PART I

INTRODUCTION

PART I INTRODUCTION

CHAPTER 1. OBJECTIVES AND SCOPE OF THE STUDY

1-1 Background and Objectives

As one of ASEAN Industrial Projects, the Government of the Federation of Malaysia has been making intensive efforts to develop a project (the Project) to establish a urea fertilizer complex in Malaysia with a joint investment by the ASEAN member countries. This Project is to produce urea by the use of natural gas produced at gas fields scattered offshore Bintulu, Sarawak in Malaysia, with the primary intent to supply this produced urea to the domestic Malaysian market and other ASEAN countries. It is also planned to produce ammonia needed for domestic use.

The Malaysian Government, as the host country for the development of this Project, has already appointed PETRONAS (state-owned petroleum corporation of Malaysia) as the execution agency for this Project (PETRONAS Project Team), made a feasibility study of the Project, and formulated a proposal on the basic scheme of the Project (as briefed in Chapter 3) on the basis of the aforesaid feasibility study. This proposal was presented at the Seventh ASEAN Economic Ministers Meeting held in Kuala Lumpur in December, 1978. As a result, the member countries have agreed in principle to take the necessary measures to implement the Project.

As one of the measures, in order to elaborate the bases of the Project, the Japanese Government was requested to assist in precisely reviewing and examining the details of the Project. Thus, Japan International Cooperation Agency (JICA) has undertaken this study. Under the foregoing background, this study focussed on reviewing and supplementing as necessary the feasibility study of this Project which had been carried out by the Malaysian Government, thereby thoroughly evaluating the feasibility of this Project. The Malaysian Government plans to build a fertilizer complex (the Ammonia and Urea Complex) capable of producing 1,000 tons per day of ammonia and 1,500 tons per day of urea. The study was based on the proposed plan except where revision or alteration were deemed necessary.

1-2 Scope of the Study

To meet the objectives of the study stated above, the scope of the study was broadly set out as follows:

A. Study of agriculture and fertilizer markets in Malaysia and other ASEAN countries

B. Study of organization and systems for marketing

C. Study on the supply of natural gas

D. Investigations of the Complex site conditions and evaluation of the proposed site

E. Study on the utilities supply and availability of infrastructure facilities

F. Examination and definition of plant facilities, including utilities and auxiliary facilities

G. Examination of technical and managerial aspects relating to the construction and operation of the Complex

H. Estimate of the capital cost required for the Complex, and financing plan

I. Projection of the manufacturing cost for ammonia and urea produced at the Complex

J. Financial projections and financial analysis of this Project

K. Economic evaluation of this Project

Detailed investigations and examinations were made concerning each of these elements. With regard to the investigation concerning the availability of natural gas, the Evaluation Study Team was not in a position to make its own estimate of the gas reserves. The Team generally evaluated the acceptability of the estimated figures by means of clarifying and

delineating the background of the reserve estimate officially adopted by the Malaysian Government.

CHAPTER 2 OUTLINE OF THE EXECUTION

2-1 Manner and Schedule

In due consideration of the importance of the Project, the JICA has organized an evaluation study team (the Evaluation Study Team) headed by Dr. Shigeo UEKI and consisting of other eleven experts*1) to undertake this study. The Evaluation Study Team accompanied by four officers in charge who were assigned from the ministries or agencies of the Japanese Government concerned, visited Malaysia for field surveys of 25 days beginning September 2, 1979. This study was made by a thorough investigation and examination of the findings, data and information obtained through the field surveys.

To assist the field surveys, a counterpart team was organized with the members consisting of staffs or experts nominated from PETRONAS.*2)

During the field surveys*3), the Evaluation Study Team collected and analyzed necessary data and information by co-working and discussing in detail with the Malaysian counterpart team. The Evaluation Study Team also made investigations on site conditions of the candidated site area and also the present status of the existing fertilizer plants and other related industries to identify underlying problems.

The market study group of the Evaluation Study Team visited the Philippines as well as Malaysia and, through cooperation of the government of the Philippines and its agencies, collected necessary data and information, while identifying underlying problems, relating to the fertilizer market and production in this country.

2-2 The Objectives of Study on Each of the Main Areas to be Studied

In light of the scope of this study stated in Section 1-2 of this Part I, the main areas to be studied may be classified as follows:

(Notes)
*1) Names of the members of the Evaluation Study Team are listed in Appendix I-1.
*2) Names of the members of the Malaysian counterpart team are listed in Appendix I-2.
*3) Names of the offices visited by the Evaluation Study Team are listed in Appendix I-3, and the schedule of the field surveys is shown in Appendix I-4.

A. Fertilizer markets

B. Natural gas supply

C. Technical aspects concerning the construction and management of the Ammonia and Urea Complex and related facilities

D. Capital requirement of the Project and financing plan

E. Financial projections and analysis, and economic evaluation of the Project

F. Overall evaluation of this Project

The objectives of study on each of these areas are set out as follows:

1) Study of fertilizer markets and distribution aspects

The primary objective of the study on fertilizer markets was to examine the possibilities of marketing to Malaysia and other ASEAN countries of the urea produced at the Complex. In addition to this study, the Evaluation Study Team also examined the possibilities of exporting urea outside the ASEAN region, presuming that all the output of the plant cannot be absorbed within the ASEAN region. Thus, the Team attempted its projection on marketable quantity of the products, and thereby evaluated the feasibility of this Project from the viewpoint of marketing.

As a basis for a projection on the future outlook of urea markets in ASEAN countries, the Evaluation Study Team forecast the future supply/demand balance of urea, in ASEAN countries, where an assumption was made that, while this Complex will commence commercial production in early 1984, another ASEAN urea project in Indonesia will also start commercial operation during 1983. Further, the Team attempted to make a prediction on the future tendency of international urea price which is used as a basis for the financial evaluation of this Project. The outcome of these studies are described in Part II and Appendix II of this report.

2) Study of the natural gas supply

It has been decided that natural gas which is used for the feedstock and fuel in this Complex will be supplied from the Central Luconia fields offshore Bintulu in the State of Sarawak. The majority of the gas produced at this gas fields is appropriated to LNG and remaining gas should be appropriated to this Project. In recognizing this situation, the study on this gas aspects focussed on the confirmation of the availability of gas for long-term supply and also to clarify the conditions on gas supply to this Complex, including the following aspects in particular:

(a) The confirmation of the recoverable gas reserves of the Central Luconia gas fields, the outcome of these studies are described in Part III and Appendix III of this report.

(b) The clarification and confirmation of projected gas demand for a long-term period.

(c) The confirmation of composition of gas to be supplied, and its supply conditions.

(d) The confirmation of plans regarding gas supply facilities.

It must be noted, however, that since the Evaluation Study Team was not in a position, as stated in Section 1–2 above, to make its own estimation of the recoverable gas reserves, the confirmation of the recoverable gas reserves was made by employing the figures officially adopted by the Malaysian Government, while evaluating in broad terms the acceptability of these figures by means of clarifying and delineating the background of this estimate.

3) Investigations of the technical aspects

For a proximity to the suppy source of natural gas, the location of the Complex should be in the Bintulu area. The Evaluation Study Team investigated site conditions of the site area which had already been selected by PETRONAS Project Team and, on the basis of findings or site investigations, examined the following aspects:

(a) Evaluation of suitability of the selected site of the Complex

(b) Possibilities of utilities supply and availability of infrastructure

(c) Definition and conceptional design of plant facilities for the Complex

(d) Planning of project implementation systems and programs

(e) Examination of organization and manpower requirement for project implementation as well as management and operation of the Complex

As the result of these investigation and examination, technical feasibility of this Project was evaluated. The outcome is stated in Part IV and Appendix IV of this report.

4) Estimate of the capital requirements and projection of financing plan

On the basis of the scope and scheme of the Project defined as the result of studies mentioned in Paragraph 3) above, the Evaluation Study Team estimated the capital requirements for this Project and then formulated a financing plan. These are compiled in Part V of this report.

5) Financial analysis and economic evaluation

On the basis of the projected capital requirements as stated above, the Evaluation Study Team estimated the manufacturing cost of the ammonia and urea produced at the Complex, and then made the financial projections and analysis as well as the economic evaluation of this Project, including the assessment of financial returns, analysis of financial structure and economic effect of the Project. The outcome of these analyses are compiled in Parts VI and VII of this report. Details of financial statements and financial indicators projected for this Project are attached as Attachment of Part VI.

CHAPTER 3 BASIC AGREEMENT AMONG ASEAN MEMBER STATES CONCERNING FUNDAMENTAL ASPECTS OF THIS PROJECT, AND PRESENT STATUS OF PROJECT PREPARATION

The basic conditions and structure for the development of this Project have already been established through discussions and agreements made among the governments of ASEAN member states. This chapter summarizes these conditions and structure in accordance with information provided by the Malaysian Government in the course of this study, a copy of which is attached as Appendix I-6.

3-1 General

The basic policy on the development of this Project had been agreed on at the Seventh ASEAN Economic Ministers Meeting held in Kuala Lumpur, in December, 1978. Since then, various issues concerning the Project have been discussed at subsequent Economic Ministers Meeting and/or ASEAN Expert Meeting, and the ASEAN member states have reached an agreement concerning the framework as summarized in the following sections.

3-2 Execution Entity of this Project

The ASEAN member states will establish a joint-venture company in Malaysia to engage in the implementation of the Project. The company will be incorporated with joint investment of these states under the relevant laws in force in the Federation of Malaysia. The outline of the company is as follows:

(1) Equity capital:

Equivalent to 30% of the total capital required. (The total capital budget required for this Project will be determined on the basis of the outcome of this study.)

(2) Ownership:

Percentage of ownership among ASEAN states is as follows:

Malaysia	60%
Indonesia	13%
Philippines	13%
Singapore	1%
Thailand	13%
	100%

(3) Manner of subscription:

The respective governments of the ASEAN states have appointed a shareholding entity of the company in each country. These appointed shareholding entities are all the shareholders for P.T. ASEAN Aceh Fertilizer Co., which as the first ASEAN project, has been established in Indonesia to engage in the manufacture of urea. Each shareholding entity will subscribe to equity shares in accordance with the percentage of the company's ownership mentioned above.

The Malaysian Government appointed Petroliam Nasional Berhad (PETRONAS), the state-owned petroleum corporation, the executing agency to promote and execute this Project.

3-3 Establishment of the Company

The basic agreement for the development of ASEAN Industrial Projects and its supplemental agreement regarding this Project, have been agreed among the ASEAN member states. The preparation work for establishing the joint-venture company is now being proceeded by PETRONAS Project Team and other shareholding entities. The first shareholders meeting was held in Kuala Lumpur in July, 1979. Subsequent meetings will be held from time to time as required. As soon as the capital requirement for the Project is finalized, the joint-venture agreement and the articles of association regarding this Project will be executed by the shareholding entities, and a joint-venture company will be established accordingly.

3-4 Agreements on Other Fundamental Issues

Agreements have already been made on supply of natural gas, marketing of products and other fundamental issues for the Project as well. Details of these agreements are described respectively in Part II and subsequent parts of this report.

3-5 Present Status of Project Preparation

A project team has been formed, primarily of staff members of PETRONAS's Processing and Manufacturing Division, for the purpose of promoting this Project, and is presently engaged in that work. The major tasks facing PETRONAS Project Team - either currently or in the near future - with regard to this Project would be the following:

(1) Final work on drafting the "Basic Agreement on Establishment of the Joint Venture Company" as well as the "Articles of Association".

(2) Engaging the services of a qualified technical consultant as well as preparation - with the assistance of the consultant - of the tender documents for selection of the process and contractor, and formulation of the detailed implementation budget.

(3) Conducting the soil and subsoil investigations prior to acquisition of land for the site; site development. (Jurutera Konsultant has already been appointed to do the soil and subsoil investigations, and is now at work on that.)

(4) Formulation of a detailed marketing and distribution plan for ammonia and urea in Malaysia. It is intended that this work will be undertaken by a marketing company, to be set up by PETRONAS and to be 100% owned by PETRONAS. PETRONAS Project Team intends to engage an internationally-experienced consultant in connection with the preparation of the marketing and distribution plan, and intends to make the selection of that consultant in the near future.

PART II

MARKET STUDY

PART II MARKET STUDY

CHAPTER 1 INTRODUCTION

The end products of this Project to be produced for sale are approximately 446,000 tons a year of urea and approximately 39,000 tons a year of ammonia. Marketing arrangements for these products which have been agreed by the ASEAN Economic Ministers are as follows:

(1) The Project will have priority right to supply the produced urea to the domestic Malaysia market and the available ASEAN markets*); the requirements of the available ASEAN markets are to be met by equal shares of urea from the Malaysian Project and the ASEAN Aceh Urea Complex in Indonesia.

(2) Off-taking of urea from this Ammonia and Urea Complex by ASEAN countries will be arranged in accordance with the Preferential Trading Arrangements among ASEAN member states.

(3) The price of urea will be set at international market prices, in terms of free-on-board, within the range of floor and ceiling prices which will be set in accordance with minimum and maximum project rates of return.

(4) In the event that there is surplus producton from the Complex, Malaysia will guarantee to absorb the surplus production at the agreed formula price, and supply it to the domestic markets, markets outside ASEAN countries, or both.

Under the above arrangements, PETRONAS, as the executing agency for the Malaysian Government related to this Project, will be responsible to take off from the Complex all urea remaining after purchases by other ASEAN countries, and to absorb it by sale to the domestic Malaysian markets and markets outside the ASEAN region. In connection with this Project, the

(Note) *) The Agreement on the establishment of the Project defines the meaning of "available ASEAN markets" as follows:

(a) the markets in the Philippines and Thailand after considering their own domestic production of urea, and
(b) the market in Indonesia if there is insufficient production of urea in Indonesia.

PETRONAS Project Team plans to establish a new marketing company which will be engaged in the marketing and distribution.

The marketing arrangements agreed by the ASEAN Economic Ministers include no statement with regard to marketing of ammonia produced by the Complex. Nevertheless, PETRONAS's policy is to supply the ammonia only to the domestic Malaysian markets, and intends to have the marketing company follow this policy.

Given this background, the major questions which may be raised in evaluating the feasibility of this Project would be as follows:

1) Whether markets in Malaysia and other ASEAN countries are likely to have a total demand sufficient to absorb the quantity of urea to be produced by the Complex in the future.

2) Whether markets in Malaysia are likely to have total demand sufficient to absorb the quantity of ammonia to be produced by the Complex in the future. What is the outlook for the marketing of ammonia.

3) Price trends of ammonia and urea in the future.

With the objectives of clarifying the above questions, the Evaluation Study Team studied the fertilizer markets in Malaysia and other ASEAN countries. This market studies focussed on the following aspects in particular:

(1) The outlook for demand for ammonia and urea in the ASEAN countries, and also the outlook regarding the quantities of the Complex's products which Malaysia and the other ASEAN countries will be able to absorb (Chapters 2 and 3).

(2) Projections of international market price trends of ammonia and urea (Chapter 4).

(3) Given the assumption that the ammonia and urea produced by the Complex cannot be entirely sold in Malaysia and the ASEAN markets, investigation on the matter of whether it will be possible to export the products to countries other than the ASEAN members, from the viewpoints of price competitiveness and the presence of effective demand (Chapter 5).

(4) Projection of possible sales quantity of the products which would be required for the sale of the Complex's products (Chapter 5).

With regard to the above subjects, the Evaluation Study Team's observations, projections, and recommendations are provided in the following chapters.

CHAPTER 2 SUPPLY AND DEMAND CONDITIONS FOR AMMONIA AND UREA IN MALAYSIA IN THE PRESENT AND FUTURE

2-1 Malaysian Agriculture

Approximately 80% of Malaysia's arable land is in Peninsular Malaysia, and of the remainder about 12% is in the State of Sarawak and about 8% is in the State of Sabah.

Malaysia's principal agricultural crops are rubber, oil palm and padi. Of the total land area of West Malaysia, approximately 60% is used for rubber cultivation, and 15% is used for oil palm, while 13% is used to grow padi. Other crops include coconut, cocoa, vegetables, sugarcane, tobacco, tapioca and pineapple (see Table II-1).

From the standpoint of farm management, Malaysia's agricultural sector is divided into the estates sector and the smallholders sector. By statistical definition, a smallholding is a holding of 100 acres (about 40 ha) or less of cultivated land. However, the estates, in contrast to these, are for the most part large-scale commercial operations. About 30% of West Malaysia's cultivated land is within estates, leaving the remaining 70% as the area of the smallholders sector.

With the objective of improving the level of income in the smallholders sector, the Federal and State governments are carrying out a variety of governmental farming schemes. These schemes account for more than 30% of the smallholders' land area (see Table II-1). The method of farm management used by smallholders who participate in these schemes is more modern than that usually used by smallholders, and in this sense, the schemes may be said to be creating a third sector in agriculture.

To achieve the basic measures set for the development of agriculture, which are to improve farm income through raising productivity and creating employment opportunities, these schemes comprise the following three types:

1) Rehabilitation of existing farm land, and improvement of farm operation

2) Development of new farm land

3) Provision of suitable agricultural support services

Among these, the improvement of existing farmland and farm operation has been given the greatest priority, and progress is being made accordingly, in regard to such activities as replanting of rubber, improvement of irrigation and drainage systems, and diversification of crops.

Along with the expansion of areas covered by these schemes, the consumption of fertilizers has increased conspicuously in recent years.

2-2 Present Conditions and Outlook for Supply and Demand of Urea

2-2-1 Present conditions

Malaysia at present is totally dependent on imports for her supply of urea; the volume of imports in recent years is as shown below.

Malaysia's Urea Imports

(Unit: ton[1])

Year	W. Malaysia	Sabah	Sarawak
1970-1975 avr.	53,130	N.A.	1,676
1976	81,042	751	1,360
1977	88,680	814	N.A.
1978	80,861	N.A.	N.A.
1979 (Jan.- Apr.)	83,988	N.A.	N.A.

Notes: 1) Tons of urea. In the case of nitrogen nutrient tons, it is expressed by "N tons" in this report.

2) N.A.; Not available.

In the case of West Malaysia, imports of urea during 1970-1975 averaged 53,000 t/y, but in 1976-1978 increased to the annual average of 84,000 tons. In 1979, the imports amounted to 84,000 tons in the four months of January - April, and, further, reportedly exceeded 170,000 tons by the end of 1979. The imports of urea, as is shown in the above, has been increasing rapidly in the recent past. It must be noted, however, that the trends of imports are not always coincidental with those of actual consumption.

Especially for 1979, without confirmation of the actual consumption, it is hasty to conclude that the consumption has grown to a great extent, because it seems that importers imported a large quantity of urea beyond immediate requirements due to fear of a possible price hike of fertilizers which may be caused by increases in oil prices.

The following observations may be made concerning consumption of nitrogen fertilizer in West Malaysia, on the basis of Table II-2, which shows consumption and potential demand for nitrogen fertilizer in Malaysia in 1974. (For the assumptions taken for the estimation of consumption and potential demand, see Appendix II-1.)

(1) Of the potential demand for nitrogen fertilizers, 33% each was for padi and rubber, 26% for oil palm and 8% for all other crops.

(2) The pattern of actual consumption is different from that of potential demand. In the actual consumption, the most important crop is oil palm, accounting for 35% of the total consumption, followed by rubber the consumption for which accounts for 34%. The consumption for padi accounts only for 21% of the total. It is a general tendency that farmers use fertilizers at the levels of recommended dosages or lower than those levels. There are several factors which affect the level of fertilizer application, of which the most important are:

(a) Degree of farmers' knowledge of proper ways of fertilizer application and also of the effects of using fertilizers.

(b) Facilities for farmers to buy fertilizers (such as existence of fertilizer retail outlets in adjacent areas, and credit facilities for buying fertilizers).

(c) Economic incentives which stimulate farmers to use fertilizers.

If the prevailing conditions for the above factors are unsatisfactory, the level of actual consumption would be at a level lower than that of potential demand. The ratio of actual to potential use is about 80% in the case of oil palm, but 60% for rubber and only 37% for padi. Generally, the ratio is fairly high in the estates sector and low in the smallholders sector.

In the case of oil palm, cultivation is being done in both estates and smallholders sectors, and almost all of the smallholders who are cultivating oil palm are

participating in government schemes. Therefore, there is a high degree of use of fertilizer by these smallholders, and the level of application is closer to the level in the estates sector than that is observed in the case of other crops.

In fact, most of smallholders use fertilizers during the first six years after replanting, because the smallholders who have replanted old trees under the RISDA's schemes are provided with subsidies to compensate them for the cost of replanting including that spent for the use of fertilizers. After that, however, they ordinarily stop using fertilizers as no subsidies are provided.

For padi, use of fertilizer is relatively high in the regions in which governmental irrigation schemes are being implemented and also in the periphery of such areas, but in regions other than these use of fertilizer cannot be said to be at adequate levels.

(3) The total consumption of nitrogen fertilizer in 1974 increased by 1.5 times compared to that in 1970, in which the highest increase was shown in consumption for oil palm (2.4 times), followed by consumption for rubber (1.3 times) and padi (1.1 times).

Increases in fertilizer consumption are derived from the following two factors, namely, expansion in cultivated areas and increases in per hectare consumption of fertilizers. Use of fertilizer for oil palm has increased especially because of an increase in the area used for cultivating these trees. In the case of rubber, whereas a sudden increase in nitrogen fertilizer consumption was shown in 1974, the consumption tended to be static during the last decade.

For padi, consumption of nitrogen fertilizer continued to increase gradually in the last few years, due to an increase in cultivated area occasioned by the expansion of double cropping area which is supported by the expansion of irrigated area and also to wider diffusion of varieties which require higher levels of fertilizer.

(4) The pattern of consumption of nitrogen fertilizer by type of fertilizer presents the following picture. Consumption in the form of NPK fertilizers (as complex fertilizer or mixed fertilizer) is highest, accounting for 73% of total nitrogen consumption, and nitrogen consumed as urea (straight fertilizer) accounts for 18%. The remaining 9% was consumed in the form of straight fertilizers other than urea (such as

ammonium nitrate and ammonium sulphate).

For padi, use of urea as straight fertilizer is the most common form, accounting for 75% of total nitrogen consumed for padi, and the remainder is applied as NPK fertilizers. In the case of oil palm, although only small quantities of urea as straight fertilizer are applied to the immature trees which are grown in coastal soil, the bulk of nitrogen fertilizer for oil palm is used as NPK. No urea fertilizer is used for rubber for fear of volatilization of nitrogen. Concerning other crops, urea as straight fertilizer is used for pineapple, but for most other crops NPK is the most used form of nitrogen fertilizer.

Urea can be used as the nitrogen source in NPK fertilizer for padi in all regions, and for oil palm in coastal soil. Consumption of urea-based NPK fertilizer accounts for about 20% of total consumption of NPK fertilizers.

(5) The situation described above concerning the supply, distribution and consumption of nitrogen for fertilizer and industrial uses may be schematically depicted as shown in the diagram on the following page.

2-2-2 Supply and demand outlook

(1) Outlook for demand

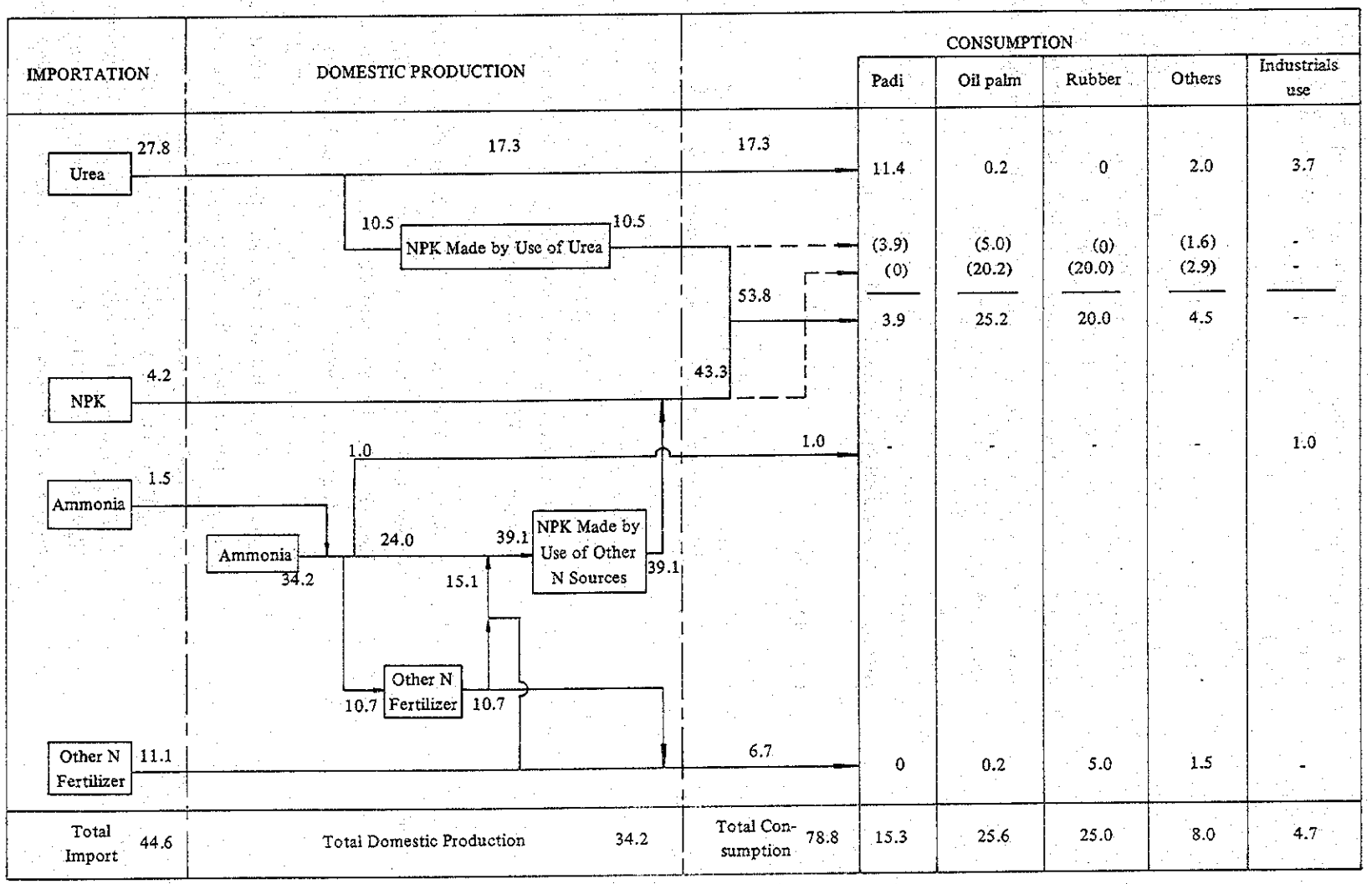
The outlook for demand for urea, as presented in this section, was projected with the objective of gaining an understanding of the most likely sales amount of urea for this Project. In this context, in order to avoid over-estimate of possible demand increase in the future, the projection of demand for urea was made on a conservative basis by means of taking into account only increases which are assured to take place during the projection period.

1) Volume of demand for nitrogen fertilizer

The projected demand for nitrogen fertilizer, by crop, is given in Table II-3. (As for the method and the assumed factors used in the demand projection, see Appendix II-1.) Total demand for all Malaysia was 83,000 tons of nitrogen in 1974, and is expected to increase 1.8 times to 150,000 N tons in 1985, and 2.2 times the 1974 level to 179,000 N tons in 1990. In terms of

SUPPLY, DISTRIBUTION AND CONSUMPTION OF NITROGENOUS FERTILIZER IN WEST MALAYSIA

(Unit: N'000 ton)



average annual rate of increase, these quantities mean the growth at the rate of 6.8% p.a. for 1974-1980, 4.1% p.a. for 1980-1985, and 3.6% p.a. for 1985-1990.

The strongest increase in demand for nitrogen fertilizer in West Malaysia will be for oil palm; such demand is expected to increase at the rate of 7.8% p.a. during 1974-1990. Second strongest growth in demand will be that for padi, at 6.8% p.a. for the same period. In contrast to that, it is expected that the demand for use for rubber will decrease. As a result, in 1990, the composition of total West Malaysian consumption of nitrogen fertilizer will be: oil palm, 55%; padi, 28%; rubber, 10%; others, 7%.

The following are the major factors which will cause change in the quantity of nitrogen fertilizer demand, for each of these crops:

(a) Oil palm

(i) Increase in the quantity of nitrogen fertilizer demand for oil palm (for the 16-year period 1974-1990, an increase of 3.3 times, or 7.8% p.a.) will be primarily ascribable to increase in the planted area for oil palm. From 1974 to 1990 it is expected that the planted area will increase by 3% p.a., or 1.6 times in the estates sector, while oil palm area in the smallholders sector will increase by 10% p.a., or 4.8 times.

(ii) In addition to increase in the total oil palm area in both sectors, there will be an increase in the area of mature trees. (In 1974, 53% of oil palm area was occupied by mature trees, but it is expected that in 1990 the percentage will be 87%.) In the case of mature trees, the recommended fertilizer application level per hectare is twice that of immature trees. It is usual that in the case of mature trees the proportion of fertilized area is lower than that of immature trees. Even if this factor is taken into account, the quantity of nitrogen fertilizer applied to a hectare of mature trees, in average, will be about 1.3 times that of immature trees. Thus, the increase in the percentage of area planted with mature trees will serve to increase demand for

nitrogen fertilizer.

(b) Padi

(i) The major causes of increase in nitrogen fertilizer demand for padi are as follows:

- Although a significant increase in the cultivated area for padi is not expected, there will be expansion of gross cultivated area due to the increase in double cropping area supported by improvement of irrigation systems, and greater diffusion of early-maturing, improved varieties.

- There will be an increase in use of fertilizer per hectare due to increased planting of improved varieties which have high yields with heavy fertilizer application.

- As a consequence of government activities, the number of farmers participating in irrigation schemes is increasing, and knowledge of fertilizer application techniques as well as of fertilizer effects is increasing among the farmers; moreover, for farmers participating in government schemes, subsidies for buying fertilizer come close to covering the total cost of fertilizer.

(ii) Diffusion of use of fertilizer for padi rapidly increased from 1974 to 1980, and will grow thereafter although at a somewhat lower rate. As a consequence, whereas the ratio of actual to potential demand was 38% in 1970 and 37% in 1974, it will rise to 70% in 1980, and 90% in 1990. It is observed that the rapid increase in diffusion of fertilizer use which took place in the late 1970's was largely attributed to expansion of fertilizer subsidy schemes as mentioned above.

(c) Rubber

(i) Consumption of nitrogen fertilizer for rubber, unlike the situa-

tion concerning oil palm and padi, will decrease. In the estates sector, there is an ongoing trend to convert from rubber to oil palm and other crops. As a result, in 1980 the planted area for rubber trees in the estates sector will decline to 91% of the area in 1975, after which there will be further declines, to 86% in 1985 and 84% in 1990. In comparison to this, up to recent times, the smallholders sector has continued to show slight increases in the planted area, which resulted in the total planted area for both sector remaining substantially unchanged. However, recently there has been an increase in the smallholders sector of the practice of planting other crops (such as oil palm), instead of replanting rubber trees. This trend can lead, in the future, to a decrease, although small, in the smallholders' rubber area as well. It is estimated that the total area for rubber covering both sectors of the estates and smallholders will decrease to 94% in 1980, 93% in 1985 and 93% in 1990, taking the area in 1970 as equal to 100%.

(ii) There are two major factors attributed as causes of this decrease in demand for nitrogen fertilizer. These are:

- Decline in the proportion of the area for immature trees in the total rubber area.

- Decline in the proportion of the area of mature trees aged at 6 to 20 years in the total rubber area.

The optimum dosage for application of nitrogen fertilizer for rubber, per hectare, is 40 N kg for mature trees and 35 N kg for immature trees. Whereas both estates and smallholders tend to follow a recommended dosage in the application of fertilizer for immature trees, for mature trees they apply fertilizer at a rate lower than the recommended dosage. In the case of the estates sector, the level of actual application is about 75% of potential level. In the smallholders sector, because the RISDA's replanting subsidy ends at 6 years after replanting, there are almost no instances of application of fertilizer to mature trees. Therefore,

even if there is no change in the total planted area for rubber, any decreases in the proportion of area planted with immature trees would result in a decrease in the volume of fertilizer demand.

For mature trees, application of fertilizer yields beneficial effects for those aged at 6 to 20 years, so there is no reason to expect fertilizer to be used for trees older than 21 years. For this reason, even if the total area for mature trees is unchanged, a decrease in the percentage of area occupied by trees aged at 6 - 20 years will result in a decrease in demand for nitrogen fertilizer.

Demand for nitrogen fertilizer in Sabah, as shown in Table II-3, is expected to increase from the level of 1974, which was 5,100 N tons, by 1.5 times to 7,800 N tons in 1980, by 2.1 times to 10,600 N tons in 1985, and by 2.7 times to 13,800 N tons in 1990. By crop, demand volume in 1990 relative to that in 1974 is expected to show increases of 3.5 times in the case of padi, 2.5 times in the case of oil palm, and 1.4 times in the case of rubber.

The major causes of this expansion of demand are:

- In the case of oil palm, an increase in planted area due to the expansion of the government land development schemes.

- In the case of padi, an increase in gross cropping area as a result of the promotion of double cropping as well as fertilizer subsidy schemes.

Demand for nitrogen fertilizer in Sarawak, relative to the volume of consumption in 1974, 3,700 N tons, will increase by 1.7 times to 6,400 N tons in 1980, by 2.1 times to 7,600 N tons in 1985, and by 2.4 times to 9,000 N tons in 1990.

At present in Sarawak farmers use nitrogen fertilizer mostly for growing pepper, the consumption for which accounts for about 60% of the total in the state. It is likely that there will be no great change in this pattern in the future, although the position of pepper in fertilizer consumption will show a gradual decline. It is projected that in 1990 nitrogen consumption for pepper will account for 45% of the total. The present consumption of nitrogen fertilizer for padi accounts for about 10% of the whole in Sarawak. It is unlikely that there will be an increase in the cropping area for padi in the

future, but it is expected that the demand for this crop will increase by about 7.3 times the 1974 level, by 1990, because of increases in subsidies for purchase of fertilizer.

2) Demand for urea

The consumption of urea in Malaysia was 63,000 tons in 1974; it is expected to increase to 118,000 tons in 1980, 152,000 tons in 1985, and 184,000 tons in 1990. In terms of average annual rate of growth, this works out to 11% p.a. for 1974-1980, 5% p.a. for 1980-1985, and 4% p.a. for 1985-1990. Thus, growth will be particularly rapid from 1974 to 1980.

There are two areas of urea use prevailing in Malaysia. One is that of fertilizer use either as straight fertilizers or as raw material for production of NPK fertilizer. Another is that of industrial use, which is mainly use as raw material for production of urea-formaldehyde adhesives.

More than 90% of urea used as straight fertilizer, which accounts for the majority of urea for fertilizer use, is for padi. Therefore increased diffusion of the practice of applying nitrogen fertilizers to padi during 1974-1980 was responsible for the major part of the increase in urea demand during those years.

Urea-based NPK fertilizer is used mainly for oil palm and padi. Although it is possible for urea to be used for all NPK fertilizer applied to padi, in the case of oil palm, urea can be used in NPK fertilizer only for oil palm being grown in the coastal soil region. It is estimated that this region accounts for 25% of total land area used for oil palm cultivation.

The projection of demand for urea in this study was made by taking into account the present situation and expected changes in the above described factors in respective types of end use.

When investigating the outlook for demand for urea to be used to make NPK fertilizer, attention has been given to the following points concerning the present conditions of the NPK fertilizer industry in Malaysia:

(i) There are three categories of supply source of NPK fertilizer in Malaysia:

(a) Imported complex fertilizer

(b) Complex fertilizer made by CCM from ammonium nitrate as nitrogen source

(c) Mixed fertilizer made by domestic small-scale mixturers by mixing imported or domestic produced ammonium nitrate, ammonium sulphate, urea, rock phosphate, and potash

Of the above three types of NPK fertilizer supplies, only (c), local mixturers, are prospective users of urea. If there are mixing plants with sufficient capacity to meet requirements, increases in demand for NPK fertilizer would effect an increase in demand for urea. However, if demands for NPK fertilizer are met by imports, there may be no increase in demand for urea to be used for mixtures.

The above projection was made on the assumption that the capacity of mixing plants will be expanded so that all of the NPK fertilizer which can be made using urea as the nitrogen source is produced in Malaysia. However, attention must be given to the underlying problems mentioned belows.

(ii) The present situation is that imported complex fertilizer and domestic mixed fertilizer are competing in the Malaysian market. Domestic mixed fertilizer, however, has an edge over imported complex fertilizer in terms of price. Specifically, in both West Malaysia and East Malaysia mixed fertilizer is priced at about M$490/ton, whereas imported complex fertilizer with the same composition is priced at about M$ 600 - 680/ton (1979 prices).

Nevertheless, farmers show a strong preference for complex fertilizer, because presently marketed mixed fertilizer is inferior to complex fertilizer in quality. For most instances, the mixed fertilizer easily absorbs moisture and becomes lumpy, and hence farmers often face difficulty in broadcasting the mixed fertilizer. Further, the mixed fertilizer has less-uniform nutrients content compared to complex fertilizer, because segregation of the materials contained in the mixed fertilizer often occurs.

Improvement of the quality of local mixtures is an essential requirement if their share should be increased. It would be necessary that adequate technical assistance or guidance be made to local mixturers, in order to promote the consumption of urea-based mixtures.

There are a number of mixing plants scattered throughout the country; their capacity is different from one to another (a small one being in the scale of about 5 - 6 tons in a batch) and, further, their operating rates vary greatly depending on the extent of orders in hand. Although there are no statistics showing accurate figures for the existing capacity of mixing plants in Malaysia, it is estimated that their capacity was about 200,000 t/y (equivalent to 30,000 N tons) in 1975. Production in 1974 was recorded as being on the order of about 170,000 tons.

It is estimated that capacity requirements for mixing plants should be increased to 207,000 t/y by 1980, 256,000 t/y by 1985 and 295,000 t/y by 1990, in order that demands for NPK fertilizer be met by local mixtures using domestically produced nitrogen fertilizer (urea, ammonium sulphate and ammonium nitrate) to the maximum extent possible, and that the importation of NPK fertilizer be done only to supplement the demands which cannot be met by the local mixtures. To increase the capacity of mixing plants as mentioned above would be prerequisite for mixed fertilizer to expand its share in NPK fertilizer demands. Nevertheless it is reasonable to presume that such expansion be made in time; in fact it is likely that local mixturers will expand their facilities along with the increase in the demand, since capital costs needed for expansion are so small that even the small private mixturers can afford to meet the requirement using their own funds.

At present urea is not being used either for rubber or oil palm planted in inland regions, in either straight form or as the nitrogen in NPK fertilizer. This is due to the prevailing idea in Malaysia, which is that because nitrogen volatilization in urea is extremely rapid, application of urea would result in nitrogen loss about 20% higher than when applying other types of nitrogen fertilizer. The present projection in this study was made on the assumption that this pattern of preference will still persist in the future.

Recently there has been some movement toward use of urea for rubber and oil palm, because the price of urea has become relatively low as compared to that of other types of nitrogen fertilizer in terms of same volume of nitrogen nutrient. (For example, in 1978, on a tender price basis, prices per kilogram nitrogen were: urea, M$1.35; ammonium sulphate, M$1.99; ammonium nitrate, M$2.38.) Instances of this movement are as follows:

(i) FERDA is going to recommend the use of urea for oil palm and rubber based on its judgement that urea is still economical to use even with application increased by 20% to make up for nitrogen loss.

(ii) RRIM is proceeding with development of rubber-coated urea. RRIM expects that if this coated urea is commercialized, it will protect urea from volatilization to decrease nitrogen loss to a level below that of other nitrogen fertilizer.

These are the factors which could obviously serve to promote increases in demand for urea. However, they are still at a trial stage and hence in the demand projection the Evaluation Study Team did not take these factors into account.

(2) Outlook for supply

Other than the Ammonia and Urea Compelx now being planned for Bintulu, there are no plans for starting urea production in Malaysia.

The production of urea in the Ammonia and Urea Complex is projected as follows (for details, see Part IV):

1984	288,800 t/y	Operating at 70% of capacity for 10 months
1985	396,000 t/y	Operating at 80% of capacity for 12 months
1986 on	445,500 t/y	Operating at 90% of capacity for 12 months

The outlook for supply/demand of urea in Malaysia is as shown in Table II-4. This projection is based on the above projection of urea production, while taking into account the demand projection discussed in the previous paragraph.

This projection indicates that in the first year of operation of the Complex, starting in 1984, of the 288,800 tons of urea produced, there will be a surplus of 114,400 tons, and as the rate of operation is increased in subsequent years the magnitude of this surplus will increase, to the level of 283,200 tons in 1986; however, after 1986, the surplus will decrease year after year to 261,300 tons in 1990, because the demand will continue to grow whereas the production volume will be maintained in the same as in 1986.

The demand projection used here, as was stated in (1) of 2-2-2, was made by taking into account only the factors which were believed to firmly effect increases in urea demand. In this context, such factors as possible use of urea for oil palm and rubber, thereby replacing other types of nitrogen fertilizer, were not taken into account in the above projection.

However, it is obvious that the urea demand will be increased to a great extent if the use of urea for oil palm and rubber is expanded. As a hypothesis, it is projected that there will be additional urea demand of 59,300 tons in 1985, if the use of urea for these crops would be expanded to 50% and 30% of nitrogen fertilizer used respectively for oil palm and rubber. As such, it is noted that there is a great possibility that the urea demand will increase more than the projected, if adequate measures are taken for promotion of urea application for these crops.

2-3 Presnet Conditions and Outlook for Supply and Demand of Ammonia

2-3-1 Present conditions

The major areas of demand for ammonia in Malaysia are as follows:

For fertilizer use:

CCM;	For use in producing ammonium nitrate and NPK
FFC;	For use in producing ammonium sulphate

For other uses:

Ajinomoto;	For use in producing monosodium glutamate
Others;	For use in processing rubber

Ammonia is now being produced by only one company in Malaysia, Esso Malaysia, and shortfalls in Malaysia's requirements are countered by means of imports.

Estimated demand for ammonia in Malaysia for 1971-1975 is shown in Table II-5. Import quantity varied year by year according to domestic production and consumption levels in the respective years. Further, the rapid increase in the import price of ammonia in 1973-1975 served to stimulate domestic production, causing dependence on domestic supply to rise. With the exception of this unusual period, it may be said that the level of Malaysia's import demand of ammonia is estimated to be 10,000 tons, which is equivalent to about 8,000 N tons.

2-3-2 Supply and demand outlook

If the production and demand of ammonia in this Project is put aside, the following are the major factors which may affect the future supply/demand of ammonia in Malaysia:

(i) Although FFC has two trains for production of ammonium sulphate (each train having 120 t/d production capacity), up to the present time FFC has operated only one train because of instability of ammonia supply and the low price of imported ammonium sulphate. However, it is planned to relocate one train in Butterworth in order to enter the market in the northern region. Therefore it may be expected that in the future there will be an improvement of the production level of ammonium sulphate in comparison to that of the present.

(ii) Ajinomoto (Malaysia) Berhad expects that demand for its products will increase in the future in accompaniment with population growth and the improvement of personal income, and has already increased production capacity in anticipation of future growth of demand. Therefore, as Ajinomoto increases its production, there will result in an increase, although slight, in ammonia demand.

CCM, the largest user, at present has no plans for building new facilities or expanding existing facilities. Further, on the supply side, Esso Malaysia has no plans to alter present production conditions.

Table II-6 shows the future supply/demand of ammonia in Malaysia which was projected by taking the above factors into account. This projection indicates the future outlooks as follows:

(i) The balance of supply and demand, excluding the influence of the proposed Ammonia and Urea Complex, will show an annual deficit of 10,700 to 11,000 tons (8,800 - 9,000 N tons).

(ii) The marketable ammonia produced by the Compelx (total production less than portion used to make urea) will be 22,500 tons (18,500 N tons) in 1984, and accompanying improvement of operating levels, the surplus will increase to 38,600 tons (31,600 N tons) in 1987 and each year thereafter.

(iii) Therefore the overall supply and demand balance for Malaysia in 1984, the year that the Complex begins operation, will show a surplus of supply, and in 1984 that surplus will be 11,800 tons (9,700 N tons), and in 1986 and thereafter it will be 27,700 tons (22,700 N tons). This surplus of 27,700 tons represents, on the basis of one stream day (330 days of operation per year), 84 t/d or 72% of the 117 t/d of marketable ammonia produced by the plant (operating at 90% of capacity).

The above projection for ammonia demand took into account only the demand of existing users as mentioned above. The only existing complex fertilizer manufacturer is CCM, and that company has no plans to expand its production capacity. Hence the projected ammonia demand did not include any ammonia demand which may effect in the event if there is any expansion of the production of complex fertilizer in the future. As stated earlier, the urea demand projection was made on the assumption that the production capacity of mixed fertilizer would expand in keeping with growth of demand for NPK fertilizer to the extent that urea can be used as the nitrogen source. However, even after such an expansion of the capacity of mixing plants takes place, there are additional requirements for NPK fertilizer based on nitrogen fertilizer other than urea, which should be met either by imports or increases in domestic production. These additional requirements are projected to be 24,000 N tons in 1980, 35,000 N tons in 1985, and 49,000 N tons in 1990. Therefore, if the domestic production of complex fertilizer

is expanded so as to meet the above requirements, it would result in additional demand for ammonia which can absorb the entire volume of the surplus ammonia from this Ammonia and Urea Complex. As stated above, the present projection did not include this additional ammonia demand, because there are so far no firm plans to expand the production capacity of complex fertilizer. Nevertheless, in view of the quantity of requirements for complex fertilizer, it is observed that such an expansion may take place in the near future, and if this factor is taken into account, the ammonia demand in Malaysia would be larger than the projected level. Therefore it is noted that there is a possibility that the ammonia demand would grow to an extent greater than the present projection.

For the projection of ammonia supply, it was assumed that the existing ammonia plant of Esso Malaysia Co. will continue to operate in the future. However, this plant was constructed in 1966, and will have been operated for 18 years in 1984 when the Ammonia plant in Bintulu will commence its production. It is general practice that after 20 years' operation ammonia plant requires a large-scale overhaul which requires a considerable investment. Further, the 160 t/d production capacity of this plant is fairly small in scale compared to other ammonia plants recently built in other countries. Malaysia was a small importer of ammonia, and the import price of ammonia was higher than international market prices. (For instance, in 1976 the price of ammonia imported into Malaysia was US$223 per ton, whereas the FOB West Europe price was around US$110 per ton.) Under such circumstances, even if the production cost of the ammonia is higher than the prevailing international prices, ammonia produced at the existing ammonia plant can afford to compete with imports in the domestic Malaysian market.

However, once the Ammonia and Urea Complex commences its production, the cost of ammonia produced at the Complex would be far below that of ammonia produced at the existing plant. In such an event, it is questionable whether the Esso Malaysia's ammonia plant can afford to continue its production. As stated above, the present projection did not take into account the possibility that the existing ammonia plant would shut down its operation, because regarding this possibility there is no assurance as yet. However, it must be noted that there is a high possibility that that plant will be shut down at the time when the Complex starts its commercial operation, and in such event the surplus of ammonia from the Complex would be absorbed by sale within the domestic market.

CHAPTER 3 SUPPLY AND DEMAND CONDITIONS FOR AMMONIA AND UREA IN OTHER ASEAN COUNTRIES IN THE PRESENT AND FUTURE

3-1 Urea

3-1-1 Indonesia

(1) Demand

The agricultural sector in Indonesia may be divided into a food crop sector and an estate crop sector. The food crop sector is comprised primarily of smallholders, who produce rice, maize, cassava and other food crops. The estate crop sector consists mainly of estates which produce, in large-scale operations, export crops such as rubber, coconut, coffee and sugarcane. Many of the estates are operated by the state. Accompanying the diffusion among smallholders in recent years of a cash economy, they have begun to cultivate export crops on a small-scale and the cumulative result of this is that at present a major share of rubber and coffee, while belonging to the estate crops sector, is being produced by smallholders.

Nearly 90% of the consumption of nitrogen fertilizer in Indonesia is within the food crop sector. Of the volume of nitrogen fertilizer which this sector consumes, about 93% (also equal to about 82% of total nitrogen fertilizer consumption) is used for padi (see Table II-7).

The outlook is for rapid growth of demand for nitrogen fertilizer in Indonesia during the early part of the 1980's, and a slower growth thereafter. Total consumption of nitrogen fertilizer in 1975 was 339,000 N tons; the outlook is for expansion by 2.1 times to 699,000 N tons in 1980, 2.6 times the 1975 level to 864,000 N tons in 1985, and similarly 2.9 times to 974,000 N tons in 1990. In terms of average annual increase, for 1975-1980 these figures work out to 15.6% p.a.; for 1980-1985, 4.3% p.a.; and for 1985-1990, 2.4%.

The major reasons for the above-described rapid increase in demand for nitrogen fertilizer from the late 1970's through the early 1980's are seen to be:

(i) Greater diffusion of fertilizing practice as a consequence of further diffusion of high-yielding varieties of rice, which require higher levels of fertilizer application than conventional varieties.

(ii) Greater diffusion of fertilizing practices by such farmers as enumerated below who either previously did not practice use of fertilizer or applied a low level of fertilizer:

- Farmers growing upland rice, or padi in rainfed areas, who previously did not use fertilizer.
- Maize-growing farmers who used little fertilizers.
- Smallholders growing export crops for which subsidized fertilizer was not permitted to be used.

In the past, in order to encourage increased foodstuff production, the Indonesian Government has provided assistance particularly for increased rice production, and by providing subsidies for designated fertilizer to be used for growing rice, kept the farmer's purchase price of fertilizer low. Because since 1976 this subsidy scheme has been extended to fertilizer to be applied to all other crops, there was rapid growth in demand for nitrogen fertilizer in 1977. Moreover, the BIMAS program by which credit facilities are made available for purchase of fertilizer has been expanded in scope from being applied to padi to being applied to secondary foodstuff crops (maize, cassava, etc.) as well. The government's strong policy regarding fertilizer is expected to have the effect of continued rapid expansion of demand for nitrogen fertilizer on the part of smallholders.

Urea is the sole nitrogen fertilizer to which subsidy has been provided by the government. Because of this reason, more than 90% of nitrogen fertilizer consumed in Indonesia is consumed as urea. It is likely that this pattern will continue henceforward, and further increases in demand for nitrogen fertilizer would result in an increase in demand for urea for the most part. In addition to fertilizer use which accounts for the overwhelming majority of urea demand, there is demand, although in a small quantity, for urea to be used for manufacturing of urea resin adhesives. As may be seen in Table II-8, demand for urea, including industrial demand, is expected to increase by 2.1 times the 1975 level to 1,403,000 tons in 1980, 2.6

times the 1975 level to 1,750,000 tons in 1985, and 2.9 times the 1975 level to 1,980,000 tons in 1990.

(2) Supply and demand

The outlook for production of urea in Indonesia including the ASEAN Urea Project in Aceh is as shown in Table II-9.

As may be seen from Table II-9, in 1984, the year that Complex operation begins, Indonesia will produce 2,932,000 tons of urea and have an exportable surplus of 1,225,000 tons, and thereafter increases in domestic demand will have the effect of gradually decreasing the annual surplus to the extent that it will amount to 952,000 tons in 1990.

3-1-2 The Philippines

(1) Demand

The Philippines' agricultural sector may be divided into a food crop sector and export crop sector. The food crop sector is comprised of ordinary smallholders who raise rice, maize, feed grains, vegetables and other food crops. The export crop sector, which produces sugarcane, bananas, pineapple and other export crops, is composed of a subsector of relatively large-scale smallholders which are organized in cooperatives, such as in the case of sugarcane growers, and a second subsector of large-scale plantations, where bananas and pineapple are grown.

Traditionally the major crop for which nitrogen fertilizer is consumed in the Philippines is sugarcane. However, since the start of the 1970's, the government has assinged high importance to increasing food production, and by implementing various programs such as Masagana 99, has promoted the use of fertilizer in production of rice, maize, vegetables and other crops. As a result, consumption of nitrogen fertilizer in the early 1970's was evenly divided between the food crop sector and the export crop sector, and, further, in 1975-1977 the food crop sector came to account for a greater share (60%) than the export crop sector (40%). In the export crop sector, about 80% of consumption of nitrogen fertilizer was for raising sugarcane.

As may be seen in Table II-10, whereas the average annual consumption of nitrogen fertilizer in the Philippines in the five-year period 1973-1977 was 160,000 N tons, it is expected to grow by 1.4 times that to 221,000 N tons in 1980, 1.8 times that to 280,000 N tons in 1985, and 2.1 times that to 339,000 N tons in 1990. The major reasons for this expansion of demand are as follows:

(i) Cultivation of padi is expected to account for the largest part of the increase in demand. At present, the high-yielding varieties, which require high levels of fertilizer application, are grown in about 80% of irrigated fields, and about 65% of non-irrigated fields. The percentages for 1970, were about 60% for irrigated fields and about 40% for non-irrigated fields; the speed with which cultivation of these HYV's spread is thus clearly evident, for both types of fields. These varieties require about 2.6 times the amount of fertilizer applied to traditional varieties, so it is expected that further diffusion of them will greatly contribute to the growth of fertilizer demand.

(ii) In accordance with progress in carrying out the Masagana Maisan Program, which is to promote intensified maize farming, as the number of farmers participating in the program has been expanded, demand for fertilizer for maize has increased. According to recent data (1977-1978), farmers participating in this program has been using 3.3 to 4 times fertilizers per unit area, as compared to those not participating in it. It is expected that this program will be expanded further and then demand for fertilizer for maize will be increased accordingly.

(iii) In contrast to this, it is unlikely that there will be great increase in demand for fertilizer for sugarcane. The level of fertilizer application per unit area of sugarcane field has already attained that which is recommended, and if there is to be any increase in demand connected with this crop, it will have to be as a consequence of an increase in the area planted with sugarcane. However, the expansion of the area for sugarcane is not likely to take place in the near future, because the cultivated area has been controlled by the government to the present level to maintain the price of sugar products in the international market.

The consumption of urea up to 1976 as shown in Table II-11, has been tending to be approximately 50% of total nitrogen consumption in both the food crop sector

and the export crop sector. However, since 1977, the proportion of urea has increased in importance, and in 1978 came to account for a share of 64.3%, representing 287,000 tons of urea. It is not expected, however, that this increase in the share of urea will be maintained in the future. The reason for this, as may be seen from the following table, is that the increase in the price of ammonium sulphate made the relative price of urea per kilogram of nitrogen decidely lower. Thereafter, as the price of ammonium sulphate, having reached an extraordinary height, has turned toward down trends, it is expected that demand for ammonium sulphate may recover.

Trend of Urea and Ammonium Sulphate Prices in the Philippines
(Ex-warehouse Price at Consuming Centers)

		May, 1975		Sept. 1976	1978
		For Food Crops	For Export Crops		
Urea	(₱/50 kg bag)	82.70	130.70	75.35	82.00
	(₱/1 N kg) [A]	3.6	5.7	3.3	3.6
Ammonium Sulphate	(₱/50 kg bag)	45.20	75.35	51.50	60.00
	(₱/1 N kg) [B]	4.3	7.2	4.9	5.7
[B] / [A]		1.2	1.3	1.5	1.6

In view of these conditions, the outlook is that about 50% of nitrogen fertilizer demand will be demand for urea, and urea demand in the Philippines, from the annual average of 182,000 tons for the five-year period 1973-1977, will increase 1.4 times by 1980 (to 256,000 tons), 1.8 times to 1985 (329,000 tons) and 2.2 times to 1990 (402,000 tons).

In addition to the above, industrial use of urea, primarily for urea-formaldehyde resin, while now at the level of 5,000 to 6,000 tons, is expected to increase to 17,000 tons by 1990.

(2) Supply

There is one urea plant in the Philippines at the present time, but it has ceased

production since 1977 because its production cost came to be higher than the international price. There is no outlook for resumption of production.

A plan does exist for construction of a large ammonia and urea complex in the Philippines, which would utilize natural gas as feedstock. At the present time it is not yet known whether efforts at developing natural gas resources will be successful, so the plans for construction of such a complex have not progressed. The government has the intention to meet the supply deficit of urea by importation from the two ASEAN Urea Projects.

Although not a plan for production of urea, the following plans for producing nitrogen fertilizer in the Philippines exist:

(a) Atlas Fertilizer Corporation (AFC) plans to double the scale of production of ammonium sulphate from the present 75,000 t/y.

(b) Planters Products Inc. as well as Maria Christina Fertilizer Corporation are now rehabilitating their plants in order to improve their efficiency.

(c) The following national project has been planned. (There are many points such as type of products, production scale, and timing which are yet to be decided.):

Ammonium Sulphate	153,000 t/y
NPK Fertilizer	432,000 t/y
Di-Ammonium Phosphate (DAP)	346,000 t/y

Of the three plans described above, (a) and (b) are taken into account in the supply projection. But (c) is excluded due to the lack of detailed plans and schedules.

(3) Supply and demand

Urea supply and demand balance in the Philippines, based on the foregoing investigation, is as shown in Table II-12. There will be shortfalls of urea of 343,000 tons in 1985 and 419,000 tons in 1990.

3-1-3 Thailand

(1) Demand

In Thailand there are no estates such as in Indonesia and Malaysia; all agricultural production is by smallholders. Through the 1950's Thailand's agriculture presented the appearance of being rice monoculture with some part of subsistence farming developing to the commercial rice farming. However, during the 1960's and 1970's, in accordance with the growth of demand for cattle feed and starch in Japan and the EC countries, there was diversification of Thailand's crops, and at the present time, as categories of export commodities, exports of maize, tapioca and sugar have come to be almost on a par with rice in terms of export values.

Of Thailand's major crops, cassava and maize ordinarily are raised without use of fertilizer. About 50% of the nitrogen fertilizer consumed in Thailand is used for padi, and in addition note may be made of the rapid increase in use of fertilizer for sugarcane (see Table II-13).

Further demand for nitrogen fertilizer, in comparison to the 77,000 N tons in 1975, is expected to increase 1.8 times by 1980 (to 139,000 N tons), 2.4 times by 1985 (182,000 N tons) and 2.8 times by 1990 (220,000 N tons).

The prospect regarding the use of fertilizer for each major crop is as follows:

(i) For padi, as a result of expansion of commercial rice farming, the fertilized area will increase, and the further diffusion of HYV's requiring higher levels of fertilizer application will serve to increase fertilizer use per hectare, so that demand for nitrogen fertilizer for padi in 1990 will have increased by 1.9 times the level of 1975.

(ii) The fastest increase in demand for nitrogen fertilizer will be that for sugarcane. In 1990 demand will be 5.7 times the level of 1975, and will account for 30% of total demand for such fertilizer.

The type of nitrogen fertilizer most commonly used in Thailand is NPK. Because there are restrictions on importation of ammonium sulphate and urea to protect the domestic urea/ammonium sulphate producer, most of fertilizer imports have consisted

of NPK.

Up to the present, use of urea was confined to one part of the country's vegetable cultivation. The present demand for urea in Thailand is at the level of only 6,000 tons or so.

Industrial urea requirements, for production of urea-formaldehyde resin and mono-sodium glutamate, is about 11,000 tons.

Up to the present time, there has not been any portent of diffusion of the use of urea for Thai crops other than vegetables, but it is expected from the viewpoint of price per unit weight of nitrogen that imported urea will tend to demonstrate advantages in the future. Further, because the tariff which had been applied to imported urea for fertilizer use has been reduced, conditions have become even more favorable for the use of urea for fertilizer to increase.

Therefore, the outlook is for use of urea for padi to gradually increase, in similar manner as has been seen in other Southeast Asian countries. Further, it is also expected that urea will be used in the manufacture of compound fertilizer.

The results, as shown in Table II-14, are that whereas the annual average consumption of urea in Thailand was 6,000 tons during 1974-1976, it is expected to increase 2.6 times by 1980 (to 16,000 tons), 9.2 times by 1985 (56,000 tons) and 18 times by 1990 (113,000 tons).

(2) Supply and demand

At present there is one urea plant in Thailand, but there are no plans either for increasing its capacity or for constructing a new plant. The rate of operation of the existing facility (owned by CFC) is low and although efforts have been made to improve its efficiency, at the present time no tangible improvement has been made.

Therefore, the supply outlook for urea in Thailand is as shown in Table II-15. That is, in 1985 there will be a shortfall of 73,000 tons of urea, and in 1990 the shortfall will be 134,000 tons.

3-1-4 Singapore

Singapore produces no urea, and has the import requirement of about 2,000 tons for fertilizer use and 6,500 tons for industrial use (for the production of urea-formaldehyde resin).

The expectation is for Singapore's level of demand for use as fertilizer to remain unchanged in the future, but industrial demand will increase to about 15,000 tons (see Table II-16).

3-1-5 Quantity of urea produced by the Complex which can be exported to ASEAN countries

The foregoing discussion of the outlook for supply and demand of urea in each of ASEAN countries is summarized in Table II-17.

The ASEAN market for urea produced by the Complex, as agreed by the ASEAN countries (see Chapter 1) is to be one half of the deficit in requirements of the Philippines, Thailand and Singapore.

According to the above projection, the exportable quantity of the Complex's urea which may be sold to these ASEAN countries will be 216,500 tons in 1985, and 285,000 tons in 1990. As a consequence, this projection indicates that it may be necessary for the Complex to export to countries outside the ASEAN region -- for four years from 1985 on -- 18,000 tons (1988) to 53,000 tons (1986). However, it must be noted that, as is stated in 2-2-2, if the use of urea for rubber and oil palm is promoted in Malaysia, the domestic sale of urea will be increased so that requirements for the exportation to outside the ASEAN region will be diminished or eliminated.

3-2 Ammonia

In principle, the ammonia produced by the Complex but not used there to produce urea, is to be sold in the domestic Malaysian market. There is therefore no need to investigate the export market for ammonia. However, in order to study the future price of ammonia, it is necessary to have a good understanding of the outlook for supply and demand of ammonia in the ASEAN region. The following clauses describe and examine the supply and demand conditions for ammonia in Indonesia and the Philippines, as these countries are believed to most strongly

influence such conditions in the ASEAN region as a whole.

3-2-1 Indonesia

(1) Supply

In Indonesia, the following two plants are planned to produce surplus ammonia for sales:

PUSRI - I	Planned annual production volume	54,000 tons
Kaltim	Planned annual production volume	149,000 tons
Total	Planned annual production volume	203,000 tons

There are plans that a part of ammonia produced at these plants is destined to supply for specific uses; the ammonia of PUSRI-I is to be used for production of DAP, and the ammonia of the Kaltim plant is to be supplied to other plants in Indonesia for industrial purposes, but no details are now available.

(2) Supply and demand

The volume of ammonia sold in Indonesia in 1970-1976, averages 2,200 tons per year. It is to be expected that Indonesia will turn to a major exporter of ammonia in the region.

3-2-2 The Philippines

(1) Supply and imports

Almost all ammonia produced domestically is used by the producers in manufacturing fertilizers (ammonium sulphate, compound fertilizer, etc.). The only company producing aqua ammonia is MCFC; the level of annual production is 2,000 N tons. In the Philippines, domestic ammonia supply has fallen below demand, and the deficit has been met by importation.

In the past, all requirements had been met by imports from Japan, but in 1977 importation from South Korea was begun.

(2) Demand

Demand for ammonia is for fertilizer production and industrial use, but details concerning industrial use are not known. Ammonia for fertilizer production is being used by AFC to make ammonium sulphate and compound fertilizer. AFC's ammonia demand is thought to be at the level of 18,000 to 27,000 t/y. Industrial-use ammonia demand is estimated to be 30,000 to 38,000 tons in terms of anhydrous ammonia.

Hereafter, when AFC's plans for increasing the capacity of ammonium sulphate production facilities, and the large-scale phosphate fertilizer project goes on-stream as mentioned in 3-1-2 (2), demand for ammonia will increase as follows:

(a) AFC ammonium sulphate requirements:

At an annual scale of production of 72,000 tons . . .	19,000 tons of ammonia required

(b) Phosphate project requirements:

Ammonium sulphate, annual production 137,000 tons	36,000 tons of ammonia required
Compound fertilizer, annual production 388,000 tons	73,000 tons of ammonia required
Ammonium phosphate, annual production 311,000 tons	70,000 tons of ammonia required
(b) Total	179,000 tons of ammonia required

(3) Supply and demand

With the exclusion of ammonia used by the producers themselves, the outlook for supply of ammonia is as follows:

Supply/Demand Situation for Ammonia in the Philippines

[Figures in parentheses are increments in event of realization of (a) and (b) above]

(Unit: NH_3 '000 tons)

	Domestic production	Demand	Import requirement
MCFC[1)]	2.4		
AFC[2)]		22.5 +(19.0)	
Phosphate project		+(179.0)	
Industrial use		28.0	
Total	2.4	50.5 +(198.0)	48.1 +(198.0)

Notes: 1) Maria Christina Fertilizer Corporation
2) Atlas Fertilizer Corporation

CHAPTER 4 OUTLOOK FOR THE TREND OF INTERNATIONAL PRICES OF AMMONIA AND UREA

4-1 Urea

4-1-1 Past trend of the international price of urea

The trend of the international price of urea in the past is as shown in Fig. II-1. Except for one period in about 1965, until the year 1971/72, the international price of urea for a prolonged period remained low. After 1972/73 the price began to rise, and following the timing of the "oil crisis", the price rose swiftly, to US$ 285/t. However, when the oil price situation became calmer, in the year 1976/77 the price fell rapidly, to US$ 124/t. After that the price again began to rise, and in the year 1979/80, reached the level of US$ 205-210/t. (The above prices are for bagged urea.)

Urea is internationally traded commodity, and the international market for urea has the following characteristics; basically it may be viewed as being one where pure competition exists:

(i) Large-scale transactions (7,000,000 tons or more) occur every year; there is a large number of transactions.

(ii) Urea trade is made among a large number of both importers and exporters, and each importer can choose from among a large number of exporters, while it is possible for each exporter to sell to a large number of importers.

(iii) Imports are often made by national organizations, and open bidding is common and frequent.

(iv) It is relatively easy to obtain information regarding quantities bought and sold, and trading prices, with the result that the actions of importers and exporters alike tend to reflect the international market trends.

Therefore, in a market such as this, prices will be led by the prices which will be offered in response to the suppliable costs by major exporters who can exert influences

on the supply situation in the market.

During the period when the supply and demand are in a tight condition, the international prices will change to a higher level.

In contrast to this, with a loose supply and demand situation, the international price will change in consonance with the level at which major competitive exporters can manage to export their products with a little profit.

Thus, on the basis of the international pricing mechanisms explained above, the formation of international prices can be regarded to depend on such two factors as the supply and demand situation in the international markets, and suppliable costs of the exporters.

On the basis of the price formation mechanisms described above, the background of the urea price trend up to today can be explained as follows:

(1) The long-term decline in the prices up to the year 1971/72 was mainly due to the following factors:

(i) There have been changes in the hydrocarbon used as the feedstock to make ammonia, such changes having been made toward lowering feedstock cost (from use of coal to use of petroleum products such as naphtha and heavy oil, and to use of natural gas).

(ii) Per ton production cost was reduced as a consequence of enlargement in the unit scale of production facilities.

As a consequence of these two and related developments, production cost was reduced year after year. At the same time new plants were added one after another, and as a result, supply ability in the international market increased greatly.

At the same time, with respect to demand:

(i) Concern over the present and imminent world food crisis grew, and particularly in the developing countries efforts at increasing food production were increased, by means of measures which included assigning greater importance

to use of high-yielding varieties of grains, which require higher fertilizer levels than do traditional varieties.

(ii) Russia, China, and other socialist nations experienced poor harvests, and chose to increase fertilizer use in order to increase their food production.

As a consequence, the aggregate import requirement increased year after year. However, with the exception of the time of the rapid increase of demand in about 1965, during the period from the 1960's to the time the "oil crisis" took place, the increase in the supply ability was greater than that of the import requirement with, as the consequence, a prolonged period of declining price.

(2) When the "oil crisis" took place, in 1973, it had the effect of disturbing the price formation mechanism by its influence on both supply and demand, as follows:

(i) Regarding supply, not only did the higher prices of feedstock cause an increase in "production cost", but other costs and freight also rose, and, consequently, there was a great increase in "production cost plus freight". Further, the short supply of feedstock led to declines in supply capacity, and suppliers refrained from placing their stock on sale in anticipation of increases in price.

(ii) Regarding demand, anxiety over steadily rising prices and emerging supply insufficiencies encouraged increased buying, and a significant scale of false demand developed.

These movements on both suppliers' and importers' sides amplified the movements of the other. Thus, the international market price reached unusually high levels.

(3) After these extraordinary conditions became settled down, the price once again began to reflect conditions in the market. However, the long-run decline in "production cost plus transportation cost" which had been evident prior to the "oil crisis" was no longer evident, and, instead, it continued to increase every year. This is because the share of raw material costs in production costs was much higher than prior to the "oil crisis", and, moreover, the cost of raw materials continued to climb.

Concerning demand, although each country experienced expansion of domestic demand, improvement of self-sufficiency had the effect that there was little change in imports. Because the supply and demand relation was this way, since 1976 the price of urea has continued to rise under the influence of increases in "production cost", and in July - December 1979, passed the level of US$200/t of bagged urea at C&F.

4-1-2 Outlook for the international price of urea in the future

When a projection is made regarding the price of urea in the future, it is essential to give attention to the situation wherein conditions are completely different from those which existed when the demand and supply curves shifted during the period from the 1960's up to the time of the "oil crisis" . These are as follows:

(1) The minimum price at which the suppliers can afford to export will rise year after year. The causes of this are as follows:

(i) It is expected that petroleum prices will continue to rise, and in accordance with those increases, the price of naphtha, heavy oil and other petroleum products will also rise accordingly. The price of natural gas is expected to rise in similar manner. Further, plant construction costs are expected to rise every year.

(ii) As a consequence, the outlook is for the production cost at existing plants to increase, reflecting increases in not only raw materials but also in other costs, including labor.

(iii) In the case of new plants, while it would be necessary for new construction to tend to be located in regions where raw material prices are relatively low, these regions also tend to be retarded in terms of improvement of infrastructure, and construction costs tend to be high. Therefore, supply cost from new plants will not be necessarily low so as to offer low export prices in the export markets.

(2) Regarding demand, the outlook is for the world gross demand to increase, but on the basis of the experience had by many countries when they suffered from shortages subsequent to the "oil crisis", there will be efforts at improving self-sufficiency,

and as a result, the outlook is that there will be a decrease in the required volume of imports (for details see Appendix II-2).

The international price of urea, as projected for the future, is shown in Fig. II-1 by a chain line. The principal presumptions on which this projection is based are summarized as follows (for details, see Appendix II-3):

(i) Regarding costs for raw materials, construction costs, labor costs and other costs, it was assumed that increases could continue in a trend similar to that encountered during the six-year period 1973 - 1979. A graphic presentation of the trend of raw material prices and other major cost components is provided as Fig. II-2 and Fig. II-3.

(ii) The projection of urea import and export quantities, on the basis of the outlook for supply and demand of nitrogen fertilizer, is as shown in Table II-19.

As is shown in Fig. II-1, it is projected that the price of urea in the international market will continue to rise until 1979/80, but will remain approximately at the same level during the early 1980's, and then will begin to rise again during the latter half of the decade.

Fig. II-4 compares the projected trend of urea prices, and "urea production cost plus transportation cost *)" for typical plants in various countries.

The international market price of urea from 1976/77 to 1979/80 continued to rise from the 1976/77 level of US$124/t (C&F India, bagged, annual average; these same conditions to apply for values quoted below) and reached the level of US$205-210/t (not an annual average) in July - December, 1979 prices.

If the 1979 price is projected by applying the price projection model used for this study, it is indicated as US$ 204/t. This means, as is evident from trends shown in Fig. II-4, that the projected cost during the period 1977 - 1979 showed increases at a rate higher than increases in "production cost plus freight" in various countries, because an increase in import volumes has

(Note) *) The transportation cost assumed here is freight cost from major exporting countries to Indian ports. The reason for this assumption is described later in this section.

created more room for exports so as to enable higher-cost producers to participate in export business, thereby raising the level of equilibrium price over the increase in the "production cost plus freight". Such increase in import volumes took place due to the following reasons:

(i) Because India has adopted a fertilizer stockpiling policy, imports by that country have increased, and

(ii) Chinese imports have been maintained at a high level in connection with so-called agricultural modernization policy.

When the projected prices are compared with international market prices which prevailed during the period 1977-1979 (as shown in Fig. II-1), in 1978/79 the latter are higher than the former, but in 1979/80 this portion is reversed. This can be explained by the following two points:

(i) Actual production cost was somewhat lower than projected values up to 1978/79 and is expected to conversely show a tendency to be higher than the projected values in 1979/80. The reason for this is that, as shown in Fig. II-3, with the exception of the natural gas price in the United States, the prices of raw materials have tended to be relatively stable since 1974, but these prices began to rise swiftly after 1979.

(ii) It seems that during 1979/80 imports were ordered in the volumes for over requirements, due to importers' anticipation that the international price may raise along with increase in petroleum prices which took place since the early 1979.

Regarding the price of urea during the first part of the 1980's, it is expected to remain at about the same level as at the end of 1970's, due to the following reasons:

(i) The start of operations of urea plants constructed by developing countries following the "oil crisis" will be concentrated in the first half of the 1980's, and as a result of that, self-sufficiency will be increased and import demand will be decreased.

(ii) Following completion of large-scale plants in Russia, and Russia's subsequent entry as an exporter in the world market, other countries' exports will be strained by the increase of Russia's exports.

As may be seen in Fig. II-4, during the latter half of the 1970's, the price was

formed at a level roughly intermediate between the cost of products produced at natural-gas-based medium-scale plants in the U.S.A. and the cost of produced at Japanese naphtha-based plants. Therefore, it was possible for Japan to export solely to China because of an advantage, relative to other countries, in terms of transportation cost. Further, Western countries exported products primarily from natural-gas-based plants, and shut down a number of other plants which were unfavorable in export competition.

However, with the start of the 1980's, the scale of trade volume will decline further, and only large-scale plants having high competitiveness in cost, such as those in Indonesia and the Mideast, or based on natural gas in the U.S.A., will be able to furnish products for sale in international markets. Most plants in Western countries and Japan will become unable to compete in export markets, and have to withdraw from them.

It is expected that prices will again rise in the latter half of the 1980's. Reasons for this are:

(i) In general the physical life of a urea plant is about 15 years, and that of an ammonia plant is about 20 years. Plants which will be prominent as suppliers of exports during this period were built in or around 1970, and many will have to be scrapped in or around 1985. Even if they are continued to be used, higher maintenance and repair costs may be expected to increase production costs, and it will be impossible to maintain the same cost levels as earlier.

(ii) The reason for there being low costs in the case of the Mideast and Indonesia is the low cost of the natural gas used as feed gas there. However, when thinking of future energy prices, it would not be acceptable to assume that natural gas will be the only energy resource to remain low in price.

There will be further development of LNG and other natural gas commercial utilization projects and, along with such developments, commercial value of natural gas, per calorie, naturally will approach that of petroleum products. When this increase in the natural gas price is considered in the developing countries, the outlook is naturally one of urea price increases in accordance with the increases in costs of raw materials as shown in Fig. II-4.

(iii) With regard to the outlook for the required volume of imports from 1985 onward, since there is no information about planning construction of plants which would

start operation in 1985 or later, it cannot be known what will be built. However, it seems likely that there will be a lull after the concentrated rush of construction of fertilizer plants in the first half of the 1980's by the developing countries, and self-sufficiency rates will begin to stabilize. Therefore, in the case of countries which are dependent on imports, the quantity of imports needed will necessarily increase in keeping with growth of domestic demand.

In view of the foregoing, it is thought that starting in 1985 the urea price will again begin to rise.

As is described above, the international price of urea is expected to remain fairly steady during the first half of the 1980's and then to start to rise during the second half. If calculations are made on the basis of the foregoing assumptions, the C&F price of bagged urea may be expected to be in the range of US$ 210 to 215/t during the first half of the 1980's, about US$ 255/t in 1987/88, and about US$ 320/t in 1990/91.

The urea price in the Asian region is taken as being formed on the basis of the market price in India. This is because India is a major import market, and moreover is at a geographically intermediate point between exporter countries (North America, Japan, East Europe, the Mideast and others). FOB prices in exporter countries must vary depending on the distance from those countries to each destination. Fig. II-5 shows the international market price in each region's prices, as of July-August, 1979.

As may be seen from this figure,

(i) The Indian delivered price which prevails is the standard for the delivered price in Asian markets such as China and Bangladesh, etc.

(ii) Even if urea is imported from neighboring countries, as may be seen in the case of when Japan exports to China, or the Mideast exports to India, C&F price is the same level as imported from countries in far distance.

In view of the above conditions, it is assumed that the amount equivalent to the freight savings due to the shorter transport distance is received as a benefit by the exporter country. Based on this assumption, the sales price of urea for this Project is set at the FOB Bintulu price which is projected by subtracting the estimated Bintulu-India freight cost from the projected C&F India price.

The outlook for the international urea price in Asian markets and the projected FOB Bintulu bulk price, on the basis of the above consideration, is as follows:

Outlook for the International Urea Price in Asia (US$/ton)

	1984	1985	1986	1987	1988	1989	1990
C&F India bagged	213	216	220	235	253	275	296
FOB Bintulu bulk	175	176	178	191	207	225	243

Note: The price is as of the beginning of each year.

4-2 Ammonia

Of the world's imports of ammonia, 93% is destined for North America and West European countries. With regard to exports also, 95% is from Canada, America, Mexico, Russia and the West European countries. Therefore, almost all trade in ammonia takes place between these countries, and there are two prices in the international market, one in the North American market and one in the West European market. Although there is a slight difference between the prices in the two markets, as is evident from the following table, they move together.

Movement of the Ammonia Price in North American and West European Markets

(US$/ton, FOB)

	Jan., 1977	Mid.-1977	Dec., 1977
W. European market price	95 ~ 105	110 ~ 120	90 ~ 95
N. American market price	95 ~ 105	100 ~ 110	83 ~ 90

In the case of Southeast Asia, only a very small scale market exists. The major importers are the Philippines and Malaysia, and the exporters are Japan, Indonesia, Australia, South Korea and others. America and West Europe export only a very small quantity to this market.

The unit of transaction of less than 50 tons is common in the Southeast Asian ammonia market, and the per ton price varies greatly from time to time, reflecting change in

production cost and freight.

In order to establish the price of ammonia produced in the Complex's plant, it is necessary to project the ammonia price under the following conditions:

(i) To project the ammonia sales price on the basis of transactions in large-lots. The price set for small-lot transactions is obtained by adding the differential in transportation cost to the price set for large-lot transactions. Thus, there is no difference in FOB price between large-lot transactions and small-lot transactions.

(ii) To project the sales price at the FOB Bintulu price. The FOB price would vary depending on the destination, but in the case of this Project the product primarily is destined for the domestic market in Malaysia, so one uniform price can be set as the FOB price for products destined to West Malaysia.

Russia, the Mideast, Indonesia, Japan, Mexico, and others will be possible ammonia exporting countries for Southeast Asia in the future. Because the scale of the Southeast Asian ammonia market is small, however, large-lot shipments (10,000 tons or more) will not be possible and the freight costs would be quite high for the relatively distant exporters (Russia, the Mideast, Mexico, etc.). In the case of Japan not only would the freight cost be high but it is certain that there will be increases in the ammonia production cost in Japan as well. Therefore, as is discussed in Chapter 3, it is Indonesia which will be the future price leader with respect to ammonia in Southeast Asia in the future.

Therefore it is possible that the FOB Bintulu price can be projected as being at the same level as the delivered ammonia price that Indonesia can supply West Malaysia, less the freight cost between Bintulu and West Malaysia.

The results are as follows (note that in estimating the production cost the presumptions are the same as in 4-1 and Appendix II-3):

Outlook for Ammonia Prices

(FOB Bintulu, US$/ton)

Beginning of 1984	1985	1986	1987	1988	1989	1990
205	206	228	253	276	298	321

CHAPTER 5 PLANS FOR SALE OF THE PRODUCTS (UREA AND AMMONIA) PRODUCED AT THE COMPLEX

5-1 Plans for Sale of the Products

5-1-1 Urea

(a) Projected production of urea and quantity to be sold

This Project plans provide for a 1,500 t/d urea plant. The rate of capacity utilization is projected as 70% in the first year, 80% in the second year, and 90% in the third year onwards. On the assumption that commercial operation of the Complex is started in March, 1984 (see Part IV), the annual production and quantity to be sold for the urea produced at the Complex, on the basis of 330 on-stream days per year, is projected as follows:

Projected Production and Salable Quantity of Urea

(Urea '000 tons)

		1984	1985	1986	1987 on
A.	Production:	288.8	396.0	445.5	445.5
B.	Inventory:	28.9	33.0	37.1	37.1
C.	Inventory carried-over from preceding year:	-	28.9	33.0	37.1
Quantity to be sold: (A - B + C)		259.9	391.9	441.4	445.5

Note: The production period is assumed to be 10 months in 1984 from March to December and 12 months in other years (from January to December).

(b) Projected sales of urea

The urea produced at the Complex is to be sold primarily in the domestic Malaysian market and other ASEAN markets. Regarding marketing arrangements for the urea, the ASEAN Economic Ministers have agreed that the Project will have priority right to supply the produced urea to the domestic Malaysian market and the "available ASEAN markets"; the requirements of the available ASEAN markets are to be met by equal shares of urea from this Project and the ASEAN Aceh Urea Complex in Indonesia. (The "available ASEAN markets" means the markets in the Philippines and Thailand after considering their own domestic production of urea, and also the market in Indonesia if there is insufficient production of urea in Indonesia.)

Based on the above arrangements, the sales projection is made on the following assumptions:

(i) The Complex will solely supply the urea to meet the whole demand in Malaysia.

(ii) To other ASEAN markets excluding Indonesia (i.e., the Philippines, Singapore and Thailand), the supply from the Complex will cover half of the projected imports requirements (demand less domestic supply) in these countries.

The projection of sales of urea for the Project, which was made on the above assumption and by using the projected supply and demand of urea in Malaysia and other ASEAN countries (as discussed in Chapters 2 and 3 of this Part II), is given in Table II-18.

This projection indicates that this Project may have a surplus after the supplying urea to the domestic Malaysian market and other ASEAN markets, as follows:

(urea '000 tons)

1984	1985	1986	1987	1988	1989	1990
0	22	53	38	18	0	0

As discussed in Chapter 2, 2-2-2, the demand for urea in Malaysia was projected on the assumption that urea will not be used for rubber and oil palm (except that planted in coastal soil regions) in the future, as prevailing at the present time. However, as stated earlier, the authorities of the Malaysian Government are now taking measures to promote the application of urea for these crops, and if these measures function in an effective manner, there is a possibility that the domestic demand for urea in Malaysia may grow to a larger extent than that projected as above. In the event that this possibility is realized, it is likely that all the produced urea will be absorbed within the ASEAN markets.

Nevertheless, should the Malaysian demand remain at the level given in Table II-18, the surplus would need to be absorbed by exports to outside the ASEAN region. In such event, assuming that it is possible to ship urea from the Complex at the projected international prices given in Chapter 4, whether or not it will be possible to export urea depends on the extent that import markets exist in the neighboring regions.

The outlook for future demand in major urea importing countries in Asia is given in Table II-20. Those countries, for the years from 1984 on, are expected to be China, Vietnam, and India. In 1986, the year when the largest quantity of urea produced by the Complex must be exported to outside the ASEAN region, the outlook is that China will have to import 1,581,000 tons, Vietnam will have to import 307,000 tons, and India will have to import 485,000 tons.

In relation to this, the country which is expected to be the region's largest exporter of urea is Indonesia. Other than that country, it is expected that Pakistan and Bangladesh will also become exporters. However, as noted above, the maximum quantity which Malaysia will have to export is 53,000 tons, and future West European countries and Japan, which are now major exporters, will have to withdraw from international markets due to increases in their production costs, so it is thought that as long as an efficient export marketing scheme is secured, and Malaysia makes an adequate effort to enter into business with India, Vietnam and China, it will not be difficult to export urea to the extent of the required amount even if the Project has a surplus as projected.

5-1-2 Ammonia

(a) Projected production of ammonia and quantity to be sold

The capacity of the ammonia plant for this Project is 1,000 t/d. On the basis of the same assumption as discussed for urea in the previous clause, the annual production and quantity to be sold for ammonia is projected as follows:

(NH_3 '000 tons)

	1984	1985	1986	1987 on
A. Production	192.5	264.0	297.0	297.0
B. Consumption for urea:	167.5	229.7	258.4	258.4
C. Marketable surplus (A - B):	25.0	34.3	38.6	38.6
D. Inventory:	2.5	2.9	3.2	3.2
E. Inventory carried-over from preceding year:	-	2.5	2.9	3.2
Quantity to be sold (C - D + E):	22.5	33.9	38.3	38.6

Notes: 1) The operation period is 10 months in 1984 (from March to December), and 12 months in other years (from January to December).

2) The consumption of ammonia for urea is estimated at a rate of 0.58 tons of ammonia per ton of urea.

(b) Projected sales

The agreement on marketing arrangements for the Project gives no statement about the ammonia produced at the Complex. Nevertheless, the Malaysian Government plans to take off all the ammonia produced for sale and to sell it to the domestic Malaysian market. There is no plan to export ammonia to other countries.

When the sales of ammonia is projected on the assumption that the ammonia

from the Complex will be supplied only to meet the demand remaining after the supply from the existing ammonia plant in Malaysia, possible sales for ammonia from the Complex, on the basis of the projected supply/demand of ammonia in Malaysia as discussed in Chapter 2, 2-3, (see Table II-6), is projected as follows:

Projected Sales of Ammonia

(NH_3 '000 tons)

	1984	1985	1986	1987	1988 on
A. Quantity to be sold:	22.5	33.9	38.3	38.6	38.6
B. Sales:	8.9*)	10.9	10.9	10.9	11.0
Balance (A - B):	13.6	23.0	27.4	27.7	27.6

Note: *) 10,700 tons x 10/12

This projection indicates that the possible sales of ammonia is about 9,000 tons in 1984 and about 11,000 tons every year after 1984, and therefore, after sales to the domestic market, there is a surplus of 13,600 tons in 1984, 23,000 tons in 1985 and about 27,000 tons a year in and after 1986. However, as discussed in Chapter 2, there is a possibility that the existing ammonia plant shuts down its production in the near future, and also another possibility that the domestic production of NPK compound fertilizer will be expanded. In such events, it is possible that all surplus ammonia yielded at 90% capacity utilization will be absorbed by sales in the domestic market. Under these possibilities, there seems to be no reason why the capacity of the ammonia plant should be altered to a smaller capacity than in the proposed plan.

5-2 Organization for Marketing of the Products

In accordance with marketing arrangements agreed by the ASEAN Economic Ministers, the supply of urea to the ASEAN countries other than Malaysia will be made by direct transactions between the joint-venture company managing the Complex and the governmental authority of each of these countries which is responsible for importation of urea from the

Complex. They will take urea at FOB Bintulu, and will distribute it through existing distribution channels in the respective countries. The projection of sales for urea to the ASEAN countries outside Malaysia was formulated on such assumptions, and therefore the Project does not call for establishment of a marketing organization in connection with the supply to the ASEAN markets outside Malaysia.

The Malaysian Government has guaranteed to absorb the surplus of urea remaining after the supply to the ASEAN markets outside Malaysia, either by sales to the domestic Malaysian market or exports to outside the ASEAN markets, or both.

The domestic Malaysian market shows a traditional bias in favor of NPK fertilizer (compound fertilizer and mixed fertilizer), and nitrogen fertilizers in forms other than urea, such as ammonium sulphate and ammonium nitrate, have been used as the nitrogen source for NPK fertilizer. In recent years there has been a rapid increase in the use of urea either as straight fertilizer or in mixed fertilizer for padi and for oil palm cultivated in coastal soil, but the proportion of nitrogen fertilizer which is accounted for by urea is not high. The increase in consumption of urea owes much to (a) the Government's aggressive promotion of schemes for increasing the production of padi and development of agriculture (especially in the smallholder sector), through subsidies for the purchase of fertilizers, and (b) performance of enhanced marketing activities for the use of urea in Malaysia. The projection of Malaysian demand for urea, which is the basis for the projected sales for the Project, is based on the assumption that the measures such as advocated above are vigorously carried out, and therefore the achievement of projected sales greatly depends on these measures and actions.

There are two types of distribution channels, those organized by the fertilizer makers (CCM, FFC), and those organized by the importers. Thus, distribution is wholly handled by private entities who necessarily make decisions largely on the basis of the potential profitability of their alternative courses of action. In the case of urea in particular, the entire present supply of which is imported, sales are done through the importer's channels. The importers treat urea as just one of the several fertilizers they handle, and follow market trends rather than seek to expand the sale of urea in particular.

Extension services to farmers are entirely a matter of the Government authorities but such action cannot be said to be aggressively oriented to increasing the use of urea. Recently, government-related institutions have begun to study the potential of using urea as straight fertilizer or in mixed fertilizer for crops other than padi and oil palm (in coastal soil) because of high prices of imported nitrogen fertilizer other than urea (especially compound fertilizer),

but such efforts have not gone beyond the phase of experimentation.

In view of the foregoing conditions, the following two sets of countermeasures are of particularly high importance, and implementation of both may be deemed vital for success of the Project:

(a) Continued expansion of the fertilizer purchase subsidy and grant arrangements; enhancement of extension services activities; further efforts by the governmental institutions at study of urea application techniques and methods; and efforts to have the results of such study put to actual use.

(b) Establishment of a means of organizing importers and distributors, and intensive performance of promotion activities closely linked to the government practices for the greater use of urea as straight fertilizer and in mixed fertilizers.

PETRONAS Project Team, as the executing agency for the Project, intends to engage a consultant for assistance in establishing a detailed marketing and distribution system, while planning to organize a new marketing company which will undertake, on behalf of the Malaysian Government, off-take and marketing in the domestic market of urea from the Complex. In view of the prevailing conditions in Malaysia, the Evaluation Study Team presumes that such steps would favorably facilitate success in urea marketing in Malaysia. Therefore, it is recommended that immediate action be taken to establish that system and set up the marketing company because considerable time is needed to attain these working objectives. At the same time, it would be necessary to implement a national level program for promotion of urea usage through joint efforts with relevant authorities or institutions. If these measures are taken with the right timing, it is likely that the projected sales for urea in connection with the Project will be attained.

The projected sales indicates a possibility that some part of the produced urea would have to be exported to outside the ASEAN region even on a temporary basis. To meet this requirement, the new marketing company will have to establish an organization, and function, not only for domestic sales but also for exports. Another step to be taken by the new marketing company is establishment of a transportation and distribution system for ammonia. It is recommended that immediate action also be taken by PETRONAS Project Team in order to establish such a system.

Table II-1 ESTIMATED PLANTED AREA BY CROP IN MALAYSIA

('000 ha)

	1970	1975			
		Smallholdings	(of which: Land Schemes)	Estates	Total
West Malaysia:					
Padi	534 (22)[1]	596	(–)	–	596 (10)[1]
Rubber	1,724	1,132	(687)	563	1,695
Oil Palm	261	214	(187)	355	569
Coconut	213	216	(–)	17	233
Beverages[2]	12	19	(2) [7]	9 [7]	28
Food Crops[3]	47	60	(4) [8]	–	60
Fruits	68	69	(–)	6 [9]	75
Spices	2	2	(–)	–	2
Miscellaneous Crops[4]	17	21	(–)	–	21
Total	2,878	2,329	(880)	950	3,279
Sabah:					
Padi	44 (11)[1]	48	(0)	–	48 (15)[1]
Rubber	105	87	(4)	17	104
Oil Palm	38	28	(24)	31	59
Miscellaneous Crops[5]	59	62	(13)	–	62
Total	246	225	(46)	48	273
Sarawak:					
Padi	127 (76)[1]	118	(–)	–	118 (64)[1]
Rubber	190	190	(6)	3	193
Oil Palm	1	12	(11)	4	16
Miscellaneous Crops[6]	80 [10]	80 [10]	(–)	–	80 [10]
Total	398	400	(17)	7	407

Notes:
1) Dry padi area which is included in padi area
2) Tea, cocoa, coffee
3) Sags, sugarcane, tapioca, sweet potato, maize, groundnut, vegetables, etc.
4) Tobacco, nipah, kapok, derris, etc.
5) Coconut, hemp, and cocoa only
6) Coconut, pepper, and sags only
7) Cocoa only
8) Sugarcane only
9) Pineapple only
10) In 1976

Sources:
1. "Monthly Statistical Bulletin, Peninsular Malaysia, July 1979"
2. "Agriculture in Peninsular Malaysia" (Ministry of Agriculture, Malaysia, Bulletin No. 148)
3. "Annual Statistical Bulletin, Sarawak, 1977"
4. "Annual Bulletin of Statistics, Sabah, 1977"
5. "Rubber Statistics Handbook, Malaysia, 1976"
6. "Oil Palm, Coconut and Tea Statistics, 1976"

Table II-2 ESTIMATED CROP-WISE DEMAND FOR NITROGEN FERTILIZERS IN MALAYSIA, BY TYPE OF FERTILIZERS USED

(N '000 ton)

	Potential Demand for Nitrogen Fertilizers	Estimated Consumption of Nitrogen Fertilizers					
		Total	Urea	Other Straight Nitrogen Fertilizers	NPK Fertilizers		
					Local Mixturers Using Urea	Other NPK Fertilizers	Total
West Malaysia:							
Padi	41.0	15.3	11.4	0	3.9	0	3.9
Oil Palm	32.1	25.6	0.2	0.2	5.0	20.2	25.2
Rubber	41.2	25.0	0	5.0	0	20.0	20.0
Others	10.1	8.0	2.0	1.5	1.6	2.9	4.5
Total	124.4	73.9	13.6	6.7	10.5	43.1	53.6
Sabah:							
Padi		0.8	0.7	0	–	0.1	0.1
Oil Palm		3.7	0.2	0.4	–	3.1	3.1
Rubber		0.5	0	0.1	–	0.4	0.4
Others		0.1	0	0	–	0.1	0.1
Total		5.1	0.9	0.5	–	3.7	3.7
Sarawak:							
Padi		0.4	0.3	0	–	0.1	0.1
Oil Palm		0.8	0	0.1	–	0.7	0.7
Rubber		0.3	0	0.1	–	0.2	0.2
Others		2.2	0	0	–	2.2	2.2
Total		3.7	0.3	0.2	–	3.2	3.2

Note: Estimations are made on the consumptions in 1974 for W. Malaysia, and in 1976 for Sabah and Sarawak.

Table II-3 PROJECTED DEMAND FOR NITROGEN FERTILIZERS IN MALAYSIA

(N '000 ton)

	1974		1980		1985		1990	
	Estimated Demand	of which Urea	Projected Demand	of which Urea	Projected Demand	of which Urea	Projected Demand	of which Urea
West Malaysia:								
Padi	15.3	15.3	28.3	28.3	36.8	36.8	44.0	44.0
Oil Palm	25.6	5.2	51.3	10.5	68.8	13.9	85.2	17.2
Rubber	25.0	–	20.1	–	16.2	–	15.9	–
Others	8.0	3.6	8.9	3.7	9.8	4.0	10.9	4.4
Total	73.9	24.1	108.6	42.5	131.6	54.7	156.0	65.6
Sabah:								
Padi	0.8	0.7	1.9	1.9	2.3	2.3	2.8	2.8
Oil Palm	3.7	0.2	5.0	1.6	7.0	2.2	9.1	2.8
Rubber	0.5	–	0.6	–	0.6	–	0.7	–
Others	0.1	–	0.3	–	0.7	–	1.2	–
Total	5.1	0.9	7.8	3.5	10.6	4.5	13.8	5.6
Sarawak:								
Padi	0.4	0.3	2.2	2.2	2.5	2.5	2.9	2.9
Oil Palm	0.8	–	1.2	0.3	1.5	0.4	1.8	0.4
Rubber	0.3	–	0.3	–	0.3	–	0.3	–
Others	2.2	–	2.7	–	3.3	–	4.0	–
Total	3.7	0.3	6.4	2.5	7.6	2.9	9.0	3.3
Malaysia Total	82.7	25.3	122.8	48.5	149.8	62.1	178.8	74.5

Table II-4 PROJECTED SUPPLY/DEMAND OF UREA IN MALAYSIA

(Urea '000 ton)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Supply:											
– Production											
ASEAN Urea Project (a)	–	–	–	–	288.8	396.0	445.5	445.5	445.5	445.5	445.5
(Assumed Capacity Utilization Rate) (%)					(70)	(80)	(90)	(90)	(90)	(90)	(90)
– Inventory Increase (b)					28.9	4.1	4.1	–	–	–	–
Supply Ability (A) = (a - b)	–	–	–	–	259.9	391.9	441.4	445.5	445.5	445.5	445.5
Demand:											
Fertilizer Use	105.4	111.5	117.4	123.0	128.5	135.0	139.5	145.2	150.9	156.3	162.0
Industrial Use	13.0	13.9	15.0	15.9	17.0	17.8	18.7	19.6	20.4	21.3	22.2
Total (B)	118.4	125.4	132.4	138.9	145.5	152.8	158.2	164.8	171.3	177.6	184.2
Surplus (or Deficit) (A - B)	(118.4)	(125.4)	(132.4)	(138.9)	114.4	239.1	283.2	280.7	274.2	267.9	261.3

Table II-5 ESTIMATED SUPPLY/DEMAND OF AMMONIA IN WEST MALAYSIA, 1971–1975

(N '000 ton)

Year	Import[1]			Demand[2]					Estimated Production[3]
				CCM		FFC	Ajinomoto		
	Anhydrous Ammonia	Aqua Ammonia	Total (A)	NPK	AN	AS	Monosodium Glutamate	Total (B)	Esso Malaysia (B – A)
1971	7.3	0	7.3	20.8	7.9	2.1	0.8	31.6	24.3
1972	7.9	0	7.9	24.9	11.3	2.9	0.8	39.9	32.0
1973	0.5	0	0.5	24.8	15.9	3.2	0.8	44.7	44.2
1974	0.4	5.4	5.8	33.6	5.8	4.3	0.9	44.6	38.8
1975	2.9	0.7	3.6	21.7	7.8	4.8	0.9	35.2	31.6

Notes:
1) Ammonia import in Malaysian import statistics is classified under the item of "ammonia and its liquid solutions". The classification by anhydrous and aqueous ammonia was estimated on the basis of the unit import prices in the import statistics and ammonia export statistics in Japan, which is the main export source of ammonia to Malaysia.

2) Demand for ammonia was estimated on the basis of ammonia requirement in production of each product.

3) Esso Malaysia's ammonia production is estimated by subtracting import (A) from demand for ammonia (B).

4) Demand for ammonia used for rubber processing was neglected in this table, because the data on the demand is not available, and also because the demand was informed to be small during the field survey (for further detail see Appendix II-1).

Table II-6 PROJECTED SUPPLY/DEMAND OF AMMONIA IN MALAYSIA

(NH_3 '000 ton)

	1984	1985	1986	1987	1988	1989	1990
Supply/Demand of Ammonia without ASEAN Fertilizer Project:							
Supply							
Esso Malaysia (A)	41.7	41.7	41.7	41.7	41.7	41.7	41.7
Demand							
CCM	42.6	42.6	42.6	42.6	42.6	42.6	42.6
FFC	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Ajinomoto	1.3	1.5	1.5	1.5	1.6	1.6	1.6
Total (B)	52.4	52.6	52.6	52.6	52.7	52.7	52.7
Deficit (C) = (B - A)	10.7	10.9	10.9	10.9	11.0	11.0	11.0
Marketable Surplus Ammonia from ASEAN Fertilizer Project (D) 1):	22.5	33.9	38.3	38.6	38.6	38.6	38.6
Surplus Ammonia with ASEAN Fertilizer Project (D – C):	11.8	23.0	27.4	27.7	27.6	27.6	27.6

Note: 1) Operational rate of the plant is assumed to be 70 % in 1984, 80 % in 1985, and 90 % in 1986 and after.

Table II-7 ESTIMATED AND PROJECTED DEMAND FOR NITROGEN FERTILIZERS, INDONESIA

(N '000 ton)

		Estimated or Actual							Projected		
		1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Food Crop											
BIMAS/INMAS											
Rice:	BIMAS (Wet)					159.8	165.4	164.0	193.3	227.8	249.9
	BIMAS (Dry)					86.2	80.3	88.1	101.9	113.4	115.1
	INMAS (Wet)	187.9	222.4	307.4	266.6	21.0	10.8	57.5	58.9	108.4	163.1
	INMAS (Dry)					10.6	15.8	99.3	106.7	134.4	151.9
Soybeans		0	0	0	1.1	0.9	1.6	2.4	3.8	8.5	12.8
Corn		0	0	0	8.9	14.2	20.7	29.7	87.6	117.4	129.9
Peanuts		0	0	0	1.1	2.6	2.9	2.9	7.7	9.4	10.2
Cassava		0	0	0	0	0	0	0	1.6	2.0	2.2
Estimate		187.9	222.4	307.4	277.7	295.2	297.4	443.9	561.5	721.3	825.1
Actual		187.9	222.4	307.4	277.7	308.4	306.2	429.3			
Non-BIMAS/INMAS											
Vegetables		6.7	5.6	4.6	13.1	2.9	7.1	13.9	9.1	14.8	23.5
Rice:	Upland								22.1	15.9	7.7
	Non-irrigated	0	0	0	0	0	0	0	11.4	8.6	6.0
	Non-B/I irrigated								7.0	3.5	0
Estimate		6.7	5.6	4.6	13.1	2.9	7.1	13.9	49.6	42.8	37.2
Estimate		194.6	228.0	312.0	290.8	298.1	304.5	457.8	611.1	764.1	862.3
Actual		194.6	228.0	312.0	290.8	311.3	313.3	443.2			
Estate Crop											
Rubber:	Estates	16.5	16.5	16.5	16.3	16.2	15.8		14.1	12.2	10.6
	Smallholders	0	0	0	0	0	0		25.0	28.0	30.7
Sugarcane		13.0	14.9	16.1	17.1	17.8	13.9		24.0	30.6	37.5
Oil Palm									5.6	7.6	9.6
Tobacco									1.0	1.2	1.3
Tea		0	0	0	0	0	9.3		2.9	3.2	3.3
Coffee									15.3	17.2	18.7
Coconut									0	0	0
Estimate		29.5	31.4	32.6	33.4	34.0	39.0	30.6	87.9	100.0	111.7
Actual		17.1	27.3	16.9	25.6	27.5	39.0	30.6			
Grand Total:	Estimate	224.1	259.4	344.6	324.2	332.1	343.5	488.4	699.0	864.1	974.0
	Actual	211.7	255.3	329.0	316.4	338.8	352.3	473.8			

Notes: 1. "Estimate" in the past years denotes the total of crop-wise demand estimation in the study.
2. "Actual" denotes the demand figures collected from the official statistics.

Source: Actual consumption; Up to 1976; "Kumpulan Data Pupuk Indonesia, 1967-76"
1977: Dept. of Chemical Industries, Indonesia

Table II-8 ACTUAL AND PROJECTED DEMAND FOR UREA, INDONESIA

(Urea '000 ton)

	Actual or Estimated			Projected		
	1975	1976	1977	1980	1985	1990
Fertilizer:						
Food Crop Sector						
BIMAS/INMAS	670.2	665.6	919.0	1,220.7	1,568.0	1,793.7
Non-BIMAS/INMAS	–	–	12.5	100.2	85.4	73.3
Total	670.2	665.6	931.5	1,320.9	1,653.4	1,867.0
Estate Crop Sector	5.8	20.4	–	68.5	78.3	88.0
Total	676.0	686.0	931.5	1,389.4	1,731.7	1,955.0
Industrial:						
Urea-formaldehyde Adhesive	0	0	0	8.9	11.7	15.2
Monosodium L-glutamate and Others	3.3	3.5	3.9	4.8	7.0	9.8
Total	3.3	3.5	3.9	13.7	18.7	25.0
Total:	679.3	689.5	935.4	1,403.1	1,750.4	1,980.0

Table II-9 UREA SUPPLY/DEMAND PROJECTION, INDONESIA

(Urea '000 ton)

			Actual	Projected												
			1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Capacity/Production																
PUSRI-I	Urea	Cap. (A)	100	100	100	100	100									
		Prod. (B)	95	95	95	95	95									
		(B/A) %	95	95	95	95	95									
PUSRI-II	Urea	Cap.	380	380	380	380	380	380	380	380	380	380	380	380	380	380
		Prod.	353	354	354	354	354	354	354	354	354	354	354	354	354	354
		(B/A) %	93	93	93	93	93	93	93	93	93	93	93	93	93	93
PUSRI-III	Urea	Cap.	570	570	570	570	570	570	570	570	570	570	570	570	570	570
		Prod.	332	428	456	513	513	513	513	513	513	513	513	513	513	513
		(B/A) %	58	75	80	90	90	90	90	90	90	90	90	90	90	90
PUSRI-IV	Urea	Cap.	47	570	570	570	570	570	570	570	570	570	570	570	570	570
		Prod.	54	428	456	513	513	513	513	513	513	513	513	513	513	513
		(B/A) %	115	75	80	90	90	90	90	90	90	90	90	90	90	90
P.T. Petrokimia	Urea	Cap.	45	45	45	45	45	45	45	45	45	45	45	45	45	45
		Prod.	11	14	14	14	14	14	14	14	14	14	14	14	14	14
		(B/A) %	24	30	30	30	30	30	30	30	30	30	30	30	30	30
Aceh (Jan., 1982)	Urea	Cap.						570	570	570	570	570	570	570	570	570
		Prod.						427	456	513	513	513	513	513	513	513
		(B/A) %						75	80	90	90	90	90	90	90	90
Kujang (Aug., 1978)	Urea	Cap.		238	570	570	570	570	570	570	570	570	570	570	570	570
		Prod.		178	439	480	513	513	513	513	513	513	513	513	513	513
		(B/A) %		75	77	84	90	90	90	90	90	90	90	90	90	90
Kaltim (Oct., 1980)	Urea	Cap.				143	570	570	570	570	570	570	570	570	570	570
		Prod.				107	434	470	513	513	513	513	513	513	513	513
		(B/A) %				75	76	83	90	90	90	90	90	90	90	90
Total		Cap.	1,142	1,903	2,235	2,378	2,805	3,275	3,275	3,275	3,275	3,275	3,275	3,275	3,275	3,275
		Prod. (C)	833	1,495	1,814	2,075	2,436	2,804	2,875	2,932	2,932	2,932	2,932	2,932	2,932	2,932
Demand																
Fertilizer Use			932	980	1,257	1,389	1,483	1,565	1,633	1,689	1,732	1,786	1,835	1,879	1,919	1,955
Industrial Use			4	12	13	14	15	16	17	18	19	20	21	22	23	25
Total (D)			936	992	1,270	1,403	1,498	1,581	1,650	1,707	1,751	1,806	1,856	1,901	1,942	1,980
Balance (C – D)			-103	503	544	672	938	1,223	1,225	1,225	1,181	1,126	1,076	1,031	990	952

Table II-10 ESTIMATED AND PROJECTED DEMAND FOR NITROGEN FERTILIZERS, THE PHILIPPINES

(N '000 ton)

		Actual or Estimated								Projected		
		1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Food Crop												
Rice:	Irrigated HYV	29.8	36.8	38.0	35.2	49.8	47.7	53.5	57.1	68.2	87.0	104.0
	Irrigated LV	4.8	5.0	5.1	5.7	5.1	4.2	4.5	4.1	3.4	1.9	1.0
	Non-irrigated HYV	0	0	2.4	2.9	4.5	3.0	3.9	5.5	10.0	15.5	17.1
	Non-irrigated LV	0	0	1.0	1.1	1.3	0.9	1.1	1.1	1.2	1.0	0.5
Corn		15.0	15.5	16.5	16.3	25.7	35.5	39.7	41.4	52.1	72.2	94.1
Vegetables		1.5	2.3	3.5	5.3	8.0	3.5	5.3	8.0	8.9	10.5	12.4
Estimate		51.1	59.6	66.5	66.5	94.4	94.8	108.0	117.2	143.8	188.1	229.1
Actual					81.1	95.1	80.3					
Export Crop												
Sugarcane		45.1	54.1	54.0	56.6	57.3	51.1	51.5	63.4	58.9	67.8	76.1
Coconut		1.9	2.2	2.6	3.1	3.6	2.6	3.1	3.6	3.2	5.6	9.4
Pineapple, Tabacco, Banana, Others		5.6	6.9	8.5	10.5	12.9	8.5	10.5	12.9	14.9	18.9	24.0
Estimate		52.6	63.2	65.1	70.2	73.8	62.2	65.1	79.9	77.0	92.3	109.5
Actual					73.4	85.6	54.5					
Grand Total:	Estimate	103.7	122.8	131.6	136.7	168.2	157.0	173.1	197.1	220.8	280.4	338.6
	Actual	107.1	125.4	117.8	153.8	180.4	134.5	156.0	179.5			

Note: See notes of Table II-7.

Source of actual consumption: Fertilizer & Pesticide Authority, the Philippines

Table II-11 ACTUAL AND PROJECTED DEMAND FOR UREA, THE PHILIPPINES

(Urea '000 ton)

	Actual						Projected		
	1973	1974	1975	1976	1977	1978	1980	1985	1990
Fertilizer:									
Food Crop Sector	73.3	113.5	85.2	N.A.	N.A.	N.A.			
Export Crop Sector	79.8	98.7	58.7	N.A.	N.A.	N.A.			
Total (A)	153.1	212.2	143.9	174.8	227.8	287.1	256.3	329.1	402.0
(Total Nitrogen Fertilizer Consumption) (N '000 ton) (B)	(153.8)	(180.4)	(134.5)	(156.0)	(179.5)	(205.4)	(220.8)	(280.4)	(338.6)
Ratio of Urea Consumption as against Total Nitrogen Consumption $(\frac{A \times 0.46}{B})$	45.8 %	54.1 %	49.2 %	51.5 %	58.4 %	64.3 %	53.4 %	54.0 %	64.6 %
Industrial:									
Urea-formaldehyde Adhesive			6.3	4.3	6.3		11.5	14.3	17.2
Total:			150.2	179.1	234.1		267.8	343.4	419.2

Source of actual consumption of fertilizer urea: Fertilizer & Pesticide Authority, the Philippines

Table II-12 UREA SUPPLY/DEMAND PROJECTION, THE PHILIPPINES

(Urea '000 ton)

	Actual		Projected											
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Production:														
Planters Products														
Capacity (A)	68	68												
Production (B)	–	–												
(B/A) %	–	–												
Demand:														
Fertilizer Use	228	287	245	256	270	284	298	313	329	344	358	373	388	402
Industrial Use	6	10	11	12	12	13	13	14	14	15	15	16	16	17
Total (C)	234	297	256	268	282	297	311	327	343	359	373	389	404	419
Balance:														
(B – C)	-234	-297	-256	-268	-282	-297	-311	-327	-343	-359	-373	-389	-404	-419

Source: Actual — FPA

Table II-13 ESTIMATED AND PROJECTED DEMAND FOR NITROGEN FERTILIZERS, THAILAND

(N '000 ton)

		Actual or Estimated				Projected		
		1973	1974	1975	1976	1980	1985	1990
Paddy:	North	0.7	0.7	1.1	1.1	1.5	1.7	2.4
	North East	10.8	8.7	14.4	17.1	16.5	21.0	26.4
	Central	25.8	21.7	23.2	29.4	30.1	38.3	47.2
	South	1.9	1.6	2.0	2.4	2.3	2.6	2.8
	Total	39.2	32.7	40.7	50.0	50.4	63.6	78.8
Vegetables		6.3	8.5	8.2	10.0	12.0	13.0	14.0
Sugarcane		6.9	7.8	11.5	25.5	36.6	53.5	65.6
Tobacco		1.2	1.6	1.6	1.2	1.5	1.9	2.3
Corn		0.1	0.1	0.1	0.1	0.1	0.2	0.2
Rubber		5.2	4.6	5.3	4.9	6.2	7.4	8.7
Others		7.3	7.7	11.7	18.7	32.1	42.5	50.0
Grand Total:	Estimate	65.8	61.2	77.3	107.9	138.9	182.1	219.6
	Actual	64.5	62.1	73.4	103.1			

Source: Actual and estimated demand; Division of Agricultural Economics, "Fertilizer Statistics" (in Thai)

Table II-14 ESTIMATED AND PROJECTED DEMAND FOR UREA, THAILAND

(Urea '000 ton)

	Estimated or Actual			Projected		
	1975	1976	1977	1980	1985	1990
Fertilizer:						
Vegetables	4.3	7.8	N.A.	7.8	12.8	18.3
Paddy						
Straight Fert.				5.4	20.7	42.8
Raw Material for Complex Fert.				0	5.9	12.8
Others				3.0	16.5	39.1
Total	4.3	7.8	N.A.	16.2	55.9	113.0
Industrial:						
Urea-formaldehyde Adhesive	4.3	3.9	4.3	5.0	5.9	6.3
Monosodium L-glutamate	8.0	6.7	7.0	10.9	14.8	18.7
Total	12.3	10.6	11.3	15.9	20.7	25.0
Total:	16.6	18.4	N.A.	32.1	76.6	138.0

Source: Actual demand; Division of Agricultural Economics, "Fertilizer Statistics" (in Thai)

Table II-15 UREA SUPPLY/DEMAND PROJECTION, THAILAND

(Product '000 ton)

		Actual		Projected													
		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Production																	
CFC Urea	Cap. (A)	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
	Prod. (B)	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	(B)/(A) %	10	13	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Demand																	
Fertilizer Use		4	8	8	10	12	16	22	29	37	46	56	66	77	88	100	113
Industrial Use		12	11	11	14	15	16	17	18	18	20	21	22	22	23	24	25
Total (C)		16	19	19	24	27	32	39	47	55	66	77	88	99	111	124	138
Balance (B – C)		-13	-16	-15	-20	-23	-28	-35	-43	-51	-62	-73	-84	-95	-107	-120	-134

Table II-16 PROJECTED DEMAND FOR UREA, SINGAPORE

(Urea '000 ton)

	1975	1976	1977	1980	1985	1990
Fertilizer:	2.2	2.2	2.2	2.2	2.2	2.2
Industrial:						
Urea-formaldehyde Adhesive	4.3	6.5	8.7	15.2	15.2	15.2
Total	6.5	8.7	10.9	17.4	17.4	17.4

Note: 1975-1977; Actual or estimated.

Sources: 1. FAO, "Annual Fertilizer Review"

2. "Fertilizer Market Study, ASEAN Region"

Table II-17 PROJECTION OF AVAILABLE ASEAN MARKET FOR MALAYSIAN UREA

(Urea '000 ton)

		1984	1985	1986	1987	1988	1989	1990
Supply/Demand Balance of Urea in ASEAN Countries:								
Indonesia	Supply Ability	2,932	2,932	2,932	2,932	2,932	2,932	2,932
	Demand	1,707	1,751	1,806	1,856	1,901	1,941	1,980
	Balance	1,225	1,181	1,126	1,076	1,031	991	952
Thailand	Supply Ability	4	4	4	4	4	4	4
	Demand	66	77	88	99	111	124	138
	Balance (A)	-62	-73	-84	-95	-107	-120	-134
The Philippines	Supply Ability	–	–	–	–	–	–	–
	Demand	327	343	359	373	388	403	419
	Balance (B)	-327	-343	-359	-373	-388	-403	-419
Singapore	Supply Ability	–	–	–	–	–	–	–
	Demand	17	17	17	17	17	17	17
	Balance (C)	-17	-17	-17	-17	-17	-17	-17
Available ASEAN Market for Malaysian Urea:								
(D) = [- (A + B + C)] x ½		203	217	230	243	256	270	285
Exportable Surplus Urea from ASEAN Fertilizer Project (Malaysia) (E)[1]:		114	239	283	281	274	268	261
Surplus Urea after Exporting to the ASEAN Countries (E – D):		–	22	53	38	18	–	–

Note: 1) As for the exportable surplus urea, see Table II-4.