, thereby showing a rapid increase in fertilizer consumption amount. Nevertheless, the country basically needs to enhance agricultural production by consuming much more fertilizer. In other words, the domestic market potential for fertilizer in the Philippines is high enough to warrant serious scrutinization of new plant construction projects for fertilizer production.

It is estimated that the world nitrogenous fertilizer demand and supply balance shows at present a supply shortage of approximately one million N tons, or 2.6% of the total estimated production, and it is expected that this shortage will persist for about three years to come. Thereafter, a slightly "oversupply" period will last for four to five years. Thus, on an assumption that a new plant is to be constructed in the Philippines, the completion of the plant will be made sometime around the commencement of the oversupply period.

Nevertheless, as far as the demand/supply forecast within Southeast Asia alone is concerned, an equilibrium of supply and demand will almost be attained if all the presently announced plant projects (eight plants) were to be implemented as scheduled. A project for constructing a plant of 1,000 NH_3 tons/day capacity in the Philippines is included within the scope of these eight plants. Therefore, no problem will be present regarding the implementation of the construction of this plant in the country in view of the fertilizer production amount considerations.

The selection of urea fertilizer as the production item of the plant is a proper choice in view of the world trend in the production item selection, production cost aspects and the major subject crops to be cultivated in the Philippines.

The world market price of urea fertilizer as of 1980 is estimated to be slightly lower than the plateau price which is prevailing at present, and is expected to be maintained for approximately three years to come. The 1980 price level will be stabilized on a level around US$200/ton FOB Japan. Thus, the C&F Philippines price will be approximately US$230/ton. Therefore, if the production-cost-plus-adequate-profit price (marginal price) of the products to be turned out from the newly projected plant is estimated to be lower than this C&F price level, prompt decision should be made concerning the finalization of the plant construction project. If estimates show a marginal price level higher than the C&F price, further careful studies should be conducted in view of the national benefit aspect of the project implementation.

3. Preliminary View of Production Economics of Nitrogenous Fertilizer in the Philippines

3.1 Set up of Alternatives

It is requested that the following four items be studied as the feedstocks for ammonia production:

(1) Naphtha

(2) LPG

(3) Fuel oil

(4) Crude oil

As to the processes for gassification of these feedstocks, the steam reforming process is employed for (1) and (2), and the partial oxidation process of (3) and (4).

Concerning the plant construction cost, the partial oxidation process will be generally considered to be higher than the steam reforming process by 20 to 30% due to the necessity of installing oxygen generation facilities.

What then will be the construction cost difference when either one of the processes is employed with different feedstocks? If natural gas is taken as the raw material feedstock for the steam reforming, the plant cost will be lower than the case of employing naphtha. This is because of the unnecessity for preliminary desulfurizarion facilities for natural gas, difference in the process requirements, difference in the capacity of the carbon dioxide removal section, etc.

What will be the difference in the construction cost between the case of using naphtha and the case of employing LPG as the feedstocks? Theoretically speaking, the LPG utilization case will involve lower construction costs to a certain extent than the naphtha feedstock. However, the plant should be designed to allow alternative employment of LPG and naphtha as the feedstock for the reason of lower procurement stability and availability of LPG.

Therefore, it is more practical to conduct the relative studies by assuming that there is no significant difference in the contruction cost between the LPG and naphtha cases. The same consideration applies to the cases of fuel oil and crude oil for both of which the partial oxidation process is to be adopted.

Through the above discussion, the feedstock problem can be boiled down to the "comparison of economic viability geared to the raw material price fluctuation between the steam reforming process and the partial oxidation process". In other words, the studies should be aimed at finding the feedstock from which the lowest cost ammonia will be made available in the event that clarification is made to the prices of more than one type of feedstock.

In this study, evaluation will be made to the production cost variation according to the fluctuation in the feedstock cost in the cases of employing the steam reforming process and the partial oxidation process for constructing a plant for manufacturing 1,000 t/d of ammonia and 1,700 t/d of urea. At the same time, the break-even point confirmation will be made regarding the two processes.

Also, case studies will be made on the alternatives of ammonia production capacities of 600 t/d, 1,000 t/d, 1,500 t/d, and urea production of 1,000 t/d and 1,700 t/d with variation of feedstock price.

3.2 Analysis of Production Economics

3.2.1 Feedstocks

Table AIII-20 shows an estimate of ammonia-urea plant construction cost in the Philippines on an assumption that the contract is awared in the year 1975.

Table AIII-20 Total Capital Requirements

(US$1,000)

	Ammonia	Urea	Total
- Steam reforming process			
600 t/d - 1,000 t/d	81,681	50,571	132,252
1,000 t/d - 1,700 t/d	112,260	71,340	183,600
1,500 t/d - 1,700 t/d	145,802	70,653	216,455
- Partial oxidation process			
600 t/d - 1,000 t/d	93,401	51,816	145,217
1,000 t/d - 1,700 t/d	132,901	73,514	206,415
1,500 t/d - 1,700 t/d	173,099	72,656	245,755

Notes: Including land, process unit, off-site (excl. utilities facilities) pre-operating expenses, interest during construction, and working capital.

Refer to Appendix II,6.1 through 6.4

The feedstock cost varies greatly depending on whether it is to be produced from imported raw materials or supplied domestically. The cost will also differ depending on the applicable duties and tax regulations. An estimate of costs of various raw materials for the year 1980 can be stated as follows by employing the currently enforced taxation regulations.

Feedstock Cost

Imported naphtha

(1) US$152/ton (FOB Mideast)

(2) US$160/ton (CIF Manila)

(3) US$230/ton (with importing charge, duty and tax)

Domestic naphtha

(4) US$217/ton (Exfactory without tax)

(5) US$274/ton (Exfactory with tax)

Imported LPG

(6) US$180/ton (FOB Mideast)

(7) US$270/ton (CIF Manila)

(8) US$350/ton (with importing charge, duty and tax)

Domestic fuel oil

(9)	US$131/ton	(High sulfur, Exfactory with tax)
(10)	US$166/ton	(Low sulfur, Exfactory with tax)

Imported crude oil

(11)	US$126/ton	(FOB Mideast)
(12)	US$133/ton	(CIF Manila)
(13)	US$163/ton	(with importing charge, duty and tax)

The economic viability order comparison in accordance with raw materials employed will be made in the following paragraphs by taking, as a prototype example, a case of production cost in turning out 1,000t/d of ammonia and 1,700t/d of urea. In this case, the cost shall include ROI 10%. (The 10% ROI shall be included in all the production cost comparisons hereafter.) Line (2) in Fig. AIII-3 indicates the urea production cost for a plant of 1,000t/d ammonia and 1,700t/d urea capacity. The urea price versus raw material price from this figure can be stated as follows:
(LPG=11MMKcal/ton; and crude oil=10MMKcal/ton were taken as the bases for conversion,and the read-out of the figures will be made respectively from the solid line (2) and the dotted line (2).)

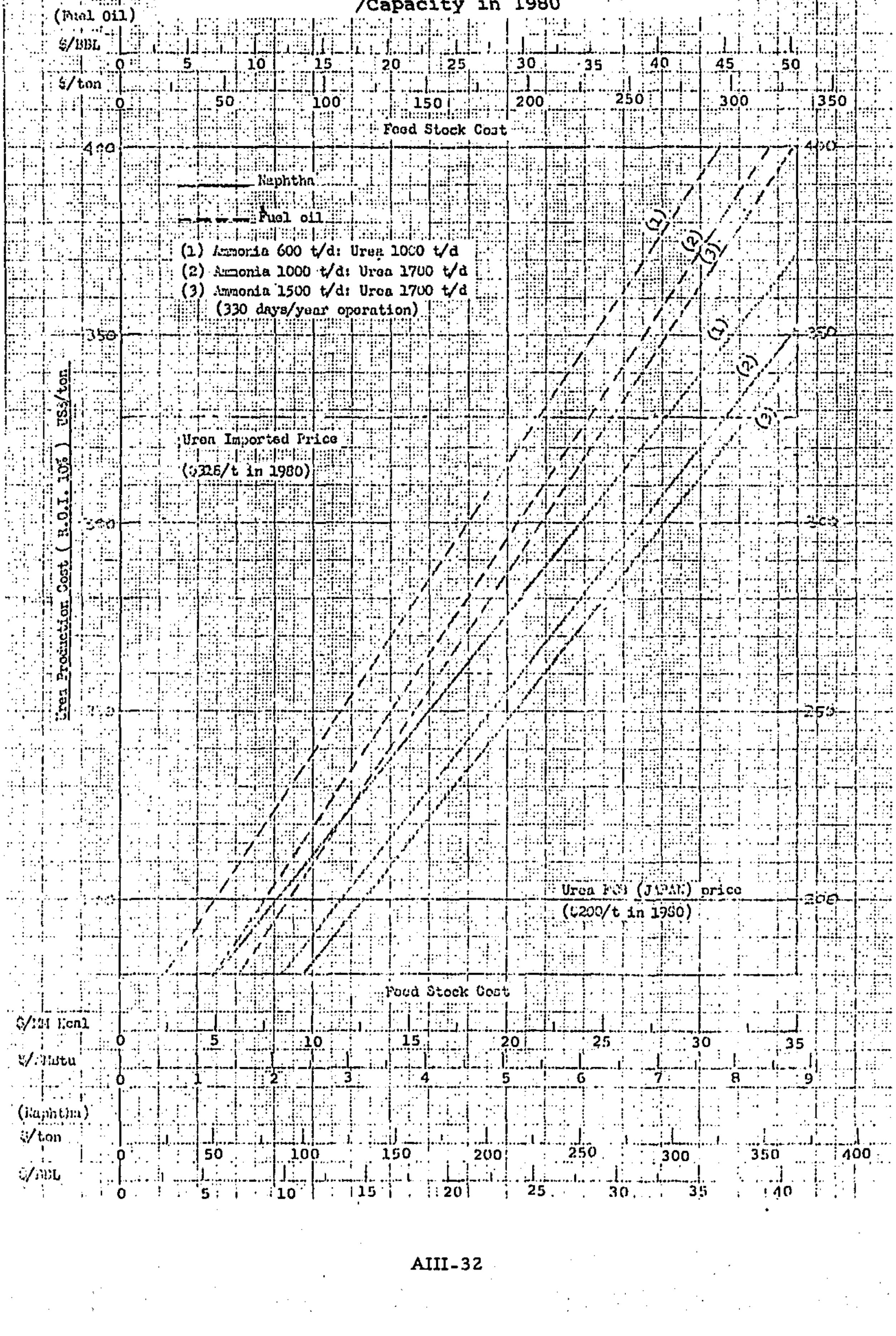
Urea Production Cost vs Feedstock

(US$/ton)

		Urea production cost
Imported naphtha		
(2)	160	224
(3)	230	267
Domestic naphtha		
(4)	217	260
(5)	274	295
Imported LPG		
(7)	270	285
(8)	350	332
Domestic fuel oil (High sulfur)		
(9)	131	249
Imported crude oil		
(12)	133	243
(13)	163	268

The taxation systems are artificially enacted institutions and are subject to alteration by the effects of fertilizer policies, etc. Therefore, when comparing advantage rating of various raw materials, the comparison should be made after subtracting miscellaneous taxation factors. The raw-material-wise urea production cost based on the raw material price without miscellaneous taxation factors can be stated as follows:

Figure AIII-3 Urea Production Cost vs Feedstock /Capacity in 1980



Imported naphtha:	US$224/ton
Domestic naphtha:	US$260/ton
Imported LPG:	US$285/ton
Domestic fuel oil:	US$249/ton
Imported crude oil:	US$243/ton

The Consultant hereby recommends as follows regarding the selection of raw materials for fertilizer production:

(1) The imported LPG involves high level of transportation cost (cryogenic vessels to be employed for the transportation), thereby affecting its economic viability. This material also lacks the stability in raw material supply. Therefore, imported LPG should not be selected as the main raw material for the operation of large-scaled fertilizer plant in the Philippines.

(2) There is a certain extent of doubt as to the quantity of supply of domestic naphtha if it is to be employed as the raw material for fertilizer production. The economic viability of this material is also inferior to the imported naphtha. Therefore, the domestic naphtha should be regared as a supplementary raw material for the production of fertilizer, and should be employed as and when any domestic naphtha surplus becomes available.

(3) The imported crude oil seems to be considerably advantageous in view both of economy and supply stability for use as the material for fertilizer production.

However, if it is possible to utilize the domestic fuel oil amply in quantity as a raw material for fertilizer production, it is more recommendable that the domestic fuel oil be employed in view of the national benefit considerations. This means that the crude oil should be used as a feed for refining, and the fuel oil produced from the refineries should be used as the fertilizer raw material in order to enhance the effeciency of crude oil utilization.

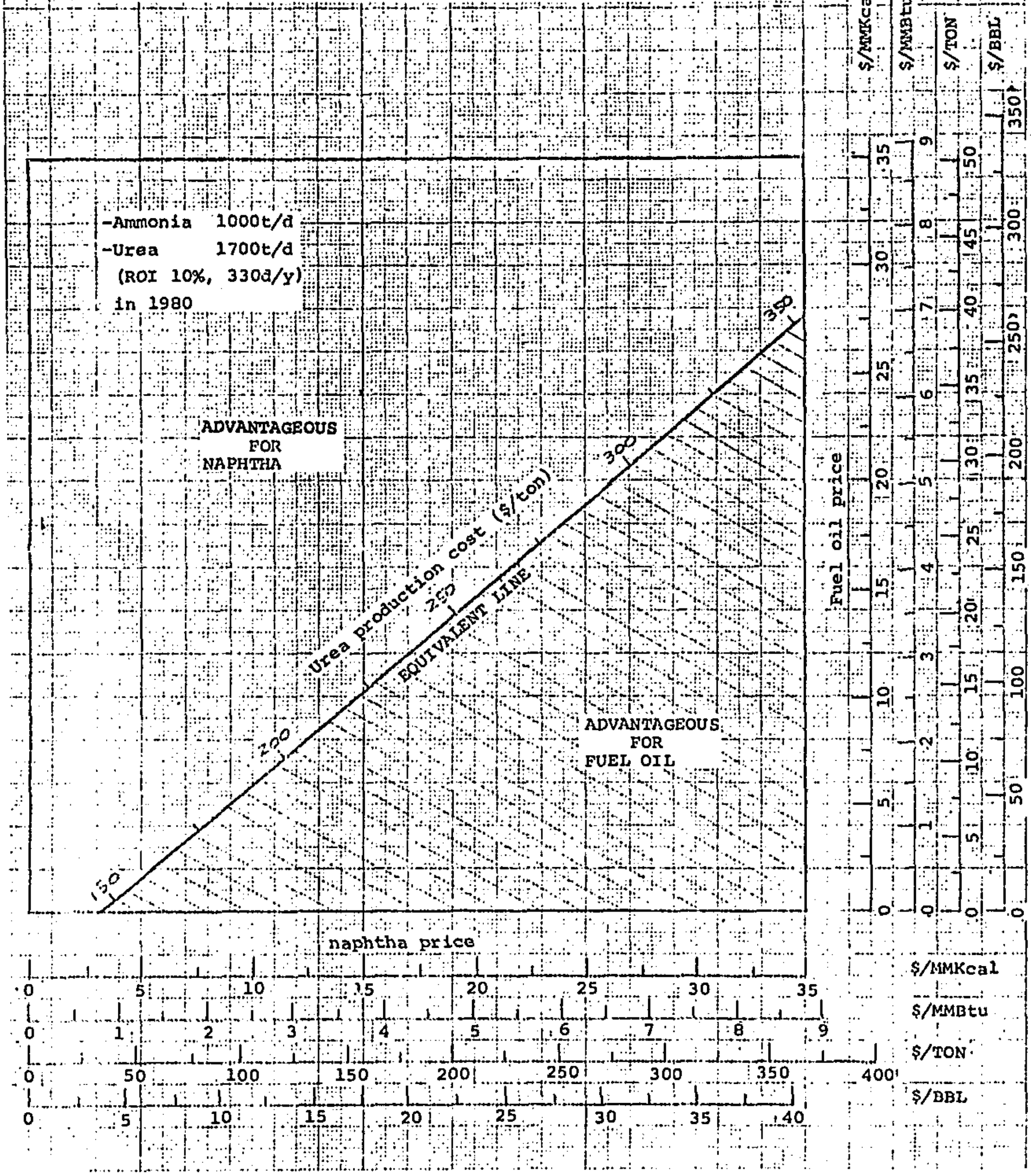
(4) As is evident from the foregoing, it is recommended that a further detailed study be made concerning the imported naphtha and domestic fuel oil as the major raw materials to be fed into a large-scale fertilizer plant.

Appendix II, 6.1 through 6.4 show the production cost regarding ammonia (1,000 t/d) and urea (1,700 t/d), for each case of the employment of imported naphtha and domestic fuel oil.

Fig. AIII-4 illustrates a graph for facilitating the judgement of advantage superiority in the case of urea production cost in the event that both naphtha and fuel oil prices are given.

Figure AIII-4

Comparison of Urea Production Cost Based on Different Feedstock



3.2.2 Production capacity

Fig. AIII-3 shows the urea production cost for each production capacity as enumerated below.

line (1): Ammonia: 600 t/d Urea 1,000 t/d
line (2): Ammonia: 1,000 t/d Urea 1,700 t/d
line (3): Ammonia: 1,500 t/d Urea 1,700 t/d

* Excess ammonia 500 t/d will be utilized as liquid ammonia.

The following table shows the production cost figures for each capacity rating on an assumption that the raw material prices are set at $160/t for imported naphtha and $131/t for domestic fuel oil. (For further details, refer to Appendix II, 6.1 through 6.4)

Ammonia and Urea Production Cost

(US$/ton)

Capacity (t/d)		Naphtha		Fuel Oil	
Ammonia	Urea	Ammonia	Urea	Ammonia	Urea
600	1,000	274	242	311	268
1,000	1,700	254	224	292	249
1,500	1,700	242	216	277	239

The production capacity should be determined in view of the national benefit considerations after taking into consideration such factors as the results of domestic fertilizer demand survey, possibility of ammonia and urea importation from Indonesia, etc., prices of the importation from overseas, and the availability of raw materials domestically suppliable within the Philippines.

3.2.3 Competitiveness in the domestic production with imports

As has been mentioned in 1.3 in this Annex, the international price of urea in the year 1980 will still be based on the Japanese export prices as criteria in general, in the Asian areas in particular. The urea price in the Philippines in 1980 will be as follows, which is estimated by FOB Japan price plus the ocean freight, the current import duties, and taxes:

US$200/t (FOB Japan)
US$229/t (CIF Manila)
US$328/t (Landed cost in Manila)

In the case of importing liquid ammonia from Indonesia at the prevailing international market price as of 1980, the liquid ammonia price will be as follows on the same assumption as above:

US$220/t (FOB Indonesia)
US$254/t (CIF Manila)
US$316/t (Landed cost in Manila)

The comparison of CIF Manila price and the production cost in the Philippines is as follows.

Urea: US$229/ton (CIF Manila)

US$216 - 268/ton (Production in the Philippines)

Ammonia: US$254/ton (CIF Manila)

US$242 - 311/ton (Production in the Philippines)

The above figures indicate ample economic viability and the national benefit for the Philippines if a large-scaled fertilizer plant construction is undertaken, even if protective import duties may be enforced.

ANNEX IV

PRELIMINARY OUTLOOK
ON
THE ALLOCATION
OF
HYDROCARBON SOURCES
IN
THE PHILIPPINES

ANNEX IV. PRELIMINARY OUTLOOK ON THE ALLOCATION OF HYDROCARBON SOURCES IN THE PHILIPPINES

1. General

This Annex intends to clarify the outlook on the allocation of hydrocarbon sources to industries for full utilization. The availability and appropriateness in allocating raw hydrocarbon materials should be studied for looking further into the subject of petrochemical industrialization.

Therefore the efficiency and economical appropriateness were preliminarily studied on the basis of the material flow and material balance for each of the products, i.e., olefins, aromatics, and nitrogenous fertilizer.

In the Philippines, available hydrocarbon sources are limited to either domestic products turned out from refineries or imported raw materials. The relation between hydrocarbon sources and the products projected in the Philippines is shown in Figure AIV-1.

For the production of ethylene and their derivatives, the feedstocks are naphtha, kerosene, atomospheric gas oil from refineries, imported naphtha, LPG, and C_2 heavier fraction in LNG. As studied in Annex II of the orientation study, the imported LPG does not warrant economy because of high transportation cost to the Philippines. The selection of domestic naphtha, kerosene, and diesel oil as the feed depends on the availability and the pricing policy effected by the Philippine Government.

The C_2 heavier fraction in LNG is applicable only when a large amount of consumption of residual LNG, such as production of urea at 2,300,000 t/y, is actually undertaken.

For the production of aromatics, domestic and imported naphtha can be utilized along with pyrolysis gasoline. However, it should be noted that the narrower range of distillation of fraction will be more effective in the production of specific aromatics, i.e., p-xylene.

When the olefin complex is established, benzene for caprolactam production will be produced from by-produced pyrolysis gasoline. Thus, the aromatics complex should be designed to supply p-xylene for p-TPA/DMT. This decreases the required amount of naphtha to approximately one half in amount which would be necessary for the production of both benzene and p-xylene for synthetic fibre raw materials production.

Most of the fractions of hydrocarbon are applicable for producing ammonia. Therefore, it is recommended that the utilization be made of hydrocarbon fractions which are at a low price level and also cannot be used for the production of other petrochemicals. Thus, the domestic fuel together with imported naphtha will be considerable raw materials for nitrogenous fertilizers.

Another source is imported LNG; however, it is desirable to combine LNG demand from several usages such as fuel, etc., in order to bring the import to a comparatively large scale. This being the circumstance, the selection of raw materials for fertilizer can be discussed separately from the raw material sources for petrochemical industries.

Regarding the employment of the Filoil Refinery as a hydrocarbon source, even expanded, it seems unlikely that enough supply of aromatics will be made to accomodate the synthetic fibre raw materials demand. For the expanded 50,000 BCD Filoil Refinery, 28,800 t/y p-xylene (41,800 t/y as p-TPA) can be produced. Regarding the ethylene production, 239,500 t/y is preliminarily estimated. When the combination of the production of olefin and aromatics is projected, 28,800 t/y p-xylene and 205,100 t/y ethylen can be produced. However, the aromatics complex producing 28,800 t/y p-xylene is rather small in comparison with the internationally planned scale. Therefore, the narrow range naphtha, which is suitable to product p-xylene and is obtainable from the expanded Filoil Refinery, should be utilized as part of feed for an aromatics complex.

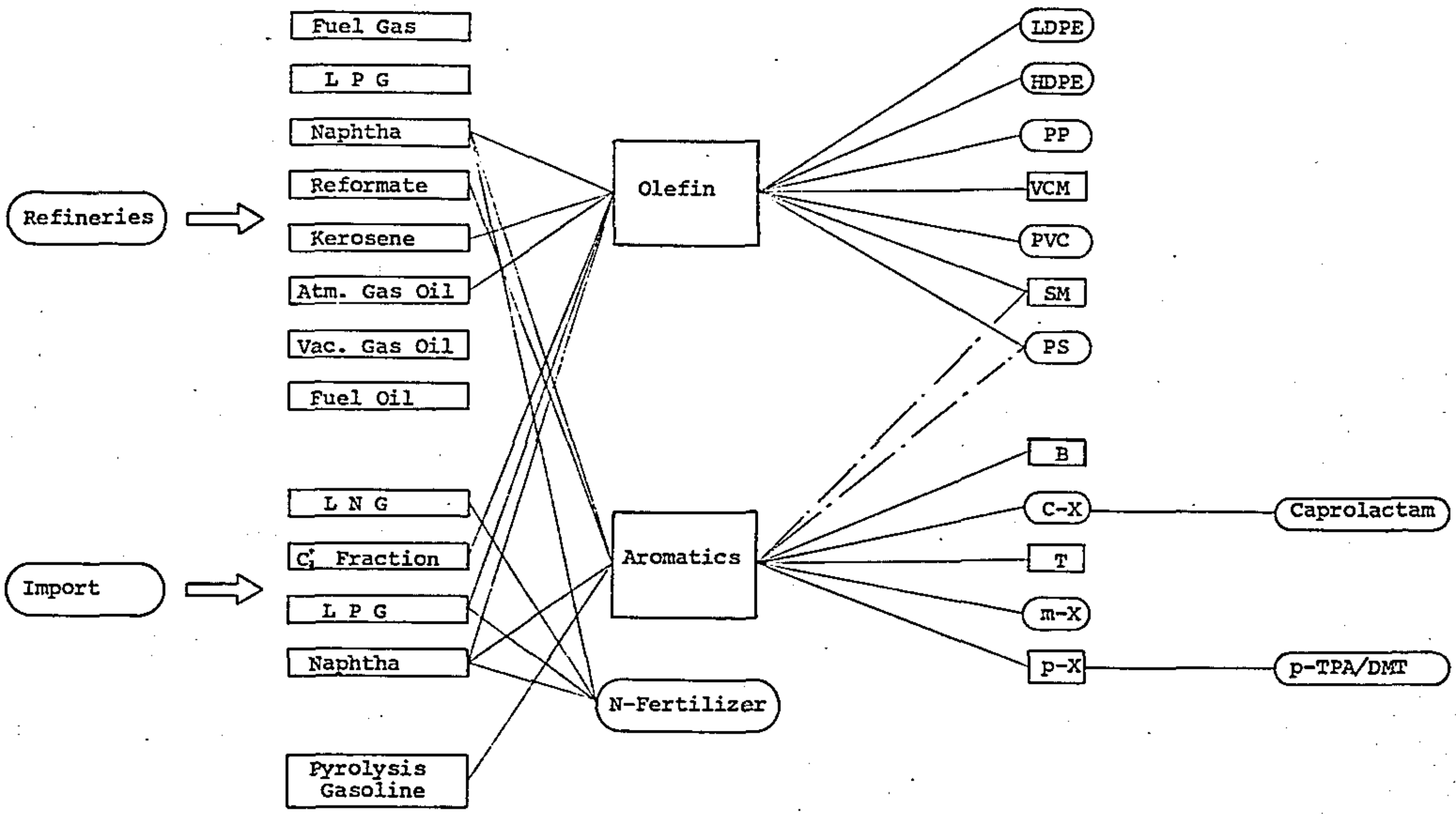


Figure AIV - 1　Hydrocarbon Source and Products in the Philippines

2. Hydrocarbon Sources for Olefins Production

2.1 Source-wise Yields of Ethylene

The typical yields of olefins and by-products are shown in the following Table AIV-1 for each hydrocarbon material. As olefins are produced through pyrolysis of hydrocarbon, a wide range of petroleum fraction can be utilized in connection with the configuration of the prices. Although the yields of olefin will be mostly decided by the distillation range of the feed, the chemical property of feed such as PONA analysis will also affects the yield.

Table AIV-1 Effects of Feedstocks on Ethylene Production

Feedstocks		Ethylene Yield Wt. %	Propylene plus By-products Wt. %
Components	Kg/m^3		
Ethane	374	78	6
Propane	508	43	28
Butane	584	32	44
Pentanes - Heptanes	659	30	50
Naphtha	731	29	56
Gas Oil	830	26	61

2.2 Technical Problems in Using the Heavier Fraction

All sorts of fractions can be used as ethylene plant feeds in bench scale tests or pilot tests. However, stable supply of olefin is one of the essential factors in the commercial operation of a petrochemical complex. Accordingly, it is recommended that the most reliable combination of process and type of raw materials be selected.

In this regard, commercially applied process for pyrolysis of feed is tubular type thermal cracking furnace. The effuluent from the furnace coils is cooled through a transfer line heat exchanger to recover heat, and then quenched by mixing circulating coolant oil. The problem in using heavier fractions of petroleum such as gas oil is the coking which takes place in these units. On the inside surface of coils of the furnace and the tubes of the transfer line heat exchanger, carbon deposits will be accumulated to cause problems.

The thermal efficiency will be lowered, thereby affecting both the stream factor and the olefin yield. The problem becomes more serious as the used component becomes heavier. Therefore, in actual planning practice, successful planners avoid the risk of applying a technology which has not yet been proven commercially. Even in the U.S.A., there have been some cases in which no satisfactory result in technology and economy was obtained by feeding heavier components in comparison with the cases of using light hydrocarbon.

This being the circumstance, it is tentatively recommended that the range of hydrocarbon raw materials be limited to light gas oil (atomospheric gas oil) produced by straightly topping the unit. Another difficulty in using vacuum gas oil is the lowering of yield of olefin caused by the chemical property degrading which is a result of thermal history of severe treatment.

Another problem to be solved is the content of sulfur in the feed. Unless desulfured, heavier fractions have a higher sulfur content than lighter fraction; e.g., naphtha has 0.05 wt %; atm. gas oil 1.1 wt. % and vac. gas oil 2.5 wt %. For an ethylene plant the allowable sulfur content in the feed is approximately 0.25 wt. %. Therefore, even when using light gas oil, pretreatment of the feed should be performed.

2.3 C_2 Heavier Fraction in LNG

Imported LNG contains C_2 heavier fractions, centering around ethane which can be utilized as a feed for the ethylene plant.

C_2 heavier fraction which will be liquefied with methane should be separated from methane before being fed to a petrochemical plant.

The amount of the heavier components in LNG depends on both the composition of feeding natural gas, and the extent of liquefaction at the dehumidification and pre-cooling section. (Refer to Figure AIV-2.)

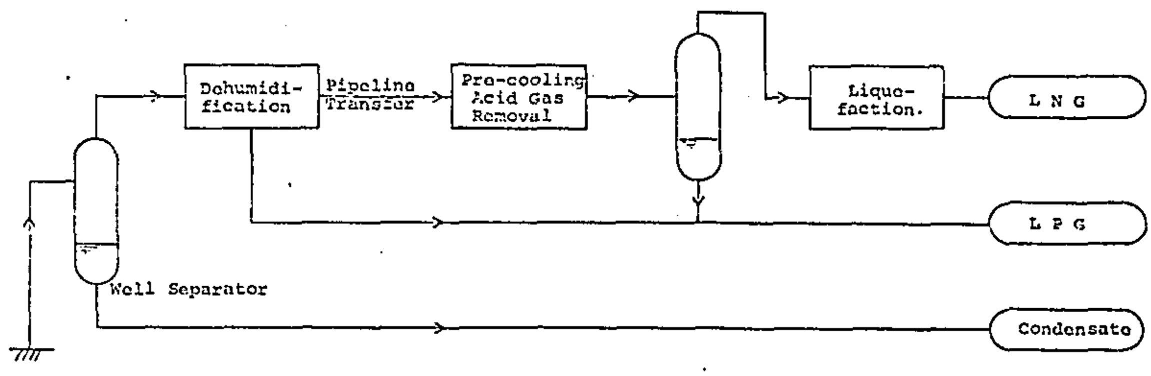


Figure AIV-2 Conceptual Scheme of LNG Production

Therefore, the amount of heavier fraction in LNG will be changed according to the LNG plant operating conditions. However, a tentative assumption was made regarding the separating conditions, and the composition of LNG imported from Indonesia was asesssed. The material balance shown in Figure AIV-3, and in Table AIV-2, has been estimated on the above-mentioned composition.

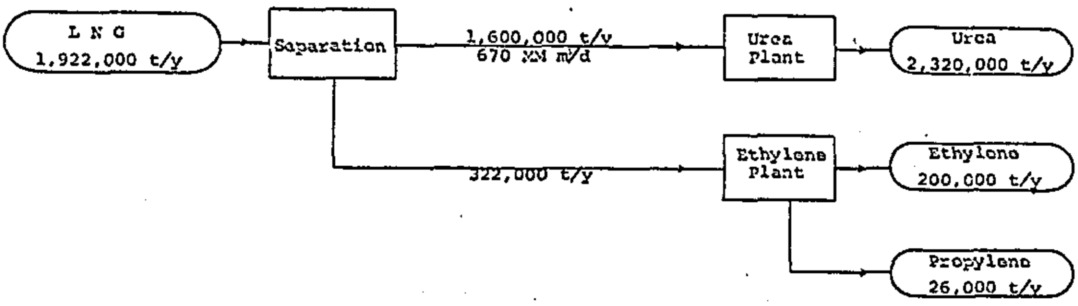


Figure AIV-3 Scheme of Olefin Production from the Heavy Fraction in Imported LNG

Table AIV - 2-1 Composition of NG.LNG.C_2 Heavy Fraction

	Natural Gas (vol %)	LNG (wt. %)	Separated C_2^+ Fraction (wt. %)
Methane	75.	81.	-
Ethane	5.7	11.5	55.
Propane	2.4	7.5	45.
Others	16.9	-	- major component is CO_2
	100 %	100 %	100 %

Table AIV - 2-2 Consumption and Production of Materials per Unit Production of Ethylene

	Unit	Consumption/Ethylene	Consumption
Ethylene	ton	1.	200,000 t/y
LNG	ton	9.6	1,920,000
Feed	ton	1.6	322,000
Residue Gas	ton	8.0	1,600,000
	Nm^3	11,040	670×10^6 Nm^3/D
Urea	ton	11.6	2,320,000
Propylene	ton		26,000

It is evident from this material balance, that for the utilization of C_2 heavier fraction in LNG, the employment of residual LNG is imperative. Therefore, unless the consumption of residual gas is secured, it is impossible to use the heavier fraction as a feed for the ethylene plant.

Even for the establishment of a petrochemical complex of a 200,000 t/y ethylene capacity, the necessary amount of LNG is approximately 2 million t/y, and residual gas will amount to 1,600,000 t/y. By consuming this 1,600,000 t/y residue gas, 2,320,000 t/y urea can be produced.

3. Hydrocarbon Sources for Aromatics Production

The major products from aromatics required at the initial stage of petrochemical industry are the raw materials for synthetic fiber, i.e., caprolactam and p-TPA/DMT. Therefore, the production of synthetic fiber raw materials and aromatic intermediates for them, i.e., cyclohexane, and p-xylene, should be firstly studied.

Synthetic fiber raw material can be produced from the imported aromatic intermediates. Therefore, the study on this subject should be separated into two parts:

1) The production of synthetic fiber raw materials on the basis either of imported intermediates or domestically produced aromatic intermediates

2) The production of aromatic intermediates from domestic hydrocarbon raw materials such as naphtha supplied from refinery or pyrolysis gasoline produced by an olefin complex

In the following paragraphs, the latter subject will be discussed for directing the optimal allocation of hydrocarbon sources in the Philippines. As discussed in the orientation report, the establishment of synthetic fiber raw material production such as p-TPA, is highly promising in the Philippines for the early 1980's, or even in the late 1970's.

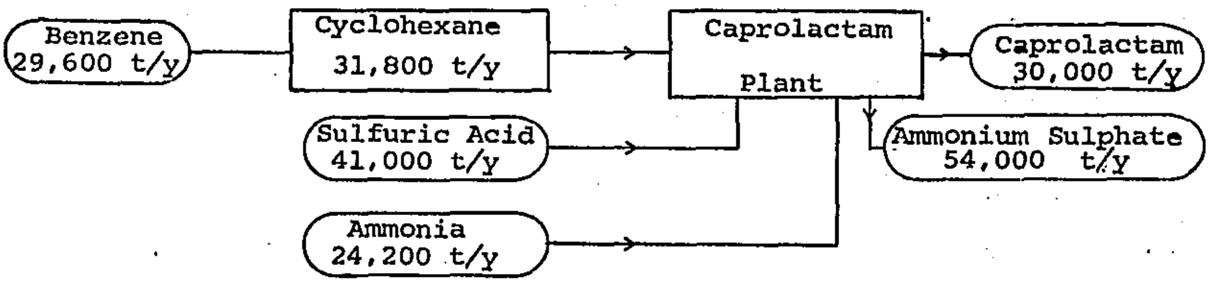
Domestic demand for synthetic fiber raw materials in 1980 will reach 50,600 t/y (as p-TPA) for polyester fiber, and 22,000 t/y (as caprolactam) for nylon fiber.

Therefore, it is assumed in the orientation study that the commencement of production of 70,000 t/y (as p-TPA) polyester raw material and 30,000 t/y of caprolactam will be made in 1980. Refer to Figure AIV-4 (1) to (3).

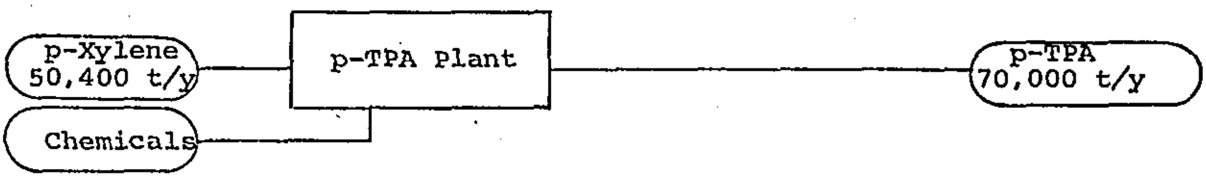
There are two aromatics supply sources in the Philippines, the one is pyrolysis gasoline, and the other is naphtha. The specific features of the aromatics production according to the sources are as follows:

3.1 Pyrolysis Gasoline

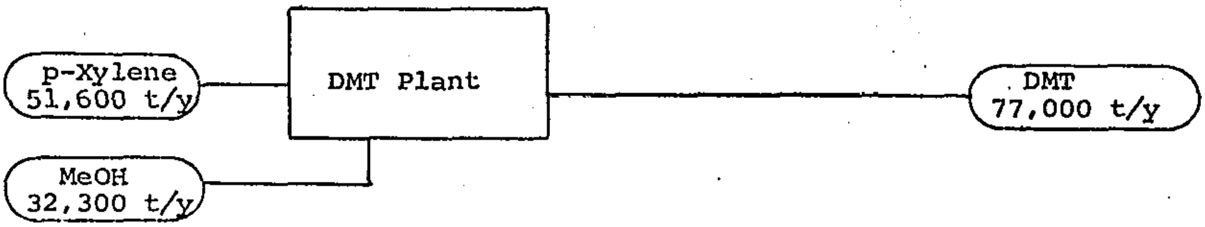
Due to the property of pyrolysis gasoline, the extracted mixed xylene is not suitable for the production of p-xylene. The major product from pyrolysis gasoline is benzene. Therefore, if the olefin complex based on naphtha or light gas oil is established, the production of cyclohexane for caprolactam is possible. (Refer to Figure AIV-5)



(1) Production of Caprolactam



(2) Production of p-TPA



(3) Production of DMT

Figure AIV-4 (1) - (3) Production Flow Scheme and Material Balance for Synthetic Fiber Raw Materials

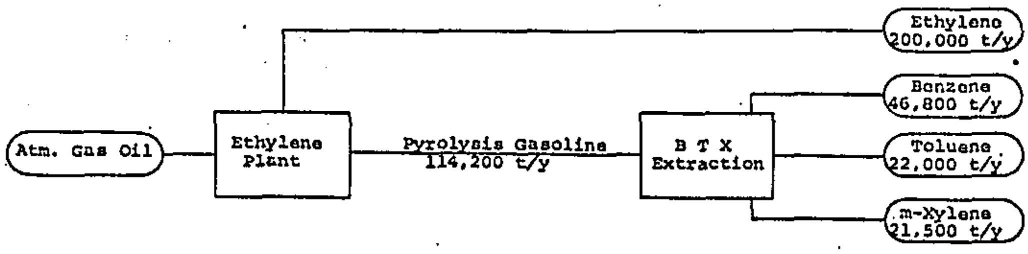


Figure AIV-5 Production of Flow Scheme and Material Balance of Aromatics from Pyrolysis Gasoline

Note: m-xylene from pyrolysis gasoline is used only as solvent.

3.2 Naphtha

The major product from reformate of naphtha is p-xylene for polyester fiber raw material. However, a variety of aromatics can be produced from reformate through the selection of the cutting range of naphtha, and the process routes arrangement. When the olefin complex is established, the benzene for caprolactam will be supplied from pyrolysis gasoline. Consequently, the objective of aromatics complex is to produce p-xylene: the feeding of suitable naphtha for p-xylene (Case B narrow range naphtha) is applied. (Refer to Table AIV-3, Figure AIV-6) If necessary, a disproportionation or transalkylation process of toluene will be applied for increasing the output of p-xylene.

However, if the olefin complex is found to be unfeasible, the objective of the aromatics complex is to supply both benzene and p-xylene to related industries.

Consequently, broad range naphtha, Case A for producing benzen and p-xylene should be selected. A dealkylation process of toluene will be applied if necessary. (Refer to Table AIV-4) It should be noted here that the amount of necessary naphtha for the production of aromatics differs greately from case to case. An assumption is made that the production of p-xylene is at 50,400 t/y gearing to 70,000 t/y of p-TPA. When producing both benzene and p-xylene, the necessary amount of naphtha is 362,300 t/y; however, for producing only p-xylene, the amount of naphtha is only 207,400 t/y.

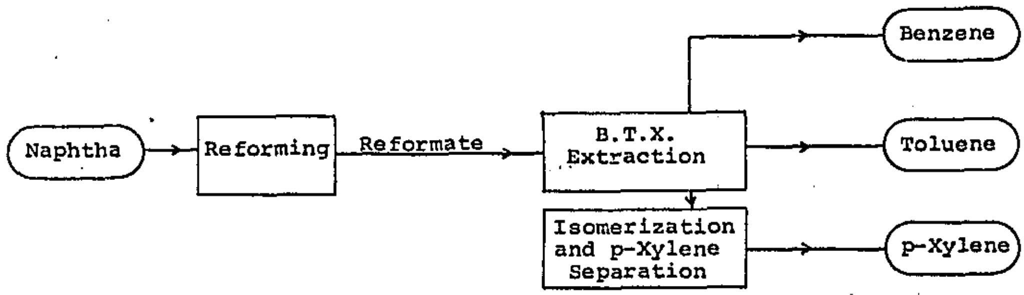


Figure AIV-6 Production Flow Scheme of Aromatics from Naphtha Production

Table AIV-3 Balance of Aromatics Production

Unit : t/y

	(A)*	(B)*
Naphtha	362,300	207,400
Benzene	20,300	2,100
Toluene	60,700	25,900
m-Xylene	58,500	58,500
p-Xylene	50,400	50,400
(As p-TPA)	(70,000)	(70,000)

Note: Property of each naphtha is based on Kuwait Crude

Table AIV-4 Change in Benzene Production by Dealkylation of Toluene

Unit : t/y

	Broad Range Naphtha (A)*	Narrow Range Naphtha (B)*
Benzene from Extraction	20,300	2,100
Benzene from Dealkylation	49,300	21,100
Total	69,600	23,200

Note: Property of each naphtha is based on Kuwait Crude

4. Hydrocarbon Sources for Nitrogenous Fertilizer

From the economic viability viewpoint, an imported naphtha basis or a domestic fuel oil basis nitrogen fertilizer production is preferable. The imported LNG is a possible raw material for fertilizer, but the following should be taken into account for conducting further studies.

a) The minimum economic scale of LNG production is approximately 2,000,000 t/y, so that the transportation and storing facilities are installed to comply with such an extensive production and distribution.

b) The required amount of LNG for the production of nitrogen fertilizer, 1,700 t/d (561,000 t/y) of urea, is approximately 390,000 t/y. Therefore, it is desired to combine the demand for LNG of several industries, i.e., fuel gas, etc., for carrying out the importation at a comparatively large scale. Otherwise, the additional cost owing to the small scale will affect the low cost merit of LNG.

c) It is possible to import LNG by the standard LNG tanker shared with the other consuming countries. However, there are additional costs due to:

  i) Elongation of the voyage by the side trip to the Philippines

  ii) Running the vessels with partly empty load after discharging LNG in the Philippines

  These costs will also shrink the merit of low LNG price.

In all the cases so far discussed, the raw material selection for fertilizer industry seems to have no relation with the studies of petrochemical complex.

The matter is not the type of hydrocarbon, but the available cost for establishing nutrient fertilizer production.

5. Preliminary Outlook on the Utilization of Filoil Refinery Output for the Petrochemical Complex

Filoil Refinery is located near Manila City. The area adjacent to the refinery is one of the possible sites for future petrochemical complex. Especially, the proximity to market makes it highly advantageous as a domestic market oriented industrial site.

The priority, therefore, has been given to the utilization of the Filoil Refinery as the hydrocarbon supplying source for the petrochemical complex.

Accordingly, the possibility should be examined converting the refinery into a chemical refinery to supply the required hydrocarbon materials such as naphtha, light gas oil, etc.

In the following paragraphs, the availability of hydrocarbon fractions for olefins and aromatics production is preliminarily estimated by taking into account the cutting range and yield of specific products, although a detailed study will be elaborated in the next step of the survey.

5.1 Production of Ethylene

From the technical reliability viewpoint, the vaccum gas oil is not suitable for the ethylene production. Accordingly, full range naphtha, kerosene and diesel oil will be the feeds for the ethylene plant. LPG will not be used as a feed because of the low availability. For a case of an expansion to 50,000 BSD feed, preliminary estimate of ethylene production capacity is as follows;

Table AIV-5 Ethylene Production based on Fr. Naphtha from Filoil Refinery

	Amount (BCD)	Sp.Gr.	Amount (t/y)	Ethylene Yields	Ethylene Production
Fr. Naphtha	11,900	0.724	452,060	0.29	131,100 t/y
Kerosene	4,300	0.804	181,400	0.27	49,000
Diesel Oil	7,200	0.846	319,600	0.25	79,900
			953,060		260,000 t/y

5.2 Production of Aromatics

As described before, there are two directions in aromatics production; (1) Production of general aromatics based on broad range naphtha, (2) Production of specific aromatics, i.e., p-xylene based on narrow range naphtha.

The pre-fractionation of the full range naphtha is required to prepare the necessary fraction to effectively produce aromatics, i.e., benzene and p-xylene. (Refer to Figure AIV-7)

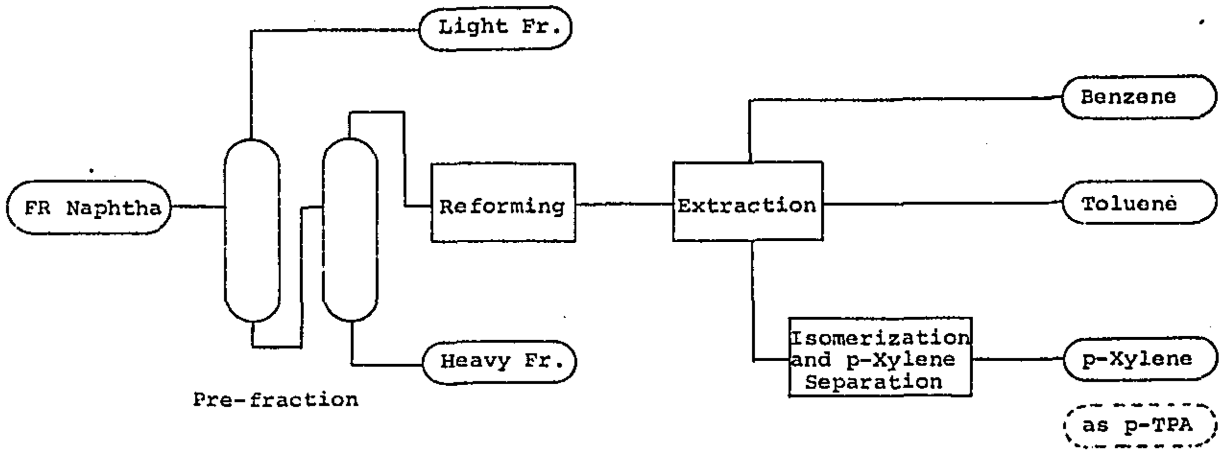


Figure AIV-7 Flow Scheme of Pre-fractionation and Aroma Production

For the expanded 50,000 BSD refinery, the following material balance will be obtained;

Table AIV - 6 Aromatic Production Based on Pre-fractionated Naphtha from Filoil Refinery

Objective of Operation	Broad Range Naphtha (A)* Benzene, p-Xylene	Narrow Range Naphtha (B)* p-Xylene
FR Naphtha	452,000 t/y	452,000 t/y
Naphtha feed for Reformer	193,800 t/y	118,600 t/y
Benzene	10,900 t/y	1,200 t/y
Toluene	21,320 t/y	14,800 t/y
m-Xylene	31,200 t/y	33,500 t/y
p-Xylene	26,900 t/y	28,800 t/y
(As p-TPA)	(39,000 t/y)	(41,800 t/y)

Note: Property of each naphtha is based on Kuwait Crude

APPENDIX I

PRICES
FOR
RAW MATERIALS, UTILITIES
AND
EVALUATION
OF
BY-PRODUCTS

APPENDIX I. PRICES FOR RAW MATERIALS, UTILITIES AND EVALUATION OF BY-PRODUCTS

1. Prices for Raw Materials in the Philippines

1.1 Current Prices for Oil Products in the Philippines

Table API-1 shows the current price structure of oil products in the Philippines which has been determined by the Government after the enhancement of price of crude oil caused by the Mideast War.

Table API-1. Posted Prices of Oil Products in 1974

Products	Posted Prices ex Tax	Special Fund	Prices Including Special Fund	In U.S. Dollars
LPG	.615 P/lit.	.020 P/lit.	.635 P/lit.	90.7 $/kl
Extra Gas	.760	.035	.795	113.6
Regular	.705	.035	.740	105.7
Avturbo	.810	.025	.835	119.3
Kerosene	.720	.025	.745	106.4
Diesel	.685	.025	.710	101.4
Solvents	.7275	.0375	.765	109.3
Fuel Oil	.5606	.0175	.5781	82.6
Asphalt	.6115	.0375	.649	92.7

Filoil is importing crude at the level of posted price of Kuwait. On the other hand, refineries owned by the Major Oils are procuring crude at a lower price level. The profitability of the Major's refineries differs from that of Filoil.

For the purpose of adjusting the difference in the costs of crude, the special fund is provided by the Government of the Philippines as shown in the above table.

Filoil is exempted from the payment of the special fund, while other refineries must pay for the fund. This being the circumstance, it is understood that price excluding tax plus special fund is the exfactory price of oil products turned out by Filoil.

The supply of raw materials is limited only from Filoil. Therefore, in this study, the price of oil products is considered to be on the level of the posted price excluding "tax plus special fund".

1.2 Escalated Oil Prices in 1980 in the Philippines

There are several viewpoints in estimating the future price of crude oil and oil products. In this report, the prices of crude and oil products are assumed to increase at the same ratio as that of inflation. The escalation factor is taken as 7 per cent per year, and this factor will also be applied to estimate the prices of oil products in 1980.

Table API-2 shows the estimated prices of oil products in the Philippines by taking the inflation factor into consideration, and by assuming that the pricing policy of the Government of the Philippines will not be changed.

Table API-2. Estimated Prices of Oil Products

			in 1980
LPG	90.7 x 1.5	= 136.1 US$/kl	251.6
Extra Gas	113.6	= 170.4	228.2
Regular	105.7	= 158.6	215.8
Avturbo	119.3	= 179.0	225.9
Kerosene	106.4	= 159.6	201.4
Diesel	101.4	= 152.1	180.1
Fuel Oil	82.6	= 123.9	128.3

1.3 Prices for Raw Materials for Petrochemical Complex and for Fertilizer Production

The raw materials shown in Table API-3 have been considered as the orientation study subjects, and the pricing of such raw materials has been made in the following manner.

Naphtha — The price of naphtha is taken as being the same as that of regular gasoline for keeping the same level of profitability for Filoil Refinery.

Gas Oil — There is no price of gas oil at this stage in the Philippines, and an assumption was made that gas oil is a mixture of kerosene and diesel oil. The average obtained by considering the product yield and price of diesel oil and of kerosene has been taken as the price of gas oil.

Fuel Oil — The price of fuel oil as the raw material for fertilizer industry has been set at the same level as that of fuel oil.

However, fuel oil without treatment cannot be used for utilities facilities because of its high sulfur content. Thus, the price of fuel as an energy source will be estimated by adding the cost of desulfurization.

LPG — LPG is assumed to be imported from Kuwait, and the price is estimated by incorporating the escalation factor of 7%/year into the price described in APPENDIX III together with the ocean freight and insurance premium etc. from Persian Gulf to the Philippines.

In addition to the said prices, the Specific Tax which is described in Title IV of National Internal Revenue Code must be considered in procuring the oil products. A summary of the raw material prices incorporating these factors is shown in Table API-3.

Table API-3. Prices of Raw Materials

in 1980

Materials	Bases	Prices (US$/ton)	Specific Tax (US$/ton)	Total (US$/ton)
Naphtha for Aromatics, Olefins, Fertilizer	Domestic Regular Gasoline	217	290P/kl=57	274
Gas Oil for Olefins	Domestic Mixture of Kerosene & Diesel Oil	193 1)	105P/kl=18	211
Fuel Oil for Fertilizer	Domestic Fuel Oil	128	15P/kl= 3	131
LPG for Olefins, Fertilizer	Imported from Mideast	343	50P/kl= 7	350
Naphtha 2) Imported	Imported from Mideast	193 3)	290P/kl=57	230

Note: 1) Price of gas oil produced from the refinery plus desulfurization cost of $10/ton.

2) For reference to facilitate comparison with the price of domestically produced naphtha.

3) These prices are estimated by adding ocean freight, insurance premium, import duty etc., required for importing materials.

2. Prices of Utilities

2.1 Current Prices

The prices of utilities shown in Table API-4 are those which PNOC is applying for the estimation of the production cost of existing Filoil Refinery. PNOC is procuring electric power from outside sources and the water is taken in from a drilled deep well.

Table API-4 Prices of Utilities for the Filoil Refinery in 1974

Electric Power (25,000 KV)	0.25 P/kWH		= $0.036/kWH
Steam ($225 460 $^{\circ}$F)	Variable cost Total cost	5.16P/$1000 7.62P/$1000	=$2.4/ton
Raw Water	Variable cost Total cost	0.85P/1000 gallon 2.80P/1000 gallon	=$0.106/m^3
Boiler Feed Water	Variable cost Total cost	5.85P/1000 gallon 23 P/1000 gallon	=$0.87/m^3
Circulating Cooling Water	Total cost	0.19P/1000 gallon	=$0.007/m^3
Instrument Air	Variable cost Total cost	3.6 P/1000CF 6.53P/1000CF	=$0.033/m^3

The data of utilities are available from the Government. However, a different estimation has been made in this study because of the fact that newly constructed utilities facilities in the form of utility center will be needed at the time of construction of petrochemical complex which will consume a large amount of utilities, and that the price for fuel oil for utilities facilities will become higher for the necessity of effecting pollution control.

2.2 Estimated Prices for Project Evaluations

The prices for utilities have been estimated as follows for the year 1980.

<u>Fuel Oil</u> As has been described in the chapter regarding the prices of raw materials, the price of fuel oil supplied from the refinery can be estimated at a level of US$131/ton. However, in order to use the fuel oil as the energy sources, the fuel oil supplied from the refinery based on Kuwait Crude contains such a high extent of sulfur that desulfurization will certainly be required.

The price of fuel oil is equivalent to US$13.2/MMKcal. The cost for desulfurization is estimated to be US$36/MMKcal for fuel oil in 1980. Therefore the price of desulfurized fuel oil in 1980 can be estimated as US$16.8/MMKcal. For fuel gas, the same price will be applied as the industrial fuel supply.

Other Utilities Prices of other utilities are estimated as shown in Table API-5, into which the cost of a newly constructed plant and the price for fuel described have been incorporated.

Table API-5 Prices of Utilities in the Philippines in 1980

Fuel gas/oil	US$16.8/MMKcal
Cooling water	US$0.04/ton
Boiler feed water	US$1.5/ ton
High pressure steam	US$12.0/ ton
Low pressure steam	US$6.9/ ton
Electricity	US$0.075/kWH

When conducting the studies on the utility center, a detailed estimation will be made by incorporating the factors to make the estimate suitable for the conditions existing in the Philippines.

3. Evaluation of By-Products from the Complex

The olefin complex and the aromatics complex both have a wide range of by-products, and the evaluation of such by-products will affect the profitability of the complex greatly. In the orientation study, the following evaluation procedure will be taken.

Methane Rich Gas

Methane rich gas can be used as clean fuel for industrial use and the price is set at a level of US$16.8/MMKcal as industrial fuel.

Hydrogen Rich Gas

Generally hydrogen rich gas has value higher than that of fuel. In this case, the price is set at a level of 1.1 times the fuel evaluation price figure, that is US$18.5/MMKcal.

Propylene

The price of propylene for producing polypropylene is set at a level of about 0.8 times the price of ethylene. However, the amount of propylene produced in the complex will be excessive, and the surplus propylene which cannot be used for polypropylene production is evaluated as LPG for domestic use.

Mixed C_4 and Mixed C_3

Mixed C_4 and C_3 are evaluated as LPG for domestic use. LPG price in the Philippines is US$251/ton as shown in Table API-6, which is equivalent to US$22.8/MMKcal. This price is taken for both Mixed C_4 and C_3.

Pyrolysis Gasoline

Pyrolysis gasoline is estimated to be at the same price as that of naphtha, as it can be used as a feed for the aromatics complex.

Pyrolysis Fuel Oil

Pyrolysis fuel oil is evaluated as clean fuel oil, that is, US$16.8/MMKcal.

The summary of the prices of by-products is shown in Table API-6.

Table API-6 Prices of By-Products from the Olefin Complex

By-Products	Evaluation Bases	Prices ex tax
Propylene		
for polypropylene	0.8 times ethylene	case by case
for remaining	Domestic LPG	US$252/ton
Mixed C_3	Domestic LPG	US$251/ton
Mixed C_4	Domestic LPG	US$251/ton
Hydrogen rich gas	Industrial fuel x 1.1	US$530/ton
Methane rich gas	Industrial fuel	US$201/ton
Pyrolysis Gasoline	Naphtha	US$217/ton
Pyrolysis Fuel Oil	Clean fuel oil	US$164/ton

4. International Price Level of Raw Materials for Petrochemical Industry.

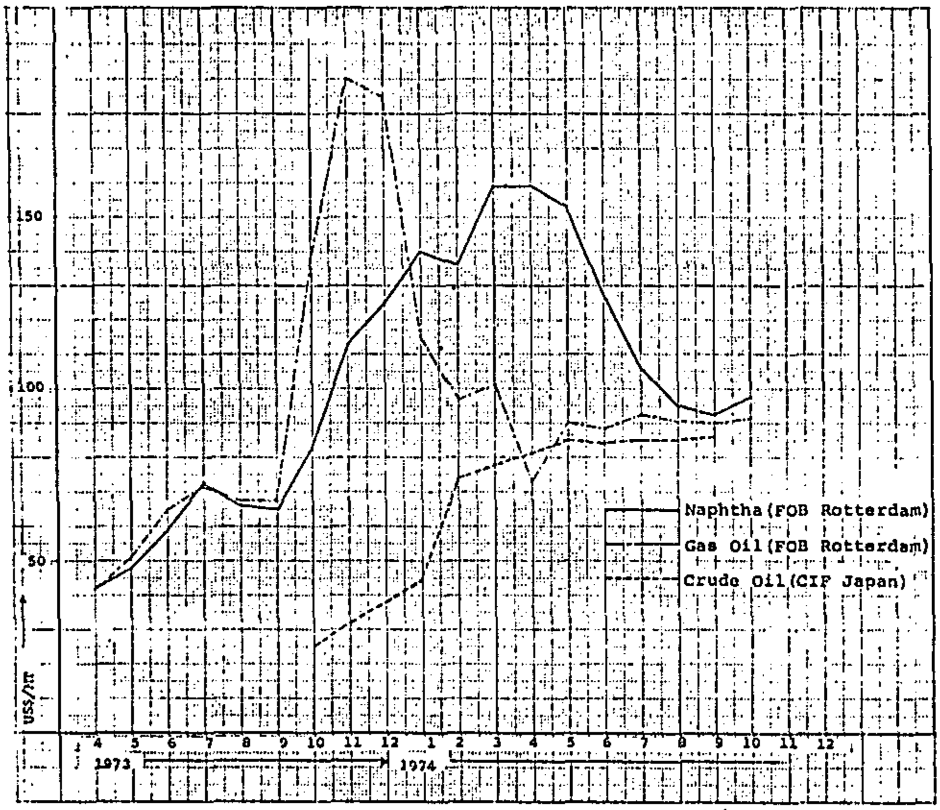
4.1 Recent Price Trend in International Market

The international market price of naphtha in the second quarter of 1973, as displayed in the attached Fig. API-1 shows an uptrend while enlarging the gap between crude oil price which also increased sharply until April, 1974. In March and April, 1974, naphtha price hit a record high of US$159/ton. From May to September, naphtha price sharply fell, while crude oil price maintaining a stably high level throughout the same period. This naphtha price downtrend persisted until naphtha price approached a level close to that of crude oil. In other words, the naphtha price fall was abnormal in view of otherwise coherent relation between the prices of naphtha and crude oil.

The international price level of naphtha therefore appears to always react speculatively on the prospect of crude oil price.

The current price of naphtha in the international market still seems volatile, but it is expected to eventually attain some reasonable level of US$110 to US$120 per ton, provided that the crude price will stay on the current level.

Figure API-1 Trend of Recent International Oil Price



4.2 Naphtha Price Level in Major Countries

Generally, in the countries where petrochemical industry is in operation, supply of naphtha to the industry is undertaken by domestic suppliers, the representatives of them being petroleum refining companies. Imported naphtha is also used at times, but it comprises only a minor proportion except in the case of Japan where imported naphtha occupies over 20 percent of the total naphtha requirements.

The naphtha price for petrochemical industry in most of the countries is politically set forth within the framework of tax systems under pricing policy for petroleum products, as shown in the attached Table API-7.

Europe

As shown in the Table API-7, the information on naphtha prices in European countries concerns itself with domestic current prices which are not bound by long-term supply contracts between petroleum refiners and petrochemical companies. When long-term supply contracts are in effect, naphtha price tends to be set on a rather high level (US$81 - 88/kl) when compared with current spot price, because such contracts were signed when crude oil price was not as yet stabilized.

Japan

Naphtha price in Japan has so far been at 25,000 yen/kl (equivalent to US$83/kl) as an agreed standard price between the national associations of petroleum refining companies and petrochemical complex; however, it has since been increased to 27,000 yen/kl (US$90/kl) as from 1975 onward. The naphtha price standard in Japan has been adjusted from time to time in accordance with the price level of imported naphtha.

U.S.A.

The present price level of naphtha in U.S.A. is US$62 - 66/kl. It is however, expected to be increased to US$88/kl in 1977 and to US$99/kl in 1980.

A summary of price level of domestic naphtha in major countries in the world is as follows:

Europe (spot average):	US$66 - 67/kl
Europe (long-term average):	US$81 - 88/kl
Japan (long-term):	US$83/kl
U.S.A. (long-term):	US$64/kl
Middle East (FOB Tanura):	US$79/kl

4.3 Tax and Tariff on Petroleum Products in Major Countries

Table API-8 shows the tax and tariff rates or amount on petroleum products in the major countries.

As it is clearly recognized in the Table API-8 and Fig. API-2, tax and tariff on naphtha as raw materials for petrochemical industry in the major countries are extremely low compared with the impositions effected on automotive gasoline.

	EXPORT PRICE (US$/Kl)					DOMESTIC PRICE (US$/Kl)						
	Singapore FOB	Iran FOB	Venezuela FOB	U.S.A. (Gulf C.) FOB	Holland ($/T) FOB	Philippines Retail	Japan Retail	U.K. Retail	France Retail	Italy Retail	W. Germany Retail	U.S.A. Retail
Aviation Gasoline	124.46	121.53	119.68									
Gasoline												
95 ~	95.11	91.15	91.94	85,87	(98/99) 106.00	169.12						
90		87.19	89.83		97.00	160.29	*333.33	*267.56	*324.51	*493.86	*266.57	*166.18
85	88.24											
Naphtha					97.50		83.00	*(95.00~ 97.00)	*(103.62)	*(90.00~ 92.00)	*(80.00~ 100.00)	
							(90.00) (after 1975)	66.50~ 67.90	72.53	63.00~ 64.40	56.00~ 70.00	
Kerosene	94.32 96.96	81.90	91.94	78.60	96.00	124.26	127.04	117.50	205.26	121.57		
Gas Oil					91.25							
Diesel Oil	83.49	75.30	80.32	75.63		127.94		272.38	220.90	232.31	275.88	
Fuel Oil												
Light		58.81			(S-1%) 70.01			100.53	92.31	76.62		
Middle					(S-3%) 63.51			94.40	75.79	77.97		
Heavy				67.62				91.65	69.57	79.29		

NOTE

*Current price as of Oct., 1974 (spot base)

*( )
Naphtha as material for petrochemical industry
Per metric tons, as of Nov., 1974

Exchange Rate
@ P 6.8/$
@ ¥ 300/$
@ $2.6/Stg
@ F 5.115/$
@ L 581/$
@ DM 3.22/$

July 15 (Philippines) · Aug.'74 (Japan)

Unit : US$/Kl

Source : Platt's Oilgram Petroleum Times June, 1974
UNICO's Information

Table API-7 Export and Domestic Prices of Petroleum Products in Major Countries

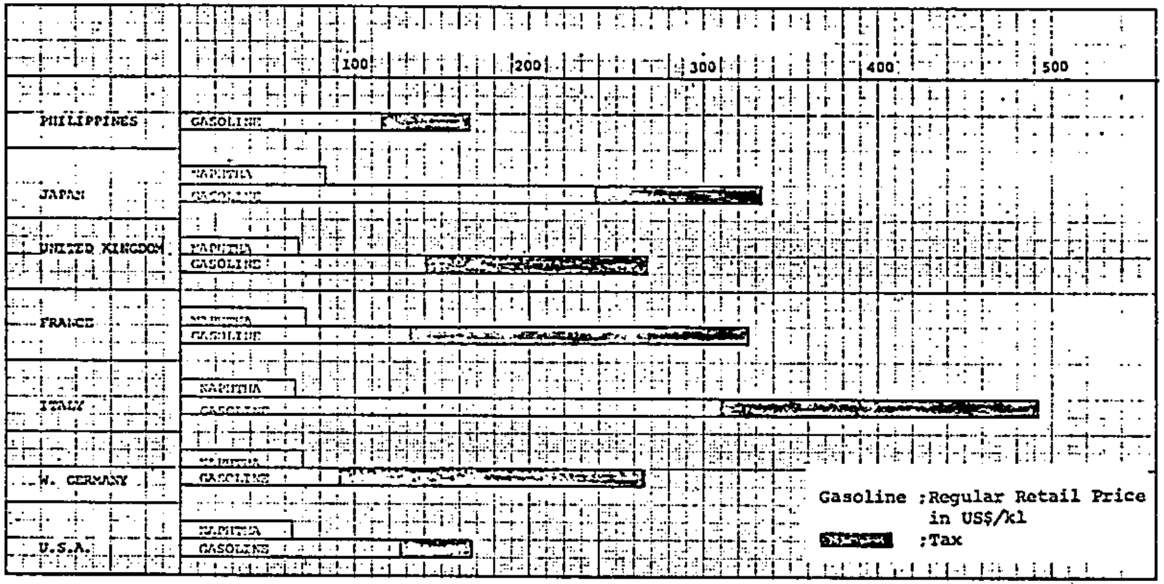


Figure API-2 Price Comparison with Naphtha and Gasoline

	Philippines		Japan		U.S.A. (N.Y.)		U. K.		W. Germany		France		Italy	
	Tariff	Tax	Tariff	Tax	Tariff	Tax	Tariff	Tax	Tariff	Tax	Tariff	Tax	Tariff	Tax
Crude	20%	0	(NH3, Petchem) 0 (after 1975.3 0.36)	0	0.66	-	0	0	0	-	0	-	0	-
Gasoline	20%	43.50	-	94.71 (after 1974.4 113.85)	3.27	39.89	127.22	-	6%	175.50	6%	192.84	6%	184.30
Naphtha	20% (For Fertilizer 0)	43.50	(NH3, Petchem) 0.41 (For Fuel 7.10(3.55))	0	0.94	-	0	-	0	-	0	-	0	-
Kerosene	20%	7,50	5.02 (3.33)	0	0.94	-	5.65	127.22	6%	124.41	6%	109,73	6%	90.35
Diesel Oil	20%	0.75	-	0	0.94	40.16	* 127.22 ** 5.65	5.65	3.5%	175.50	3.5%	115.13	3.5%	80.54
Fuel Oil	20%	2.25	-	49.50	0.94	-	5.65	-	3.5%	-	3.5%	-	3.5%	-
A	"	"	2.11	"	"	-	"	127.22	"	3.53	"	98.57	"	59.20
B (No.1)	"	"	2.11	"	"	-	"	5.65	"	9.53	"	72.62	"	51.20
C (No.2)	"	"	2.11	"	"	-	"	-	"	9.53	"	65.62	"	40.00
Lub. Oil	-	-	-	-	0.94	-	-	-	7%	-	7%	-	7%	-
LPG	20%	13.50	0.92/T	0	-	-	0	-	3.5%	-	3.5%	-	3.5%	-

NOTE

Exchange Rate
₱ = $0.15
Stℓ1 = $2.57
Fr 1 = $0.24
L = $0.0016
DM = $0.39
¥ = $0.0033

* For automobil
** For others

U.S.A., U.K., W.G., France, Italy } Tariff: as of Jan.,1973; Tax: as of Apr.,1973 (Platt's Oilgram Petroleum Times,

Tariff in U.S.A. revised as of May,1973 (imposed as "Import Licence Fee")

Unit : US$/Kl

Source : Platt's Oilgram Petroleum Times
UNICO's Information

Table API-8 Tax and Tariff Rates in Major Countries

4.4 Tax and Tariff System on Petroleum Products in Japan

Tax and tariff schedule in force in Japan on the petroleum products are as shown in the attached Table API-9 and Table API-10.

The respective imported petroleum products or crude oil are taxed in accordance with the tariff rates specified in the Table API-9.

Particular fractions purposely used for the specified industrial production, as a feed for the petrochemical industries in particular, are favoured by tax credit as shown in the Table API-10, in which the principle is to credit back the imposed tariff in certain proportions.

Table API-9 Tax and Tariff on Petroleum Products in Japan

	Purpose of Use	Tariff	Tax	
Crude Oil	Ammonia Production	¥110/Kl	0	
	Petrochemical	*	0	
	Town Gas	0	0	
	Refining (Sulfur: less 1%)	¥530/Kl	0	
	Heavy Oil Desulfurization (as Feed)	(Credit) ¥500/Kl		
	Others	¥640/Kl	0	
Gasoline	Ammonia Production	¥125/Kl	0	
	Petrochemical	*	0	*Gasoline Tax ¥29,200/Kl
	Town Gas	*	0	Local Road Tax
	Power Plant, Steel Mill	¥1,075/Kl	*¥34,500/Kl	¥5,300/Kl
Kerosene	Kerosene	¥1,010/Kl	0	
Heavy Oil	A. Refining	¥640/Kl	(¥15,600/Kl)	**Tax on Diesel Oil
	Agriculture	**"TQ System"		
	Forestry	1st: 955/Kl	0	**"TQ System": Tariff Quota System
	Fishery	2nd: 2,280/Kl	0	1st: Granted quota to cover shortage of domestic supply
	B. Refining	¥640/Kl	0	2nd: Out of quota
	Others	"TQ System"		
		1st: 730/Kl	0	
		2nd: 2,280/Kl	0	
	C. Refining	¥640/Kl	0	
	Others	"TQ System"		
		1st: 660/Kl	0	
		2nd: 2,200/Kl	0	
LPG	Ammonia Production	¥280/T	0	
	Petrochemical	*	0	
	Others	¥550/T	0	
Others	Liquid Methane Gas	0	0	
	Petrocoke	0	0	
	Catalyst (excl. Fe. Pt. $SiAl_2O_3$)	4%	0	
	Sulfur	0	0	
	Anti-nock	0	0	

(Revised in 1974
Valid until March 31, 1975)

Table API-10 Tax Credit on Feed for Chemical Industries in Japan

Purpose of Use	Property liable for tax-credit	Credit	Creditable Party
Ethylene, Propylene Buthylene, Butadiene Benzene, Xylene or Petro-resin	Gasoline for thermal cracking, Kerosene, Diesel Oil	¥391/Kl	Petrochemical Company
Benzene, Toluene, Xylene and/or N-Hexane	Reformed gasoline, Reformed Hydrocarbon, Aromatics rich functions as feed for Hydrocarbon extraction	¥369/Kl	"
B. T. X.	Reformed Hydrocarbon for hydro-dealkylation unit	¥369/Kl	"
Iso-propyl alcohol, Acetone or Iso-propyl ether	Petrogas as feed to olefin absorbing unit for production of alcohol and keton production line	-	
No.2 Buthyl Alcohol, Methyl-ethyl Keton or Alkyl-phenol	- same as above -	¥687/Kl Equivallent	"
Vinyl Chloride or Acetylene	Gasoline for thermal cracking	¥458/Kl	"
Acetic Acid, Formic Acid Propion Acid, Succinic Acid or Aceton	Gasoline for oxidation reactor	¥470/Kl	"
Methyl-alcohol	Gasoline for reforming Petrogas as feed for reforming	¥467/Kl	"
Linear-alkyl Benzene	N-parafin in Kerosene	¥613/Kl	Petrochemical Company
Di-ethyl Hexyl Alcohol Nunal Alcohol or N-Buthyl	Petrogas as feed for mixed gas production unit	¥685/Kl	"
Aldehyde, Cyclohexane or Caprolactam	Gasoline for cracking furnace	¥473/Kl	"
Gas Industry	Gasoline	¥292/Kl	Certified Gas Industry
	Gasoline	¥484/Kl	Common Gas Industry
	Gasoline	¥473/Kl	Ammonia Producer
	Petrogas	¥712/T	"
	Petro-asphalt	¥389/T	"

APPENDIX II

ESTIMATES OF CAPITAL REQUIREMENTS AND PRODUCTION COST

APPENDIX II ESTIMATES OF CAPITAL REQUIREMENTS AND PRODUCTION COST

1. Premises of Estimation

1.1 Time of Operation and Construction

(1) The complexes are expected to commence commercial operation in mid-1979.

(2) A period of 3.5 years is taken for the construction of the complex and the contracts for the construction are to be concluded by early 1976.

1.2 Priorities in the Philippines

The petrochemical complexes are assumed to be granted by the Government of the Philippines with a certificate of priority industry.

1.3 Operation Conditions

(1)	Plant life:	15 years
(2)	Number of operation days:	330 days
(3)	Annual production:	Rated capacity x 100%

1.4 Price Escalation

Price escalation on the required items are assumed on the basis of an inflation factor of seven (7) per cent per year on current prices through 1980; thus it is calculated as follows:

$$(1 + 0.07)^6 \doteqdot 1.5$$

1.5 Period of Evaluation and the Basic Year

The prices, costs, etc. employed in the production cost estimation are in expected figures for the year 1980 and/or in yearly average throughout 10 years of operation starting in mid-1979 when the commercial operation commences.

1.6 Financial Categories

Own capital:	30% of the fixed capital requirement
Long term foreign loan:	70% of the fixed capital requirement
Repayment:	Equally divided ten annual instalments

1.7 Interest

1) Long term foreign loan

Current supplier's credit from the Export-Import Bank of Japan is considered to be adopted.

The interest rate is calculated as follows:

Ex-Im Bank

80% x 7% = 5.6%

Commercial Bank

20% x 10%= 2.0%

Total Interest: 7.6%

2) Local loan for working capital

Interest Rate: 18% p.a.

1.8 Average Principal Unpaid

Period of deferred payment: 10 years

Total principal for deferred payment: A

Annual repayment of principal: a

Average principal unpaid through 10 years

$$= a \times \frac{10\ (10+1)}{2} \div 10 = 5.5a$$

$$= \text{or } 5.5 \times \frac{1}{10} A$$

1.9 Local Laws and Regulations on Finance

Local laws and regulations currently effective in the Philippines are to be applied:

Example:
- National Internal Revenue Code (as amended to PD No. 436)
- Investment Incentive Act (Republic Act No. 5186)

2. Estimates of Capital Requirements

The capital requirements for the complex are estimated by the following categories and methods.

2.1 Fixed Capital

The items described below are the capital requirements for the installation of the complex. In addition to these items, three (3) per cent of contractor's tax is considered inclusively in the fixed capital requirements.

2.1.1 Land Cost

The land cost includes, in addition to the price of land, the site development cost. The unit cost of land is estimated to be US$ 15/m^2. Total land cost for each plant is assessed by multiplying the unit cost by the required area for each plant.

2.1.2 Plant Facilities

(1) Process plant

The scope of the process plant encompasses the following:

1) Equipment and materials

2) Civil work

3) Field erection work

4) Supervision

5) Engineering and contractor's fee

6) Licence and know-how fee

7) Catalysts and chemicals

8) Spare parts

The process plant includes not only the above items which are for the process equipment but also for the following:

a) Control room

b) Secondary electrical substation (secondary transformers), electrical wires

c) Offices in plant site

d) Process control analysis equipment in plant site

e) Receiving and handling facilities for chemicals and catalysts

f) Cooling tower

g) Fire fighting facilities in plant site

h) Primary waste and waste-water treating facilities (including incinerators, etc.)

i) Minor maintenance shop, warehouses for special storage

j) Small-sized receiving/holding facilities such as feed tanks to be installed normally on production units to facilitate operations

(2) Offsite facilities

The offsite facilities include those for storage and shipping such as warehouses, tanks, etc. and the common service facilities such as offices. Although the utilities facilities are common facilities, they will be deemed as being a process plant, rather than as offsite facilities, in view of the fact that the utilities are to be sold to each plant included within the complex.

Further, because of the fact that proposed plant site is located near Manila, such facilities as housing facilities etc. are not considered.

2.1.3 Pre-operating Expenses

This item includes the loss caused during the test operation, labor cost, initial charges, start-up cost, etc. which will be incurred prior to the commencement of commercial operation. It further includes the cost incurred by training and education of operators, technical assistance expenses, legal expenses for establishing and registering the company, the project management cost of the owner, etc.

These cost can be estimated as a whole in the following.

(1) Start-up expenses:

- 0.5 month of raw material cost and utilities cost
- 12 months of labor cost

(2) Guarantee fee for DBP:

Guarantee fee required to pay for DBP is subject to negotiation; however, it is tentatively assumed as follows:

Commitment fee:	0.5%
Guarantee fee: (unused)	0.5%/year
Guarantee fee: (used)	1.0%/year

Guaranteed amount:

Principal of deferred payment loan:

Fixed capital x 0.7

Aggregate interest on deferred payment loan:

Fixed capital x 0.7 x 0.076

x (5.5 + 3.5 ÷ 2)

Guarantee fee during construction period:

Fixed capital x 0.7 x $\{1 + 0.076 \times (5.5 + 3.5 \div 2)\}$

x (0.005 + 0.005 x 3.5)

Note: For convenience, the guarantee fee during construction period is assumed and the "unused rate" of 0.5 per cent per year has been applied.

2.1.4 Interest During Construction

Interest during construction is assessed as follows by assuming that all the payment is made at the middle of the construction period.

Fixed capital requirements x 0.7 (ratio of own capital)
x 0.076 (average interest) x 3.5 (construction period) x 1/2

2.1.5 Contingency

This item signifies the provisions to cover the unforeseen cost during construction and/or preoperation period. Five (5) per cent of the total cost of land, plant facilities and preoperating expenses is estimated for the provisions.

2.2 Working Capital

This signifies the fund necessary for the running of the company including such items as the accounts receivable, prepaid expenses, etc., required after the commencement of commercial operation.

One month expenses of variable cost, labor, technical assistance, and tax and insurance are counted for the study.

3. Cost Items to be Set for the Production Cost Estimation

3.1 Variable Cost

Variable cost shall include those items the amount of which will vary according to the variation in the production amount, including such items as raw materials, utilities, catalysts, chemicals and also by-products deduction. Each of the above items is referred to in Appendix I.

3.2 Fixed Cost

3.2.1 Labor Cost

The labor cost includes the direct wages and salaries as well as fringe benefit cost for the operators necessary for the operation of the plant.

Average local labor cost is assumed to be US$3,920/man-year.

3.2.2 Technical Assistance Fee

This item includes the cost incurred on the invitation of expatriate skilled engineers of the contractor, the process owner, the consultants, etc. for receiving assistance in the plant operation.

Average cost is estimated to be US$156,000/man-year.

3.2.3 Depreciation and Amortization

ISBL:	15 years
Off-site facilities:	"
License and know-how:	10 years
Catalysts and chemicals:	"
Spare parts:	"
Preoperating expenses:	"
Interest during construction:	"

3.2.4 Maintenance

This item includes the cost for repair works ordered by contractors and the cost for procuring equipment and materials for maintenance. The cost for the owner's engineers is included within the scope of the plant overhead cost.

The annual maintenance cost shall be calculated on a constant rate against the facility costs.

Process plant (for ISBL alone):	3 per cent
Offsite facilities:	1 per cent

3.2.5 Tax and Insurance

Real property tax on booked value of the facilities and insurance thereon are taken into account as follows.

(1) Real Property Tax

In accordance with the Real Property Tax Code (PD No. 464), the following taxes on real properties are imposed; however, for the convenience of calculation, the following approximate rates are applied.

a) On land:

Assessed level:	50%
Rate of levy:	0.5 - 2%
Tax:	0.25 - 1.0%
Average:	(-- 0.625%)

b) On plant facilities:

Assessed level:	100%
Rate of levy:	0.5 - 2%
Tax:	0.5 - 2%
Average:	(-- 1.25%)

c) Total average tax of above a) and b):

Land 0.625% x 0.05 = 0.03125

Plant 1.25% x 0.95 = 1.1875%

Total = approx. 1.21%

(2) Insurance: 0.8% on Total facilities

(3) Total (1) + (2) = 2.01 --- approx. 2.0%

(4) Depreciation of assessed value:

15 years straight depreciation

Therefore;

Average annual tax and insurance:

2.0% x 2/3,

or, 0.02 x 2/3

3.2.6 Interest and Guarantee Fee During Operation Years

(1) Interest for deferred payment (annual average):

Fixed capital requirement x 0.7 x 0.076 - 10

(2) Interest on working capital:

Working capital x 0.18

(3) Guarantee fee for DBP:

Guarantee fee required to pay for DBP is subject to negotiation; however, it is tentatively assumed as follows:

Commitment fee:	0.5%
Guarantee fee: (unused)	0.5%/year
Guarantee fee: (used)	1.0%/year

Guarantee fee during the operation years:

Guarantee fee applied to this period is assumed, and the "used rate" of 1.0 per cent per year has been applied.

$$\text{Fixed capital} \times 0.7 \times \left\{ (5.5 \div 10) + (22 \times 0.076 \div 10) \right\} \times 0.01$$

(5.5 ÷ 10) : average principal unpaid

(*22 x 0.076 ÷ 10) :

average aggregate unpaid interest

$$* \sum_{n=0.1}^{1.0} \frac{n(n+1)}{2} = 22$$

4) Other expenses

The miscellaneous expenses incurred during the operating years are estimated and included as being 0.2 per cent of the total fixed capital requirements.

3.2.7 Plant Overhead

The plant overhead cost includes those expenses which are required for the administration of the plant other than the costs required for directly operating the process plant. In other words, the plant overhead cost includes such cost items as the production technical control cost, accounting, personnel administration, general affairs, engineering effected by the engineers on the part of the owner, maintenance, process control analysis, etc. Cost equivalent to the labor cost is estimated for the calculation.

3.3 Running Royalty

Running royalty shall be paid in the case when the payment is obligatory by the contract. And it is consist of the basic royalty and the proportional royalty on the production amount. In this study, the payment of running royalty is not counted.

3.4 Selling Expenses

This item includes direct material costs such as product bags, etc. for the sale of products. All the selling costs except LDPE have already been deducted from the exfactory price.

1) LDPE: US$15/ton

2) Others: 0

Note: Selling expenses will be required for other olefin products. However, only the production of LDPE is studied in this orientation study.

3.5 General Administration Expenses

This item includes the headquarters expenses, business expenses, etc. which are outside the scope of plant expenses. For this item, 3% of the total sales amount is counted.

3.6 Contingency

Unforeseen expenses during operation is estimated to be 2 per cent of the total variable cost, total fixed cost, running royalty, selling expenses and general administration expenses.

3.7 Profit

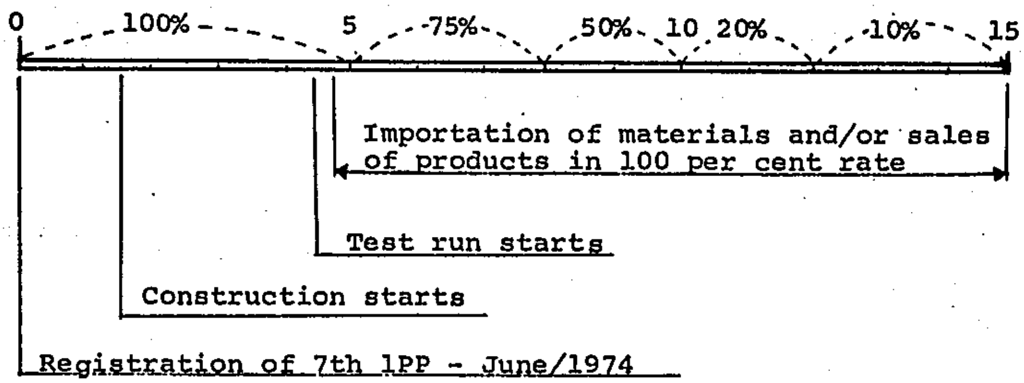
Ten (10) per cent of return on the fixed capital requirements is taken as the profit for the plant.

3.8 Sales Tax

1) In accordance with the Title V. of National Internal Revenue Code, seven (7) per cent of sales tax on imported materials, sales of by-products and final products shall be applied unless otherwise stated.

2) However, in the case of products and by-products, as provided in the said code, such tax is imposed on the proportions of value added in respective plant, i.e., the total amount of raw materials and other supplies procured from outside is excluded from the amount of sales when obtaining the basis for imposing the sales tax.

3) Further, such sales tax is assumed to be subject to the privileged conditions of tax exemption under Investment Incentive Act. (Sect. 8); thus practical tax rate applied in the calculation is estimated as follows:



100% x 4/12	=	33
75% x 3	=	225
50% x 2	=	100
20% x 2	=	40
10% x 3	=	30
Total:		428

Annual average: 428% ÷ 10 = 42.8%

Therefore,

Sales tax: 7% x 57.2% ≒ 4.0%

4. Olefins

4.1 Ethylene - Naphtha Basis

Rated Capacity	(ton/y)	200,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	144,074
- Land	(10^3US$)	900
- Plant Facilities	(10^3US$)	107,725
Process Unit	(10^3US$)	84,725
Offsite	(10^3US$)	23,000
- Pre Operating Expenses	(10^3US$)	15,803
- Interest during Construction	(10^3US$)	13,413
- Contingency	(10^3US$)	6,221
Annual Production	(ton/y)	200,000
Working Capital	(10^3US$)	11,797
Total Capital Requirements	(10^3US$)	155,872

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	187,964	939.8
By-Products	-128,540	-642.7
Utilities	30,264	151.3
Total Variable Cost	89,687	448.4
(2) Fixed Costs		
Labor	313	1.5
Technical Assistance Fee	312	1.5
Depreciation	6,979	34.8
Amortization	3,843	19.2
Maintenance	2,657	13.2
Tax and Insurance	1,408	7.0
Interest	8,794	43.9
Plant Overhead	313	1.5
Total Fixed Cost	24,621	123.1
(3) Running Royalty	0	0.0
(4) Selling Expenses	0	0.0
(5) General Administrative Expenses	3,429	17.1
(6) Contingency	2,354	11.7
(7) Total Production Cost	120,093	600.4
Profit and Loss	14,407	72.0
Net Sales	134,500	672.5
Sales Tax	4,586	22.9
Gross Sales	139,087	695.4

4.2 Ethylene - Gas Oil Basis

Rated Capacity	(ton/y)	200,000
Operational Rate	(%)	
Fixed Capital Requirements	(10^3US$)	153,388
- Land	(10^3US$)	900
- Plant Facilities	(10^3US$)	116,270
Process Unit	(10^3US$)	91,394
Offsite	(10^3US$)	24,876
- Pre Operating Expenses	(10^3US$)	15,301
- Interest during Construction	(10^3US$)	14,280
- Contingency	(10^3US$)	6,623
Annual Production	(ton/y)	200,000
Working Capital	(10^3US$)	8,266
Total Capital Requirements	(10^3US$)	161,654

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	163,032	815.1
By-Products	-135,154	-675.7
Utilities	33,233	166.1
Total Variable Cost	61,112	305.5
(2) Fixed Costs		
Labor	313	1.5
Technical Assistance Fee	312	1.5
Depreciation	7,545	37.7
Amortization	3,924	19.6
Maintenance	2,873	14.3
Tax and Insurance	1,521	7.6
Interest	8,589	42.9
Plant Overhead	313	1.5
Total Fixed Cost	25,394	126.9
(3) Running Royalty	0	0.0
(4) Selling Expenses	0	0.0
(5) General Administrative Expenses	2,595	12.9
(6) Contingency	1,782	8.9
(7) Total Production Cost	90,883	454.4
Profit and Loss	15,338	76.6
Net Sales	106,222	531.1
Sales Tax	3,622	18.1
Gross Sales	109,844	549.2

4.3 Ethylene - LPG Basis

Rated Capacity	(ton/y)	200,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	136,478
- Land	(10^3US$)	900
- Plant Facilities	(10^3US$)	102,558
Process Unit	(10^3US$)	79,558
Offsite	(10^3US$)	23,000
- Pre Operating Expenses	(10^3US$)	14,410
- Interest during Construction	(10^3US$)	12,706
- Contingency	(10^3US$)	5,893
Annual Production	(ton/y)	200,000
Working Capital	(10^3US$)	13,705
Total Capital Requirements	(10^3US$)	150,183

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	169,960	849.8
By-Products	-87,705	-438.5
Utilities	22,923	114.6
Total Variable Cost	105,178	525.8
(2) Fixed Costs		
Labor	313	1.5
Technical Assistance Fee	312	1.5
Depreciation	6,630	33.1
Amortization	3,606	18.0
Maintenance	2,500	12.5
Tax and Insurance	1,338	6.6
Interest	8,785	43.9
Plant Overhead	313	1.5
Total Fixed Cost	23,801	119.0
(3) Running Royalty	0	0.0
(4) Selling Expenses	0	0.0
(5) General Administrative Expenses	3,869	19.3
(6) Contingency	2,656	13.2
(7) Total Production Cost	135,506	677.5
Profit and Loss	13,647	68.2
Net Sales	149,154	745.7
Sales Tax	5,086	25.4
Gross Sales	154,240	771.2

4.4 Low Density Polyethylene

Rated Capacity	(ton/y)	110,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	197,461
- Land	(10^3US$)	1,500
- Plant Facilities	(10^3US$)	156,450
Process Unit	(10^3US$)	124,280
Offsite	(10^3US$)	32,170
- Pre Operating Expenses	(10^3US$)	12,585
- Interest during Construction	(10^3US$)	18,383
- Contingency	(10^3US$)	8,526
Annual Production	(ton/y)	110,000
Working Capital	(10^3US$)	22,606
Total Capital Requirements	(10^3US$)	220,068

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	70,070	637.0
By-Products	0	0.0
Utilities	14,040	127.6
Total Variable Cost	84,110	764.6
(2) Fixed Costs		
Labor	313	2.8
Technical Assistance Fee	312	2.8
Depreciation	9,762	88.7
Amortization	4,942	44.9
Maintenance	3,717	33.7
Tax and Insurance	1,973	17.9
Interest	13,211	120.1
Plant Overhead	313	2.8
Total Fixed Cost	34,547	314.0
(3) Running Royalty	0	0.0
(4) Selling Expenses	1,650	15.0
(5) General Administrative Expenses	3,609	32.8
(6) Contingency	2,478	22.5
(7) Total Production Cost	126,395	1,149.0
Profit and Loss	19,746	179.5
Net Sales	146,142	1,328.5
Sales Tax	4,983	45.3
Gross Sales	151,125	1,373.8

5. Aromatics

5.1 Caprolactam

Rated Capacity	(ton/y)	30,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	67,418
- Land	(10^3US$)	780
- Plant Facilities	(10^3US$)	52,700
Process Unit	(10^3US$)	43,400
Offsite	(10^3US$)	9,300
- Pre Operating Expenses	(10^3US$)	4,745
- Interest during Construction	(10^3US$)	6,276
- Contingency	(10^3US$)	2,911
Annual Production	(ton/y)	30,000
Working Capital	(10^3US$)	7,434
Total Capital Requirements	(10^3US$)	74,853

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	30,582	1,019.4
By-Products	-9,234	-307.8
Utilities	5,823	194.1
Total Variable Cost	27,171	905.7
(2) Fixed Costs		
Labor	235	7.8
Technical Assistance Fee	390	13.0
Depreciation	3,269	108.9
Amortization	1,755	58.5
Maintenance	1,275	42.5
Tax and Insurance	664	22.1
Interest	4,459	148.6
Plant Overhead	235	7.8
Total Fixed Cost	12,285	409.5
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	1,183	39.4
(6) Contingency	812	27.0
(7) Total Production Cost	41,453	1,381.7
Profit and Loss	6,741	224.7
Net Sales	48,195	1,606.5
Sales Tax	1,643	54.7
Gross Sales	49,839	1,661.3

5.2 p-TPA

Rated Capacity	(ton/y)	70,000	
Operational Rate	(%)	100	
Fixed Capital Requirements	(10^3US$)	100,361	
- Land	(10^3US$)	795	
- Plant Facilities	(10^3US$)	79,300	
Process Unit	(10^3US$)	59,300	
Offsite	(10^3US$)	20,000	
- Pre Operating Expenses	(10^3US$)	6,580	
- Interest during Construction	(10^3US$)	9,343	
- Contingency	(10^3US$)	4,333	
Annual Production	(ton/y)	70,000	
Working Capital	(10^3US$)	13,012	
Total Capital Requirements	(10^3US$)	113,373	
Production Cost		10^3US$/y	US$/ton
(1) Variable Costs			
Raw Materials		41,412	591.6
By-Products		0	0.0
Utilities		7,700	110.0
Total Variable Cost		49,112	701.6
(2) Fixed Costs			
Labor		78	1.1
Technical Assistance Fee		312	4.4
Depreciation		4,550	65.0
Amortization		3,126	44.6
Maintenance		1,627	23.2
Tax and Insurance		921	13.1
Interest		6,989	99.8
Plant Overhead		78	1.1
Total Fixed Cost		17,683	252.6
(3) Running Royalty		0	0.0
(4) Selling Expenses		0	0.0
(5) General Administrative Expenses		2,003	28.6
(6) Contingency		1,375	19.6
(7) Total Production Cost		70,175	1,002.5
Profit and Loss		10,036	143.3
Net Sales		80,211	1,145.8
Sales Tax		2,735	39.0
Gross Sales		82,946	1,184.9

5.3 DMT

Rated Capacity	(ton/y)	77,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	95,813
- Land	(10^3US$)	795
- Plant Facilities	(10^3US$)	74,700
Process Unit	(10^3US$)	54,700
Offsite	(10^3US$)	20,000
- Pre Operating Expenses	(10^3US$)	7,252
- Interest during Construction	(10^3US$)	8,920
- Contingency	(10^3US$)	4,137
Annual Production	(ton/y)	77,000
Working Capital	(10^3US$)	18,001
Total Capital Requirements	(10^3US$)	113,814

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	51,439	668.0
By-Products	0	0
Utilities	17,710	230.0
Total Variable Cost	69,149	898.0
(2) Fixed Costs		
Labor	117	1.5
Technical Assistance Fee	312	4.0
Depreciation	4,361	56.6
Amortization	2,955	38.3
Maintenance	1,542	20.0
Tax and Insurance	883	11.4
Interest	7,676	99.6
Plant Overhead	117	1.5
Total Fixed Cost	17,965	233.3
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	2,613	33.9
(6) Contingency	1,794	23.3
(7) Total Production Cost	91,523	1,188.6
Profit and Loss	9,581	124.4
Net Sales	101,104	1,313.0
Sales Tax	3,447	44.7
Gross Sales	104,551	1,357.8

5.4 Benzene

Rated Capacity	(ton/y)	46,800
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	14,313
- Land	(10^3US$)	60
- Plant Facilities	(10^3US$)	10,480
Process Unit	(10^3US$)	8,680
Offsite	(10^3US$)	1,800
- Pre Operating Expenses	(10^3US$)	1,821
- Interest during Construction	(10^3US$)	1,332
- Contingency	(10^3US$)	618
Annual Production	(ton/y)	46,800
Working Capital	(10^3US$)	1,611
Total Capital Requirements	(10^3US$)	15,924

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	25,350	541.6
By-Products	-15,593	-333.1
Utilities	2,737	58.4
Total Variable Cost	12,494	266.9
(2) Fixed Costs		
Labor	15	0.3
Technical Assistance Fee	0	0
Depreciation	638	13.6
Amortization	467	9.9
Maintenance	249	5.3
Tax and Insurance	128	2.7
Interest	952	20.3
Plant Overhead	15	0.3
Total Fixed Cost	2,467	52.7
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	448	9.5
(6) Contingency	308	6.5
(7) Total Production Cost	15,719	335.8
Profit and Loss	1,431	30.5
Net Sales	17,150	366.4
Sales Tax	584	12.4
Gross Sales	17,735	378.9

5.5 Reformate

Rated Capacity	(ton/y)	273,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	44,127
- Land	(10^3US$)	210
- Plant Facilities	(10^3US$)	31,600
Process Unit	(10^3US$)	26,200
Offsite	(10^3US$)	5,400
- Pre Operating Expenses	(10^3US$)	6,300
- Interest during Construction	(10^3US$)	4,108
- Contingency	(10^3US$)	1,905
Annual Production	(ton/y)	273,000
Working Capital	(10^3US$)	10,037
Total Capital Requirements	(10^3US$)	54,165

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	99,221	363.4
By-Products	-23,922	- 87.6
Utilities	3,833	14.0
Total Variable Cost	79,132	289.8
(2) Fixed Costs		
Labor	47	0.1
Technical Assistance Fee	0	0
Depreciation	1,897	6.9
Amortization	1,544	5.6
Maintenance	740	2.7
Tax and Insurance	382	1.4
Interest	3,849	14.1
Plant Overhead	47	0.1
Total Fixed Cost	8,508	31.1
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	2,629	9.6
(6) Contingency	1,805	6.6
(7) Total Production Cost	92,075	337.2
Profit and Loss	4,412	16.1
Net Sales	96,488	353.4
Sales Tax	3,290	12.0
Gross Sales	99,778	365.4

5.6 C_8 from Reformate

Rated Capacity	(ton/y)	58,500
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	25,252
- Land	(10^3US$)	90
- Plant Facilities	(10^3US$)	16,200
Process Unit	(10^3US$)	13,400
Offsite	(10^3US$)	2,800
- Pre Operating Expenses	(10^3US$)	5,519
- Interest during Construction	(10^3US$)	2,351
- Contingency	(10^3US$)	1,090
Annual Production	(ton/y)	58,500
Working Capital	(10^3US$)	6,580
Total Capital Requirements	(10^3US$)	31,833

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	99,908	1,707.8
By-Products	-53,134	-908.2
Utilities	5,270	90.0
Total Variable Cost	52,043	889.6
(2) Fixed Costs		
Labor	15	0.2
Technical Assistance Fee	0	0
Depreciation	987	16.8
Amortization	1,035	17.6
Maintenance	385	6.5
Tax and Insurance	198	3.3
Interest	2,353	40.2
Plant Overhead	15	0.2
Total Fixed Cost	4,991	85.3
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	1,711	29.2
(6) Contingency	1,174	20.0
(7) Total Production Cost	59,920	1,024.2
Profit and Loss	2,525	43.1
Net Sales	62,445	1,067.4
Sales Tax	2,129	36.4
Gross Sales	64,575	1,103.8

5.7 p-Xylene

Rated Capacity	(ton/y)	50,400
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	39,134
- Land	(10^3US$)	180
- Plant Facilities	(10^3US$)	28,900
Process Unit	(10^3US$)	24,800
Offsite	(10^3US$)	4,100
- Pre Operating Expenses	(10^3US$)	4,717
- Interest during Construction	(10^3US$)	3,643
- Contingency	(10^3US$)	1,689
Annual Production	(ton/y)	50,400
Working Capital	(10^3US$)	8,698
Total Capital Requirements	(10^3US$)	47,832

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	65,027	1,290.2
By-Products	-1,519	-30.1
Utilities	5,185	102.8
Total Variable Cost	68,693	1,362.9
(2) Fixed Costs		
Labor	54	1.0
Technical Assistance Fee	0	0
Depreciation	1,421	28.1
Amortization	1,762	34.9
Maintenance	553	10.9
Tax and Insurance	286	5.6
Interest	3,377	67.0
Plant Overhead	54	1.0
Total Fixed Cost	7,511	149.0
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	2,286	45.3
(6) Contingency	1,569	31.1
(7) Total Production Cost	80,060	1,588.4
Profit and Loss	3,913	77.6
Net Sales	83,973	1,666.1
Sales Tax	2,863	56.8
Gross Sales	86,837	1,722.9

5.8 Cyclohexane

Rated Capacity	(ton/y)	31,800
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	4,439
- Land	(10^3US$)	15
- Plant Facilities	(10^3US$)	2,900
Process Unit	(10^3US$)	2,400
Offsite	(10^3US$)	500
- Pre Operating Expenses	(10^3US$)	919
- Interest during Construction	(10^3US$)	413
- Contingency	(10^3US$)	191
Annual Production	(ton/y)	31,800
Working Capital	(10^3US$)	2,043
Total Capital Requirements	(10^3US$)	6,482

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	15,920	500.6
By-Products	0	0
Utilities	277	8.7
Total Variable Cost	16,197	509.3
(2) Fixed Costs		
Labor	47	1.4
Technical Assistance Fee	0	0
Depreciation	175	5.5
Amortization	179	5.6
Maintenance	68	2.1
Tax and Insurance	35	1.1
Interest	573	18.0
Plant Overhead	47	1.4
Total Fixed Cost	1,125	35.4
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	519	16.3
(6) Contingency	356	11.2
(7) Total Production Cost	18,199	572.3
Profit and Loss	443	13.9
Net Sales	18,643	586.2
Sales Tax	635	19.9
Gross Sales	19,279	606.2

6. Capital Requirements and Production Cost for Fertilizer

6.1 Ammonia - Steam Reforming

Rated Capacity	(ton/y)	330,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	105,645
- Land	(10^3US$)	1,500
- Plant Facilities	(10^3US$)	82,850
Process Unit	(10^3US$)	56,990
Offsite	(10^3US$)	25,860
- Pre Operating Expenses	(10^3US$)	6,889
- Interest during Construction	(10^3US$)	9,835
- Contingency	(10^3US$)	4,561
Annual Production	(ton/y)	330,000
Working Capital	(10^3US$)	6,614
Total Capital Requirements	(10^3US$)	112,260

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	44,880	136
By-Products	0	0
Utilities	5,073	15
Total Variable Cost	49,953	151
(2) Fixed Costs		
Labor	117	0
Technical Assistance Fee	234	0
Depreciation	4,820	14
Amortization	3,175	9
Maintenance	1,626	4
Tax and Insurance	985	2
Interest	6,082	18
Plant Overhead	117	0
Total Fixed Cost	17,158	51
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	2,013	6
(6) Contingency	1,382	4
(7) Total Production Cost	70,508	213
Profit and Loss	10,564	32
Net Sales	81,072	245
Sales Tax	2,764	8
Gross Sales	83,837	254

6.2 Ammonia - Partial Oxidation

Rated Capacity	(ton/y)	330,000
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	125,410
- Land	(10^3US$)	1,950
- Plant Facilities	(10^3US$)	98,300
Process Unit	(10^3US$)	72,440
Offsite	(10^3US$)	25,860
- Pre Operating Expenses	(10^3US$)	8,059
- Interest during Construction	(10^3US$)	11,675
- Contingency	(10^3US$)	5,415
Annual Production	(ton/y)	330,000
Working Capital	(10^3US$)	7,491
Total Capital Requirements	(10^3US$)	132,901

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	47,553	144
By-Products	0	0
Utilities	8,659	26
Total Variable Cost	56,212	170
(2) Fixed Costs		
Labor	148	0
Technical Assistance Fee	312	0
Depreciation	5,803	17
Amortization	3,630	11
Maintenance	2,068	6
Tax and Insurance	1,187	3
Interest	7,154	21
Plant Overhead	148	0
Total Fixed Cost	20,454	61
(3) Running Royalty	0	0
(4) Selling Expenses	0	0
(5) General Administrative Expenses	2,300	6
(6) Contingency	1,579	4
(7) Total Production Cost	80,546	244
Profit and Loss	12,541	38
Net Sales	93,087	282
Sales Tax	3,174	9
Gross Sales	96,261	291

6.3 Urea - Total Recycle (Based on 6.1)

Rated Capacity	(ton/y)	56,100
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	59,484
- Land	(10^3US$)	1,500
- Plant Facilities	(10^3US$)	43,250
Process Unit	(10^3US$)	29,750
Offsite	(10^3US$)	13,500
- Pre Operating Expenses	(10^3US$)	6,623
- Interest during Construction	(10^3US$)	5,538
- Contingency	(10^3US$)	2,568
Annual Production	(ton/y)	56,100
Working Capital	(10^3US$)	11,855
Total Capital Requirements	(10^3US$)	71,340

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	82,646	147
By-Products	0	0
Utilities	10,476	18
Total Variable Cost	93,123	165
(2) Fixed Costs		
Labor	101	0
Technical Assistance Fee	156	0
Depreciation	2,660	4
Amortization	1,800	3
Maintenance	913	1
Tax and Insurance	553	0
Interest	4,888	8
Plant Overhead	101	0
Total Fixed Cost	11,175	19
(3) Running Royalty	0	0
(4) Selling Expenses	5,610	10
(5) General Administrative Expenses	3,297	5
(6) Contingency	2,264	4
(7) Total Production Cost	115,469	205
Profit and Loss	5,948	10
Net Sales	121,418	216
Sales Tax	4,140	7
Gross Sales	125,558	223

6.4 Urea → Total Recycle (Based on 6.2)

Rated Capacity	(ton/y)	56,100
Operational Rate	(%)	100
Fixed Capital Requirements	(10^3US$)	60,113
- Land	(10^3US$)	1,500
- Plant Facilities	(10^3US$)	43,250
Process Unit	(10^3US$)	29,750
Offsite	(10^3US$)	13,500
- Pre Operating Expenses	(10^3US$)	7,166
- Interest during Construction	(10^3US$)	5,596
- Contingency	(10^3US$)	2,595
Annual Production	(ton/y)	56,100
Working Capital	(10^3US$)	13,401
Total Capital Requirements	(10^3US$)	73,514

Production Cost	10^3US$/y	US$/ton
(1) Variable Costs		
Raw Materials	95,010	169
By-Products	0	0
Utilities	10,476	18
Total Variable Cost	105,487	188
(2) Fixed Costs		
Labor	101	0
Technical Assistance Fee	156	0
Depreciation	2,660	4
Amortization	1,863	3
Maintenance	913	1
Tax and Insurance	553	0
Interest	5,195	9
Plant Overhead	101	0
Total Fixed Cost	11,545	20
(3) Running Royalty	0	0
(4) Selling Expenses	5,610	10
(5) General Administrative Expenses	3,679	6
(6) Contingency	2,526	4
(7) Total Production Cost	128,848	229
Profit and Loss	6,011	10
Net Sales	134,859	240
Sales Tax	4,598	8
Gross Sales	139,458	248

APPENDIX III

ESTIMATES OF PRICES
FOR
IMPORTED RAW MATERIALS
AND
PRODUCTS

APPENDIX III. ESTIMATES OF PRICES OF IMPORTED RAW MATERIALS AND PRODUCTS

1. Bases for Imported Price Calculation

The general procedure of the calculations of the prices of the imported items is based on the following:

1.1 FOB Price

FOB price at the sea port of exporting country

1.2 Ocean Freight

Ocean Freight to Manila port or an appropriate place where the cargo is to be discharged and landed

The following types of transportation are considered, depending upon the kind of the cargo.

(1) Liner Boat:
Dry bagged cargoes

(2) Ordinary Bulk Carrier (Tramper):
Ordinary liquid cargoes

(3) Special Bulk Carrier (Tramper):
Corrosive cargoes
High pressure cargoes

Note 1: For the convenience of estimating the freight for a special boat, a freight rate on the basis of a new boat was used, which will have been made available by the year of operation.

2: Escalation of freight is based on ordinary inflation; however, the freight also depends on the availability of boats. Thus 1.1^3 times the present average rate is expected to be applicable.

1.3 Marine Insurance

Current rates are adopted for respective cargoes with required standard conditions.

1.4 CIF Manila

1 + 2 + 3 of the above

1.5 Import Duty

Import duty on various items including raw materials, intermediates, products, etc. is as per attached Table APIII-1 as stipulated in the Tariff and Customs Code of the Philippines (as amended by PD No. 34).

Table APIII-1 List of Import Duty Rate

LDPE	30%
HDPE	30%
PVC	50%
PP	30%
Cyclohexane	10%
p-Xylene	10%
Acetic Acid	10%
Methanol	50%
DMT	10%
p-TPA	10%
Caprolactam	10%
Benzene	10%
Toluene	10%
Crude Oil	20%
Naphtha	20%
LPG	20%
Urea	20%
Ammonia Sulfate	20%
Ammonia (liq.)	10%

1.6 Miscellaneous Charges and Fees

Including wharfage duties, berthing charges, storage, arrastre, tonnage duties, other surcharges, brokerage, etc.

1.7 Sales Tax (Percentage Tax)

(1) According to Article IV or V of National Internal Revenue Code (as amended by PD No. 436), specific tax or percentage tax on imported materials are calculated.

(2) Depending on the nature of use or purpose of said imported materials, tax exemption under Investment Incentive Act (Republic Act No. 5186 as amended by PD No. 92, Jan. 6, 1973) is applied in average figures.

1.8 Leakage and Breakage

Leakage for bulk cargoes and breakage for dry bagged cargoes are estimated on the basis of normal conditions as follows:

(1) Dry ragged cargoes

- Ordinary export grade bags
- 20 tons containers
- Normal breakage

  Plastic resins: 0.6%
  Fertilizer: 0.8%

(2) Liquid cargoes

- Direct handling from carrier by a pipeline to storage in plant site
- Normal leakage

  Ordinary liquid cargoes: 0.4%
  High pressure cargoes: 0.8%

1.9 Importing Charges

(1) Interest 2 - 3%

(2) Importing charges

L/C opening charges: 0.3 - 0.5%
General expenses: 1.0 - 2.0%

(3) Importer's commission 3 - 7%

Depending on the imported item, the above charges are applicable; however, importer's commission is excluded in the event that such items to be imported are usually deemed to be imported directly by users and not through importers.

2. Estimates of FOB Prices

2.1 Raw Materials

As to the raw materials which are requested to be examined, LPG, which is not widely available for petrochemical industries in the Philippines, shall be imported from foreign country(ies).

The imported prices of naphtha to be compared with the prices of domestically produced naphtha to know the price position in the Philippines, is also assessed in this chapter.

Japan is importing LPG mainly from Mideast, and the price has recently been increased by the oil producing countries. The price of LPG from the Majors was also increased. The price of LPG once was approximately US$110/ton; however, it has now reached a level of US$120/ton for the Major Oils and US$128/ton for direct import LPG on the FOB basis.

The price level of US$120/ton will be taken as the price of LPG in the year 1974, and thereafter price escalation up to 1980 will be considered.

The naphtha price position is as described below. The following description has been made to compare the prices of domestic naphtha and imported naphtha prevailing in the Philippines. After the oil crisis, the price of naphtha has drastically been increased, and thereafter a stable level has been attained.

The price of naphtha is now at a level of US$27.9/gallon FOB Mideast (US$73.3/kl) for spot contracts. On the other hand, imported naphtha price in Japan is around US$80/kl on FOB Persian Gulf on long-term supply contracts; however, the price is now expected to decrease to the level of prevailing spot procurement. Therefore, the price level of US$73.7/kl is taken as the basic price for the year 1974.

2.2 Products

2.2.1 Assumption

As is described in Annex I, the prices in Japan will further dominate on the Prices in Asian countries. Therefore, the estimation is valde based on Japanese Prices. Assumptions to predict future price trend of petrochemical products are as mentioned below:

(1) Naphtha price in 1974 is ¥27,000/kl in Japan.

(2) Naphtha price increases by 7% per year after 1974.

(3) Utility cost increases with the rise of naphtha price.

(4) Costs of labour, interest, sales and administration, and profit increased by 50% during 1971 to mid-1974 and yearly by 7% thereafter.

(5) Price is estimated for products manufactured by the existing plants, and depreciation cost remains constant.

2.2.2 Ethylene

The equation for ethylene price, P_n (¥/kg), is as follows:

$$P_n = 82.08 \times (1.07)^n + 7.56 \quad (¥/kg)$$

where;
'n' stands for the year, e.g., 1975 = 1, 1976 = 2, 1977 = 3, etc.

Price of ethylene in each year up to 1981 calculated by above equation is shown below:

	(¥/kg)	(US$/ton)
1974	89.64	299
1975	95.40	318
1976	101.52	338
1977	108.12	360
1978	115.14	384
1979	122.67	409
1980	130.74	436
1981	139.36	465

2.2.3 LDPE

The equation for LDPE price, Pe_n (¥/kg) is described as follows:

$$Pe_n = 154.66 \times (1.07)^n + 40.00 \quad (¥/kg)$$

where, n indicates the year.

Price of LDPE in each year calculated by above equation is as follows:

	(¥/kg)	(US$/ton)
1974	194.66	649
1975	205.51	685
1976	217.06	724
1977	229.48	765
1978	235.42	785
1979	256.92	856
1980	272.11	907
1981	288.35	961

2.2.4 Aromatics

Price of reformate in the n th year is described by the following equation:

$$(REF)_n = 8.050 \times \{3.5788 \times (1.07)^n + 0.1788\} \quad (¥/kl)$$

a. BTX

$$(BTX)_n = REF_n \times \frac{1}{0.363} - 13,722 \times (1.07)^n - 4,322 \quad (¥/tonBTX)$$

$$B_n = BTX_n \times \frac{1}{1.045} \times 1.3 \quad (¥/ton)$$

$$T_n = BTX_n \times \frac{1}{1.045} \quad (¥/ton)$$

$$X_n = BTX_n \times \frac{1}{1.045} \quad (¥/ton)$$

b. Cyclohexane

$$(CX)_n = 0.93B_n + 17,405 \times (1.07)^n + 1,030 \quad (¥/ton)$$

c. p-Xylene

$$(PX)_n = 1.15X_n + 33,333 \times (1.07)^n + 14,922 \quad (¥/ton)$$

d. Acetaldehyde

$$(AL)_n = 80,613 \times (1.07)^n + 14,053 \quad (¥/ton)$$

e. Acetic Acid

$$(AA)_n = 0.765(AL)_n + 22,092 \times (1.07)^n + 5,614 \quad (¥/ton)$$

f. Methanol

$$(ME)_n = 42,789 \times (1.07)^n + 6,270 \quad (¥/ton)$$

g. DMT

$$(DMT)_n = 0.67(PX)_n + 0.36(ME)_n + 108,933 \times (1.07)^n + 25,438 \quad (¥/ton)$$

h. p-TPA

$$(TPA)_n = 0.719(PX)_n + 142,629 \times (1.07)^n + 14,724 \quad (¥/ton)$$

i. Caprolactam

$$L_n = CX_n + 13,068 \times (1.0487)^n + 151,185 \times (1.07)^n - 7,860 \quad (¥/ton)$$

Calculated results by equations mentioned above for aromatics are shown in Table APIII-2.

2.3 Estimated Prices in the Philippines

As the result of calculation based on the basic and premised condition as described in 2.1 and 2.2 of this Appendix, the CIF prices of such materials and products are estimated as shown in Table APIII-3.

Table APIII-2(1) FOB Price Forecast for Aromatics in Japan

(US$/ton)

	Reformate /kl	BTX	Benzene	Toluene	Xylene	Cyclo-hexane	p-Xylene	Methanol	DMT	p-TPA	Capro-lactam	Acet-aldehyde	Acetic Acid
1974	100	216	269	207	207	311	398	163	774	811	833	315	333
1975	107	232	289	222	222	335	424	173	820	863	893	334	353
1976	114	249	310	238	238	358	451	184	869	917	956	354	374
1977	122	266	331	255	255	383	479	195	921	976	1,024	376	396
1978	130	285	355	273	273	409	509	207	977	1,038	1,097	399	420
1979	139	305	380	292	292	438	541	220	1,036	1,105	1,174	423	446
1980	148	327	407	313	313	469	576	234	1,100	1,177	1,257	450	473
1981	159	350	435	335	335	501	613	249	1,168	1,253	1,345	478	502

Table APIII-2(2) FOB Price Forecast for Aromatics in Japan

(¥/ton)

	Reformate /kl	BTX	Benzene	Toluene	Xylene	Cyclo-hexane	p-Xylene	Methanol	DMT	p-TPA	Capro-lactam	Acet-aldehyde	Acetic Acid
1974	30,107	64,895	80,730	62,100	62,100	93,514	119,670	49,059	232,211	243,395	249,907	94,666	100,125
1975	32,265	69,879	86,932	66,870	66,870	100,500	127,489	52,054	246,153	259,002	268,111	100,308	105,968
1976	34,423	74,796	93,048	71,576	71,576	107,492	135,397	55,259	260,764	275,370	287,096	106,346	112,262
1977	36,732	80,058	99,593	76,610	76,610	114,974	143,859	58,688	276,400	292,885	307,394	112,807	118,975
1978	39,203	85,688	106,598	81,999	81,999	122,981	152,913	62,357	293,128	311,626	329,100	119,720	126,157
1979	41,846	91,710	114,088	87,760	87,760	131,544	162,598	66,283	311,025	331,676	352,304	127,116	133,843
1980	44,674	98,153	122,105	93,927	93,927	140,707	172,961	70,484	330,175	353,131	377,118	135,031	142,066
1981	47,700	105,048	130,681	100,524	100,524	150,512	184,050	74,979	350,667	376,086	403,651	143,499	150,866

Table APIII-3 List of Materials and Products Prices Estimated for the Year of 1980

CATEGORY	COMMODITY	IMPORTED			DOMESTIC		APPLICATION IN THE STUDY	NOTE
		PRICE (US$/T)		IMPORT OF ORIGIN	PRICE (US$/T)	ORIGIN		* Landed Price means Ex-customs gate price including all charges
		FOB	LANDED*					
OLEFINE RESINS	LDPE	907.-	1,489.-*	Japan	na	na	for comparison as products	* Ex-customs Gate Price imported by the local Importer
	HDPE				na	na		HDPE, PVC and PP will be calculated in the next study
	PVC				** na	** na		** No information is available for locally produced PVC
	PP				na	na		
MATERIALS AND INTERMEDIATES FOR SYNTHETIC FIBRES	BTX	327.-		Japan	na	na	for reference	* Based on pipeline handling from boat directly, imported by user
	Cyclohexane	469.-	*595.-	Japan	na	na	for comparison	
	P-Xylene	576.-	*725.-	Japan	na	na	as intermediate	** Dry cargo handling at Manila port in bagged-container base imported by local importer
							-"-	
	Acetaldehide	450.-		Japan	na	na	sub-material	
	Acetic Acid	473.-	*614.-	Japan	na	na	sub-material	
	Methanol	234.-	*431.-	Japan	na	na	sub-material	
	DMT	1,100.-	1,663.-**	Japan	na	na	for comparison	
	P-TPA	1,177.-	1,558.-**	Japan	na	na	for comparison	
	CAPROLACTAM	1,257.-	1,657.-**	Japan	na	na	for comparison	
	Benzene	407.-	*520.-	Japan	na	na	for reference	
	Toluene	313.-	*405.-	Japan	na	na	for reference	
RAW MATERIALS	Crude Oil	125.50	*163.-	Mid. East	na	na	as material	*Based on pipeline handling from boat directly, imported by user
	Naphtha	151.50	*230 -	Mid. East	274.-	FRC	as material	
	LPG	180.-	*350.-	Mid. East	252.-**	FRC	as material	**FRC's current selling price
	Fuel Oil (L.S.)				166.-	FRC	as material	
	Fuel Oil (H.S.)				131.-	FRC	as material	
	Gas Oil				211.-	FRC	as material	

Table APIII-3 List of Materials and Products Prices Estimated for the Year of 1980 (Continued)

BY-PRODUCTS	Methane				201.-	FRC	as by-product	
	Hydrogen				530.-	FRC	as by-product	
	Mixed C_3				251.-	FRC	as by-product	
	Mixed C_4				249.-	FRC	as by-product	
	Propylene				250.-	FRC	as by-product	
	Pyrolysis Gasoline				222.-	FRC	as by-product	
FERTILIZER	Urea	200.-	*328.-	Japan			for comparison	-* Dry cargo handling at Manila Port in bagged-container base
	Ammonia Sulfate	98.-	*179.-	Japan			as by-product	
OTHERS	Ammonia (liq.)	220.-	*308.-	Indonesia			for comparison	* handled by pipeline from boat In case imported by local consumer directly, it is 316.-
	Sulfuric Acid				76.-**	Various	as sub-material	** handled by pipeline from barge