EVALUATION STUDY REPORT

THE CONSTRUCTION PLAN OF THE ASEAN ACEH UREA FERTILIZER PROJECT THE REPUBLIC OF INDONESIA

NOVEMBER 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

The Government of the Republic of Indonesia conducted a feasibility study for the development of a project named the ASEAN Urea Fertilizer Project - Indonesia to establish a urea fertilizer complex in the North Aceh district of North Sumatra in Indonesia by joint investment and management of the ASEAN member countries.

The Government of Japan, in compliance with a request made by the government of the Republic of Indonesia, has agreed to provide with technical assistance for an evaluation study of the feasibility study which had been conducted by the Government of Indonesia as mentioned above concerning the aforesaid project, and the Japan International Cooperation Agency has been endorsed to undertake this evaluation study.

The Japan International Cooperation Agency has organized a study team headed by Dr. Shigeo UEKI and consisting of other 11 experts for the purpose of this study. The study team together with six officers of ministries and agencies concerned of the Government of Japan visited Indonesia about one month from 5th February 1978 to discuss with the authorities of the Government of Indonesia concerning all aspects of this project, investigate site conditions of the contemplated plant site, collect necessary data and information including visits to existing fertilizer plants and new plants under construction in Indonesia. During this period, some member of the team have also visited other ASEAN countries to find fertilizer markets and supply possibilities of required machinery, equipment and materials in these countries.

This report is to compile the outcome of the study which has been investigated and examined on the basis of findings, data and information collected through such visits and field surveys. The study, as a conclusion, has proven the feasibility of this project which contemplates to set up a urea fertilizer complex at Kuala Geukeh or Kuala Jangka in the North Aceh district with a capacity of producing urea at a rate of approximately 570,000 tons per annum.

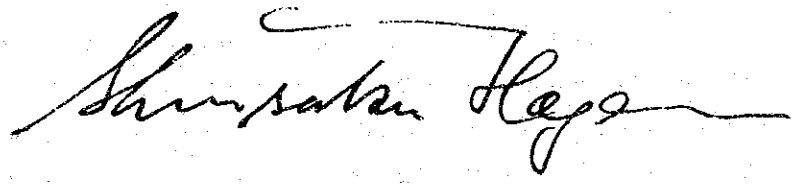
We, the Japan International Cooperation Agency, present this report with our sincere hope that this study will contribute to further economic development of the ASEAN countries as well as further promotion of amity and cooperation between the ASEAN and Japan.

We also take this opportunity to express our gratitude and appreciation to His Excellency Gen. Mohammed Jusuf, the former Minister of Industry (present Minister of Defense), Gen. Agus Sujono, Director General, Directorate General of Chemical Industry,

Ministry of Industry and other officials or authorities concerned of the Government of the Republic of Indonesia for their vast assistance and cooperation extended to the execution of this study.

November, 1978

Shinsaku Hogen

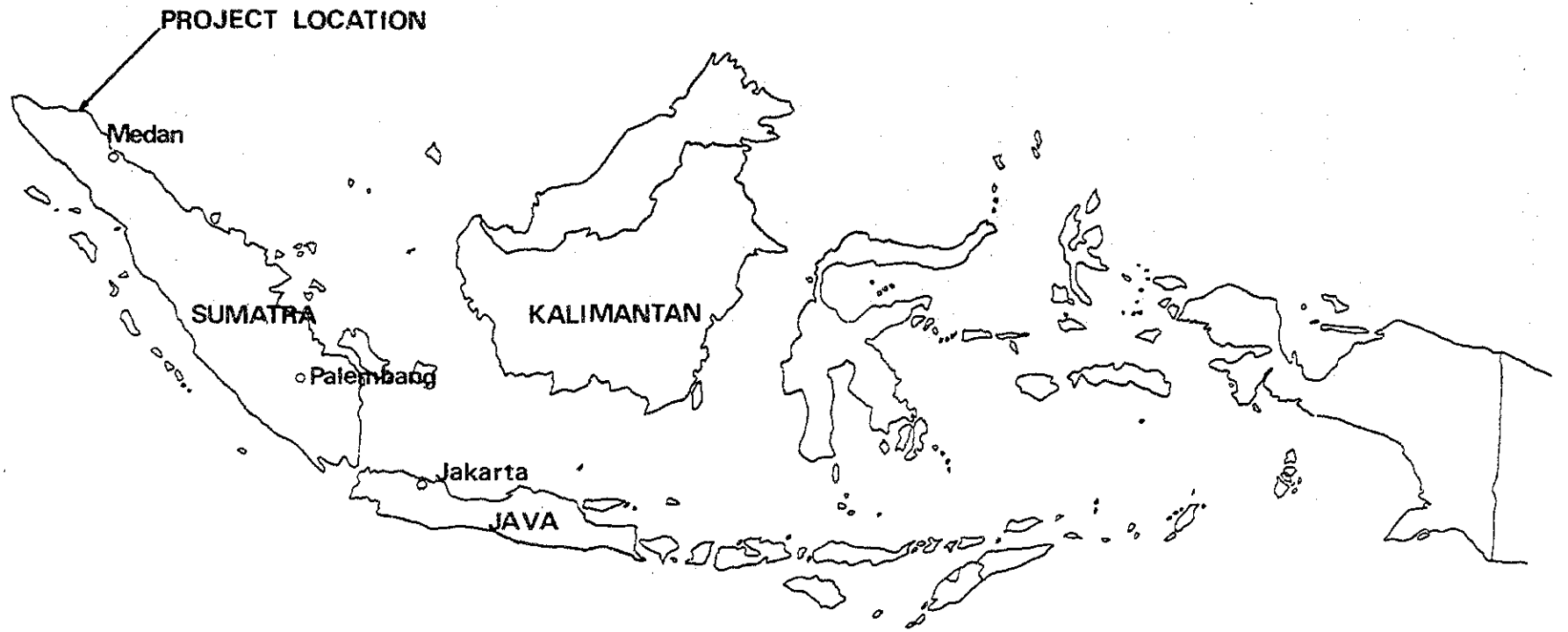


President

Japan International Cooperation Agency

ASEAN ACEH FERTILIZER PROJECT

PROJECT LOCATION MAP



ABBREVIATIONS

BTU	(British Thermal Unit: 1 BTU = 0.252 kcal)
MMBTU	(Million BTU)
SCF	(Standard Cubic Feet: 1 SCF = 0.0283 Nm^3)
SCFD	(Standard Cubic Feet per Day)
MSCF	(Thousand SCF)
MMSCF	(Million SCF)
BSCF	(Billion SCF)
BSCFD	(Billion SCF per Day)
TSCF	(Trillion SCF)
STB	(Standard Tankage Barrel: 1 STB = 0.159 Litre at 60°F)
psia	(Pound per Square Inch Absolute: 1 psia = 0.068 Atomosphere)
MW	(Megawatt)
DWT	(Deadweight Ton)
EL	(Elevation Level: EL = 0 at Standard Elevation = Indian Spring Low Water)
ton	(Metric ton unless particularly remarked)
$	(US Dollar unless particularly remarked)
Exchange Rate:	(Rp 415 per US$)

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I. INTRODUCTION

1.01 The Government of the Republic of Indonesia (GRI) has been making intensive efforts to develop a project (ASEAN Urea Project-Indonesia), as one of the ASEAN Industrial Projects, to construct a urea fertilizer complex in Indonesia with joint investment by the ASEAN member countries. This project is to produce urea by use of the natural gas produced at the Arun gas field in the North Aceh (Aceh Utara) district of North Sumatra, Indonesia with aiming at the supply of the produced urea to ASEAN countries.

1.02 At the request of the GRI, Japan International Cooperation Agency (JICA) has undertaken a comprehensive study to make precise investigations on the proposed plan for the project and eventually to make a full evaluation of its feasibility. This report presents the outcome of the study.

1.03 An evaluation study team (Evaluation Team) was organized by the JICA for the purpose of this study. The Evaluation Team has conducted, as the initial step, field surveys in the respective ASEAN countries, particularly in Indonesia for about one month from February 5, 1978. This study has been made on the basis of findings obtained through the field surveys. Prior to the finalization of the study, the Evaluation Team had presented an interim report to the GRI and held a meeting to discuss with the Indonesian authorities concerning the outcome of the study. Thus the study has been finalized with full consideration of comments presented by the authorities as well.

1.04 The objectives of this study were to precisely examine and evaluate the overall feasibility of the project from technical and economic standpoints.

The scope of the study tehrefore covered a wide range, encompassing a variety of problems to be investigated which can broadly be defined as follows:

A. Market study:

Study on the possibilities and trade terms for the marketing, destined mainly to ASEAN countries, of the urea produced at the contemplated urea complex.

B. Natural gas study:

Study of the availability and supply conditions of natural gas to be fed to the complex.

C. Investigations of technical aspects:

Investigations on the site where the complex is to be built, investigations of plant facilities and related infrastructure facilities to be constructed for the project, and examination of project management and implementation.

D. Estimates of capital requirement and financial plan:

Estimation of capital requirement and examination of financial plan for the project.

E. Financial analysis and economic evaluation:

Estimation of production cost of the urea produced at the complex, financial analysis and economic evaluation of the project to evaluate economic feasibility, financial viability and economic benefit of the project.

1.05 The outcome of the foregoing studies is described in detail in Part II and subsequent parts of this report. This part gives a summary of those descriptions as well as the conclusion of the study.

II. MARKET STUDY

2.01 The Evaluation Team conducted a study on the present consumption and the background market conditions of nitrogenous fertilizers (particularly urea) including those of urea for industrial use in ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand) and, on the basis of the above study, the Team drew a projection on the future demand for those fertilizers in ASEAN countries. At the same time, the Team investigated the present production and the possible future production of nitrogenous fertilizers in these countries. Thus the Team formulated the projection on the future supply/demand balance of nitrogenous fertilizers, particularly urea, in ASEAN countries and in the ASEAN region as a whole. The projected supply/demand is shown in Tables 1 and 2 respectively for nitrogenous fertilizers as a whole and for urea in particular. It must be noted here that, for the projection of the supply/demand, an assumption has been made that, while this project will start commercial production at the beginning of 1982, the ASEAN Urea Project - Malaysia will also start commercial production at the beginning of the subsequent year.

2.02 The figures given in Table 1 indicate that, although all ASEAN countries are so far the importers of nitrogenous fertilizers, the ASEAN region will attain a regionally balanced supply/demand in 1981 and thereafter will become the net exporters of nitrogenous fertilizers due mainly to increase of production in Indonesia. Especially after the onset of this plant and the Malaysian urea plant, the regional surplus of nitrogenous fertilizers will further increase year after year to reach a peak of 667 thousand tons N in 1986/87, although this surplus will thereafter tend toward gradual decrease owing to the increasing demand in these countries.

2.03 Among ASEAN countries, Indonesia is the largest consumer of nitrogenous fertilizers. In 1977, ASEAN countries consumed 860 thousand tons N of nitrogenous fertilizers as a whole, of which approximately 55% was by Indonesia, followed by the Philippines at 21%, Thailand at 13% and Malaysia at 11%. Singapore's consumption accounted for only 0.1% of the whole consumption in the region.

2.04 Urea is the main item of the nitrogenous fertilizers consumed in the ASEAN region. As shown in Table 2, urea consumption in the ASEAN countries totaled approximately 1.25 million tons of urea, or 577 thousand tons N in 1977, accounting for 67% of the regional consumption of nitrogen for fertilizers in that year. More than 99% of the total urea

consumption in the region was consumed in three countries, Indonesia, Malaysia and the Philippines, whereas urea consumption in Singapore and Thailand was very small. The percentage of urea consumption in the ASEAN countries as well as the percentage of urea against nitrogenous fertilizers consumed in each of these countries as of the aforesaid year are shown below:

	Percentage of urea consumption in ASEAN countries	Percentage of urea against nitrogenous fertilizers consumed in each of the ASEAN countries
Indonesia	74.3 (%)	90.4 (%)
Malaysia	6.7	40.7
Philippines	18.2	58.3
Singapore	0.2	92.0
Thailand	0.6	3.3
	100.0	

2.05 In addition to the demand of urea for fertilizer as mentioned above, there also exists the demand for industrial use in each of the ASEAN countries. The regional consumption of urea for industrial use was about 38 thousand tons in 1977.

2.06 It is likely that the demand for urea will steadily increase in Indonesia and other ASEAN countries with the exception of Singapore. The projected future demand for urea in ASEAN countries is shown in Table 2. In the whole of the ASEAN region, urea demand is expected to increase to 1.61 million tons in 1980, and 2.25 million tons in 1985.

2.07 On the other hand, Indonesia will attain a remarkable expansion of urea production in the immediate future. The production capacity of urea including this project in the country will increase to 2.38 million tons in 1980 and to 3.28 million tons in 1982. After 1983, when the Malaysia project is completed, Malaysia will also have the production capacity of approximately 0.5 million tons of urea. In addition, the Philippines should have a urea production capacity of 0.3 million tons after 1985, if a new urea plant is built as planned. Thus urea production capacity of 0.3 million tons after 1985, if a new urea plant is built as planned. Thus urea production capacity in the whole of the ASEAN region is estimated to reach 2.4 million tons in 1980 and 4.1 million tons in 1985.

2.08 The supply/demand in the ASEAN region, which is a urea-importing region at present, should reach a balance in 1978, and after 1979 this will become a urea-exporting region.

The exportable surplus of urea in this region will increase from approximately 0.49 million tons in 1981 to 1.08 million tons in 1983, 1.17 million tons in 1984, and 1.24 million tons in 1985. After 1985, it is expected to decrease gradually. It must be noted that this projection has been based upon a rather conservative forecast on the demand. If the government authorities of Indonesia and the other countries take positive measures to extend and encourage the use of urea by farmers, it is quite possible that the demand for urea will be about 10% higher than the projected figures. On the other hand, it may be that the urea project in the Philippines will not materialize. Table 3 shows the supply/demand projection revised by taking these factors into account. If this projection is taken as a possible case, it is predicted that the exportable surplus of urea in the region will gradually decrease after reaching 0.89 million tons in 1983.

2.09 Indonesia is the largest consumer and producer of urea in the ASEAN region. After 1978, Indonesia will become an exporter of urea and after 1982, when the plant in this project starts operation, there will be an exportable surplus of at least 1 - 1.2 million tons, including those produced by this project. The other ASEAN countries will preferencially take off the urea produced at this plant as required by each country. It was agreed by all ASEAN countries, however, that when the new urea plant in Malaysia comes into production, the export to the ASEAN market should be equally shared by both plants. Consequently, as shown in Table 4, Indonesia will be required to export annually at least 0.6 to 1 million tons of urea outside the ASEAN region for more than five years from 1983. In view of such situations, it is obvious that the possibilities of export from Indonesia destined outside the ASEAN region would greatly affect the feasibility of this project.

2.10 From the above point of view, the Evaluation Team investigated the future outlook of the world's supply and demand of nitrogenous fertilizers and in particular those of urea in Asia, and thus examined the possibilities of urea export from Indonesia. The results showed that after 1979, the world's supply and demand will move in an oversupply structure, the surplus increasing year after year until 1985. In such a world market situation, exporters whose manufacturing costs are uncompetitive will have to stop or reduce their production. It is likely that the traditional exporters such as North America, Western Europe and Japan will be affected unfavourably in their exportation of fertilizers. Even if these countries adjust their production, however, the world's supply and demand structure of nitrogenous fertilizers will still continue to be that of an over-

supply situation. Indonesia will have to realize that export competition will become more serious in the future.

2.11 Asia will be a large consumer of nitrogenous fertilizers, especially urea, in the 1980's. As shown in Table 5, India, China, Vietnam and Pakistan, being major importers, are likely to continue importing urea. These countries compose the prospective market for the export of urea from Indonesia. It must be emphasized, however, that price competitiveness and enhancement of organizations and activities for export business are crucial for Indonesia to sustain successful exportation under such world market conditions as mentioned earlier.

2.12 The Evaluation Team has made the analysis and prediction on the future international price of urea under the above-mentioned world-wide oversupply condition. The predicted CIF price of bagged urea in the Asian market, on the basis of India which is the chief importer, is as follows:

1982	US$181/T
1983	US$198/T
1984	US$223/T
1985	US$243/T

With these prices as the basis, the competitive price from Indonesia to the other Asian countries is estimated at US$160/T, FOB bulk, in 1982 constant price.

2.13 The sales projection of this project based on the above-mentioned studies and investigations is shown in Table 6. As for the urea produced at this plant, in accordance with the basic agreement among ASEAN countries concerning this project, the Indonesian Government will be responsible for the remainder not taken off by other ASEAN countries by marketing it in Indonesia and also exporting it outside the ASEAN region. The Indonesian Government intends to appoint PUSRI as the sales agent if the other shareholders agree to it. When considering PUSRI's experience and the amount of import required by the prospective importing countries outside the ASEAN region, it is quite possible to manage the quantity of export palnned here. Also, judging from the production cost of this project, it has adequate competitiveness price-wise in the export market. Therefore, it is concluded that the sales projection of this project is feasible.

III. NATURAL GAS STUDY

3.01 The natural gas which is used for the feedstock will be supplied from the Arun gas field located in the North Aceh district of North Sumatra. The majority of the gas produced at this gas field is appropriated to LNG, which the Indonesian Government has committed to export to Japan and the West Coast of the U.S.A., and it is intended that the remainder should be appropriated to this project.

3.02 Enumerated below are the gas reserves in the Arun gas field which have been officially announced by the Indonesian Government on the basis of reserve estimates made by Degolyer and MacNaughton:

(1)	Initial wet gas in place (Containing water of 1.01 TSCF or 5.9%)	17.19 TSCF
(2)	Initial dry gas in place (Containing carbon dioxide and nitrogen of 2.42 TSCF or 14.08%)	16.18 TSCF
(3)	Initial hydrocarbon in place (Including condensate)	13.76 TSCF
(4)	Initial dry hydrocarbon in place (Excluding condensate)	13.10 TSCF

3.03 This gas is transmitted to the LNG plant located at Lhokseumawe through a 42 inch gas pipeline which has already been laid down in a connection of about 30 km from the gas field to the LNG plant. Condensate contained in the transmitted gas is separated at the condensate separater set up at the LNG plant site, and the dry gas after the separation of condensate is supplied to both the LNG plant and this fertilizer plant. In light of such gas supply conditions, the examination of gas availability is made in terms of the initial dry gas in place excluding condensate but containing carbon dioxide and nitrogen. From the figures enumerated in 3.02 (2) above, it is estimated at 15.52 TSCF. Thus the recoverable gas reserve is estimated at 14 TSCF if a gas recovery rate of 90% is taken as the basis.

3.04 For the demand side, the gas committed for the LNG is 8.78 TSCF on a FOB basis for a 20-year supply (total of 4.48 TSCF for LNG destined to Japan and an additional 4.3 TSCF recently committed for the West Coast of the U.S.A.). When the gas required for fuel in the liquefaction, boil-off during the storing and for the auxiliary facilities is added, the requirement of gas (containing carbon dioxide and nitrogen) for the LNG is estimated at 12.24 TSCF. The gas required for injection and fuel at the Arun gas field is estimated at 0.2 TSCF for a period of 20 years. Thus the quantity of gas which can be available for supply to this plant is estimated as:

$$(14.0 - 0.2) - 12.24 = 1.56 \text{ TSCF}$$

The gas requirement of this plant, including fuel use, is approximately 20 BSCF per year. Thus the 20-year requirement of the plant is 0.4 TSCF. In view of these figures, as far as the estimate of gas reserve taken here is accurate, it can be justified that a sufficient quantity of gas is available to meet the 20-year requirement of this plant. In light of an engineering practice applied to the above-mentioned reserve estimate made at the stage, however, it should be reasonable to still deem it as being in an accuracy of around ± 10%, although the Evaluation Team observed that the estimate is fairly accurate.

When considering the gas balance discussed above, the gas reserves of the Arun gas field can be looked over as having an allowance of about 8% against the 20-year gas supply required for the LNG plant and this fertilizer complex. If the most pessimistic view is taken, it must therefore be concluded that the gas reserves might be rather marginal for future supply. Even in such an event, however, an adequate quantity of gas will be assured for supply at least for a period of 12 years, which has been decided as the minimum economic life of this fertilizer complex. Furthermore, there are new gas fields being developed as well in this area, so that any shortage of gas after the 12 years can possibly be supplemented with the gas supplied from these new fields.

On these viewpoints, the Evaluation Team observes that there seems to be no underlying problems on the availability of gas that ensure the stable operation of the plant at least during the life span of this project.

3.06 The gas analysis provided by the Indonesian authorities indicates that the available gas has a quality adequate to be used as the feedstock for the contemplated production of ammonia and eventually urea in this project. As mentioned earlier, the gas is supplied after separating the condensate at the LNG plant. The Indonesian Government will be responsible for undertaking the construction of a branch pipeline connecting the fertilizer

complex from the outlet of the condensate separator. In accordance with the agreement of the ASEAN Economic Ministers Meeting, the price of gas has been set at US$0.60 to 0.65/MMBTU on a plant-gate basis.

IV. INVESTIGATION OF TECHNICAL ASPECTS

4.01 With regard to the fertilizer complex to be built in this project, the major aspects requiring technical investigation and examination can be generally defined as follows:

A. Selection of the plant site
B. Definition of the project scheme
C. Conceptional design of plant facilities, including utilities, auxiliary and other related infrastructure facilities
D. Planning of project implementation programs
E. Examination of managerial aspects of the constructed plant

The outcome and conclusion of investigation and examination on each of the above aspects are summarized in the following sections.

4.02 Plant site

For a proximity to the supply source of the natural gas which is used as the feedstock, the complex has to be located in the vicinity of the LNG plant. As the result of investigation on this area, the following two areas were selected as alternative sites:

Site A:	Kuala Jangka	Approximately 50 km west of Lhokseumawe
Site B:	Kuala Geukeh	Approximately 15 km west of Lhokseumawe (adjacent to the west boundary of the LNG plant site).

Comparison of the general suitability and economic advantage between these two sites indicated no significant difference in the order of superiority; in other words, these sites either is acceptable as the site for the contemplated complex. The Indonesian Government and the Aceh Provincial Government both intend to select Kuala Geukeh as the site. Thus the Evaluation Team has proceeded with the conceptional design of facilities and other technical investigations of this project on the basis that the complex will be located at the Kuala Geukeh area.

4.03 Product items and the scale of the plant

This project contemplates to produce prilled urea, as the final product, at a rate of approximately 570,000 tons per annum. Ammonia, an intermediate material for urea, will first be manufactured by the synthesis of (a) hydrogen which is obtained by the reforming of natural gas and then the separation of co-produced carbon dioxide, with (b) nitrogen contained in the air. Urea will be manufactured from thus produced ammonia and carbon dioxide obtained in the process of manufacturing ammonia.

A capacity of the ammonia plant and the urea plant to be constructed at the complex has been set on the basis of 330 onstream days per annum, as follows:

Ammonia	1,000 T/D
Urea	1,725 T/D

These plant capacities have been selected on the basis that the produced ammonia will be fully converted into urea. A typical process respectively for ammonia and urea was presumed for the purpose of examining materials and utilities requirements which are the bases for defining the concept and scale of plant facilities for the complex. It must be noted, however, that this does not purport to be a restrictive recommendation for the process evaluation and selection which will be performed in the subsequent stage after this study. Although there are several processes which are recommendable for the manufacturing of ammonia and urea, any process adopted will not significantly change the plant facilities and capital cost for the process plant. The outcome of technical studies presented here, therefore, is applicable to any of the processes which have been adopted in the complex.

4.04 Plant Facilities

Environments on the selected site require the setting-up of a complex comprising the facilities which enable the plant operation to be self-reliance on a grass-roots basis. The main facilities to be involved in the complex are as follows:

A. Water facilities

Water for the complex is taken from the Peusangan River, approximately 25 km west of the site, transmitted to the complex through an installed water pipeline, treated at the water treatment facilities and supplied to meet the respective requirement.

B. Power generation facilities

All the required electric power will be generated at the complex. For this purpose a gas-turbine power plant with a capacity of 15MW will be installed, for which natural gas will be used as fuel.

C. Shipping facilities

Except for the shipping to the surrounding areas all shipping of the product urea will be made in bulk. For the case requiring the export of bagged urea, bagging facilities at PUSRI's bulk-depot in Belawan or Padang will be utilized. On the above presumption, this complex will have a bulk-urea storage which is capable of storing up to 50,000 tons.

D. Other auxiliary facilities

Auxiliary facilities include plant maintenance facilities, laboratories, effluent treatment facilities, storage facilities, offices, housing colony and all the other required facilities.

4.05 Infrastructure facilities

The main items of the related infrastructure facilities to be constructed within the scope of this project are as follows:

A. Port facilities (Dredged harbor)

- Standard capacity of vessels calling the port:	7,500 to 10,000 DWT
- Water depth:	-10 m
- Wharf:	One wharf equipped with loading facilities for bulk urea

B. Connecting road

Approximately 1.2 km of a road connecting the site to the highway.

4.06 Plan for the construction of the complex

As for the construction of the complex, it is assumed that, while the execution entity of this project will be responsible for placing the order directly to local contractors for the construction of the housing colony and the water pipeline, an experienced foreign general contractor selected by competitive bids will assume a single turn-key responsibility under a general contract for the design, engineering, procurement, construction and commissioning of the plant facilities and other auxiliary and infrastructure facilities except those mentioned above, in which all equipment and machinery, materials and subcontract services will be procured through competitive bids.

For the project management to be performed by the project sponsor, it is assumed that PUSRI's experience will be utilized as much as practicable, with assistance provided by an experienced foreign consulting firm which is employed as technical advisors. The construction period is scheduled to be 36 months from the effective date of the general contract until the completion of the performance test.

4.07 Plant management

This plant will need to staff a total of 625 persons. It has been agreed at the ASEAN Economic Ministers Meeting that a joint-venture company will be established in Indonesia by the joint investment of the ASEAN countries to engage in the implementation of this project. As the Indonesian Government has already decided to nominate PUSRI to be the Indonesian shareholding entity of this company, PUSRI will hold the majority of the equity in the joint-venture company. As for the operation of the plant, although PUSRI's experienced personnel may be staffed, it is supposed that a large number of required staff should still be met by the recruitment of untrained personnel. On such a presumption, it has been planned that this project will carry out the programs prepared for the training of these new staff to be provided during the construction of the complex as well as on-the-job-training to be provided during the plant operation. For these purposes it is also contemplated that experienced foreign management advisors will be retained to assist these trainings and the supervision of the plant operation during the initial period.

V. CAPITAL REQUIREMENT AND FINANCING PLAN FOR THE PROJECT

5.01 On the basis of the scope of this project as mentioned above, the capital requirement for the project has been estimated. Assumptions taken for the estimation of the capital requirement are as follows:

1) The plant will be completed by the end of 1981 to start commercial operation at the beginning of 1982.

2) The plant will be constructed under the same contract system as employed recently for the construction of fertilizer plants in Indonesia where a general contractor will be responsible for the construction of the most part of the complex on a cost-plus-fee basis, and the equipment and machinery, materials and subcontract services will be procured by competitive bids.

5.02 On the above assumptions, capital requirement for this project is estimated at US$313 million (US$213.73 million for the foreign exchange portion and US$99.27 million for the local currency portion). The breakdown into main items of the estimated capital requirement is shown below:

(Thousand U.S. Dollars)

		Foreign Exchange Portion	Local Currency Portion	Total
1)	Base Project Cost[1)]			
	- Cost for plant and other facilities	155,550	58,870	214,420
	- Preoperational expenses	1,720	5,050	6,770
	Total	157,270	63,920	221,190
2)	Contingency	39,110	31,430	70,540
3)	Initial working capital	3,970	3,920	7,890
Total Project Cost (total of 1) to 3) above)		200,350	99,270	299,620

(Thousand U.S. Dollars)

	Foreign Exchange Portion	Local Currency Portion	Total
Interest during Construction[2)]	13,380	0	13,380
Total Financing Required	213,730	99,270	313,000

Notes: 1) The base project cost was calculated on the assumption that all the orders to procure the equipment, machinery, materials and services were placed early 1978.

2) On the assumption that 30% of total project cost will be financed by the equity capital and the remaining 70% by loans, the interest during construction was calculated for the loan portion, hypothetically taking an interest rate of 4% per annum.

5.03 If the commencement of the operation scheduled for this project at the beginning of 1982 is delayed due to delay in the commencement of the construction, the total capital requirement for this project is estimated to increase up to the following amounts due to the rise in the price of equipment, machinery and materials and other affecting factors:

(Thousand U.S. Dollars)

	Foreign exchange	Local currency	Total
Delay of 6 months	222,280	106,220	328,500
Delay of 12 months	230,830	113,170	344,000

When these estimates are compared to the original estimate, a delay of 6 months amounts to an increase of about 5% and a delay of 12 months about 10%.

5.04 The financing plan for this project, formulated on the basis of the original estimate above, is as follows:

(Million U.S. Dollars)

Equity Capital	(30%)	93.9
Long-term Loan	(70%)	219.1
		313.0

In accordance with the agreement made at the ASEAN Economic Ministers Meeting, 60% of the equity capital will be subscribed by Indonesia and the remaining 40% by the other four ASEAN countries. Of the long-term loan, US$213.73 million shall be appropriated to the funds required in foreign currency and the remaining US$5.37 million to the funds required in local currency.

VI. FINANCIAL ANALYSIS

6.01 On the basis of the capital requirement discussed above, the Evaluation Team has estimated the manufacturing cost of the urea produced at this plant and made a financial analysis of this project. The outcome of these estimate and analysis are summarized below:

1) Manufacturing Cost (1982 constant price: US$/T, bulk urea)

	1982	1983	1984	1987	1993	1984-93 (average)
Rate of operation	75%	80%	90%	90%	90%	90%
US$/T	127.4	120.9	108.6	103.4	93.1	100.8

2) Financial Returns

Internal Rate of Return

Before tax:	12.25%
After tax:	10.33%

3) Break even point (an average of 12 years):

Operation at 51.5% of the plant capacity

6.02 The conditions presumed in the above calculations are as follows:

1) Terms of the Loan

Definite terms could not be presumed on since the source of the loan is not defined yet. However, the following terms were hypothetically applied in the calculations.

Rate of interest:	4% per annum
Repayment terms:	Equal annual installments for principal over 15 years including 4-years grace period.

2)	Commencement of commercial operation:	January 1982
3)	Production capacity:	570,000 T/Y
	Operational rate:	
	First year (1982)	75% (427,500 T/Y)
	Second year	80% (456,000 T/Y)
	Third year onward	90% (513,000 T/Y)
4)	Sales price (Ex-factory price in 1982):	
	Bulk urea:	US$160/T
5)	Price of natural gas:	US$0.6/MMBTU
6)	Depreciation period:	
	Plant facilities:	12 years
	Port facilities, water intake facilities, water pipeline, and housing colony for employees:	30 years
7)	Income tax:	Taxation at 45% of taxable income with tax holiday for the initial 5-year period
8)	Economic life span:	12 years

6.03 The Evaluation Team has also conducted the sensitivity analysis of the manufacturing cost and financial returns of the project affected by changes in the major conditions presumed above. The outcome of this analysis is as follows:

1) Change in the urea sales price by ±US$15/T (bulk urea)

Urea sales price	US$145	US$175

Internal Rate of Return (IRR) (After tax)	8.3%	12.3%

2) Increase in the interest rate or the capital requirement:

	Interest Rate at 6% (Increase by 2%)	5% Increase in Capital Requirement
I.R.R. (after tax):	10.11%	9.6%
Manufacturing cost (bulk urea as of 1987):	US$105.00/T	US$106.10/T

6.04 The results of the financial analysis studied above may be summarized as follows:

1) A minimum extent of financial viability may be maintained even if the sales price of bulk urea should drop to US$145 per ton on an ex-factory basis.

2) Although the terms of loans applied to the financial analysis are so far a hypothetical assumption, it is obvious that such favourable terms will greatly contribute to the stability of this project.

3) No vital effects will be exerted on this project even if the price of natural gas should be increased to US$0.65/MMBTU.

4) The operation with low capacity utilizatiion over a long period will exert a considerably serious affect upon the viability of this project. However, the operational rate maintaining the break even point is 51.5% (an average of 12 years), so that the viability may be maintained if the decline in operation is only temporary.

5) On the presumption that the above mentioned conditions may be fulfilled, it is concluded that this project has an ample viability to be implemented.

VII. ECONOMIC EVALUATION

7.01 The economic importance of this project can be defined on two different angles; one is for Indonesia, the host country for the project, and the other for the other four ASEAN countries. For Indonesia, the importance should be the contribution to her national economy in terms of the value-adding of indigenous natural resources and also of foreign exchange earnings which could be gained through the export of urea produced by means of efficient utilization of natural gas and labour resources available in the country. On the other hand, for the other ASEAN countries, it should be the expansion of the investment opportunities as well as the assurance of a stable supply source of low-cost urea which could contribute to the expansion of their economy and also to their foreign exchange savings. From this point of view, quantitative and qualitative analyses have been made on the economic contribution of this project to the ASEAN countries.

7.02 The economic benefits and the economic cost of this project have been assessed and the economic internal rate of return (IRR) has been computed on this basis. The economic internal rate of return (IRR) for the economic life span of this project (12 years) is estimated at 12.6%. Other economic contributions include the foreign exchange earnings or savings. Although the contributions in this field are considerable, these are secondary to meet the objective of this project.

7.03 The economic internal rate of return of this project as discussed above indicates that this project can be expected to bring sufficient economic returns. Furthermore, the implementation of this project will be the first step for the ASEAN countries to develop a common market, seeking the opportunities for a joint investment to promote industrialization in the whole of the ASEAN region on the basis of economies of scale and their respective comparative advantages.

CONCLUSION

The following is a conclusion of this study with regard to the feasibility of this project which has been derived from the outcome of studies summarized above:

1. In view of the future import requirements for urea in ASEAN countries which have been projected by taking into account of the supply from the ASEAN Urea Project - Malaysia, it is likely that the future urea market in the ASEAN region will be less than enough to absorb all the annual output of this contemplated plant which is estimated at approximately 510,000 tons. Consequently, this project may be required to export about 200,000 tons of urea outside the ASEAN region every year.

   As for the urea produced at this plant, the Indonesian Government will be responsible to take off the remainder after exported to other ASEAN countries and to market it by means of domestic distribution in Indonesia and/or export outside the ASEAN region. For this end the government intends to appoint PUSRI as the marketing agent to engage in such off-taking and marketing. It is likely that the world urea market in the 1980's will move in oversupply tendency and therefore that competition among the exporters of urea will become more serious. Such circumstances will not warrant optimistic views on the prospect of urea export from Indonesia. The cost of the urea produced in this plant, however, is well competitive with the predicted international price of urea in the future. Also, it is possible to find sufficient export markets in Asian countries, especially India, Pakistan and Vietnam to which Indonesia is located in a distance of close proximity. In view of these factors and also taking into consideration of PUSRI's experience and activities in the field of urea export, it is concluded that the sales projection of this project is feasible.

2. As for natural gas to be used for the feedstock in this plant, the Evaluation Team observes that the gas will be available for the supply assuring the stable operation of the plant during the life period of this project.

3. The plant site of this project is located along a sea coast which enables direct access to product shipment on large-sized ocean-going vessels if port facilities are constructed. The water to be used at the complex will be taken from the Peusangan River, located approximately 25 km west of the plant site, where the water is adequately available in terms of quality and quantity. A reliable supply of electric power will be assured as required by

setting up an in-plant power generator. It is contemplated to adopt a gas-turbine generator fueled with natural gas. There is so far no data available for precise investigation of soil conditions of the site area. As far as available data compiled by the Indonesian authorities are analyzed, however, the selected site seems to have characteristics comparatively suitable for putting the plant. As a result of the investigations of overall site conditions, it is concluded that the selected site has no inherent obstacles for constructing and operating the plant, although it is required to have utilities facilities, port facilities and other infra-structure facilities as mentioned above.

4. This contemplated complex consists of a 1,000 T/D ammonia plant and a 1,725 T/D urea plant. A number of ammonia/urea plants in this scale are presently operating in several countries. In Indonesia, PUSRI efficiently operates three units of ammonia/urea plants in the order of this scale. There are several foreign engineering firms which have well experience in the design, engineering and construction of such plants. Since it is contemplated that the complex will be constructed by one of these experienced engineering firms, this project will encompass little technical risk.

5. PUSRI will participate in the execution body of this project. It is therefore expected that project management, staff training, operational management and other managerial aspects to be performed by the execution body will be realized with effective utilization of PUSRI's experience as well as mobilization of its experienced staff.

6. This project is a so-called grass-roots project which includes the construction of not only utilities and auxiliary facilities but also infrastructure facilities such as port and road. It has resulted in a comparatively large amount of the capital requirement. Consequently, the capital-related costs such as depreciation and interest items in the production cost of urea are comparatively high for the case of this project, although the production cost remains in an internationally competitive range because of low costs of the feedstock and utilities offsetting the high capital-related costs as discussed above. It must be noted, however, that since the capital-related costs take up a large portion of the production cost, as stated above, the interest rate of loans will greatly affect the production cost.

7. The return on investment of this project is not so high, but it is within a range of return which can justify the financial viability of this project and also enables a reasonable return on equity. Furthermore, the financial structure of this project can afford to bear financial burden even if sales price and other major affecting factors unfavourably change. Thus it is concluded that this project is financially viable.

8. From the economic viewpoint, this project will generate a reasonable return for ASEAN countries and thus will contribute to each of the countries to meet the objective of the project.

As a conclusion, the Evaluation Team views that this project is technically and economically feasible, having financially sound ground.

RECOMMENDATION

1. The estimated amount of urea exported from Indonesia will account for a considerably large portion against the size of prospective import markets.

   In order to maintain urea export, it will be necessary to export urea from the most competitive plants in Indonesia. It leads to a very complicated distribution pattern of urea shipped for both domestic and export markets.

   Therefore, it is recommended to establish an integrated marketing and distribution arrangement and organization so that the organization will be able to administrate these systems to enable successful export responding to changes in the situation of the export and domestic market, and also changes in the situation of domestic production of urea.

2. As indicated in the part of the financial analysis, delay in the award of a general contract may result in increased investment. It is essential to take steps for the invitation to bids for the selection of general contractor as early as possible.

   For this purpose, it is recommended that the following actions, inter alia, should promptly be carried out:

   a. Land acquisition
   b. Soil and subsoil investigation
   c. Preparation of bid specifications
   d. Determination on the type of a general contract
   e. Establishment of procurement procedures

Table 1. SUPPLY/DEMAND BALANCE FORECAST OF NITROGEN FERTILIZER, ASEAN REGION

(N 000 ton)

		1975/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88
INDONESIA	CAPACITY	289	289	582	942	1099	1199	1499	1769	1769	1769	1769	1769	1769
	SUPPLY	105	181	409	719	868	1017	1261	1489	1531	1558	1558	1557	1556
	DEMAND	339	352	474	559	634	699	745	784	817	844	864	891	915
	BALANCE	-134	-171	-65	160	234	318	516	705	714	714	694	666	641
PHILIPPINES	CAPACITY	101	101	101	101	101	101	101	101	101	175	249	249	249
	SUPPLY	35	31	19	25	25	25	24	24	24	72	122	134	141
	DEMAND	135	156	180	194	208	221	233	245	257	269	280	292	304
	BALANCE	-100	-125	-161	-169	-183	-196	-209	-221	-233	-197	-158	-158	-163
MALAYSIA	CAPACITY	43	43	43	43	43	43	43	43	352	352	352	352	352
	SUPPLY	37	37	36	36	35	35	35	34	257	274	309	308	308
	DEMAND	79	85	95	98	100	104	108	112	117	121	125	130	134
	BALANCE	-42	-48	-59	-62	-65	-69	-73	-78	140	153	184	178	174
THAILAND	CAPACITY	27	27	27	27	27	27	27	27	27	27	162	297	297
	SUPPLY	-1	2	2	1	0	0	-1	-1	-2	-2	85	179	199
	DEMAND	65	108	110	120	130	139	148	156	165	174	182	190	198
	BALANCE	-66	-106	-108	-119	-130	-139	-149	-157	-167	-176	-97	-11	1
SINGAPORE	CAPACITY	0	0	0	0	0	0	0	0	0	0	0	0	0
	SUPPLY	-2	-3	-4	-5	-6	-7	-7	-7	-7	-7	-7	-7	-7
	DEMAND	1	1	1	1	1	1	1	1	1	1	1	1	1
	BALANCE	-3	-4	-5	-6	-7	-8	-8	-8	-8	-8	-8	-8	-8
ASEAN TOTAL	CAPACITY	460	460	753	1113	1270	1370	1670	1940	2249	2323	2532	2667	2667
	SUPPLY	274	248	462	776	922	1070	1312	1539	1803	1895	2067	2171	2197
	DEMAND	619	702	860	972	1073	1164	1235	1298	1357	1409	1452	1504	1552
	BALANCE	-345	-454	-398	-196	-151	-94	77	241	446	486	615	667	645

Table 2. SUPPLY/DEMAND PROJECTION OF UREA, ASEAN COUNTRIES

(Product 000 ton)

		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
INDONESIA	CAPACITY	525	525	1142	1903	2235	2378	2805	3275	3275	3275	3275	3275	3275
	SUPPLY	394	363	829	1483	1801	2061	2421	2788	2858	2914	2913	2912	2911
	DEMAND	676	686	932	1105	1257	1389	1483	1565	1633	1689	1732	1786	1835
	BALANCE	-282	-323	-103	378	544	672	938	1223	1225	1225	1181	1126	1076
PHILIPPINES	CAPACITY	68	68	-	-	-	-	-	-	-	150	300	300	300
	SUPPLY	18	10	-6	-10	-11	-12	-12	-13	-13	84	189	210	225
	DEMAND	144	175	228	236	245	256	270	284	298	313	329	344	358
	BALANCE	-126	-165	-234	-246	-256	-268	-282	-297	-311	-229	-140	-134	-133
MALAYSIA	CAPACITY	-	-	-	-	-	-	-	-	496	496	496	496	496
	SUPPLY	-8	-9	-10	-11	-12	-13	-14	-15	356	380	428	427	426
	DEMAND	49	81	84	87	92	97	104	112	119	128	136	144	152
	BALANCE	-57	-90	-94	-98	-104	-110	-118	-127	237	252	292	283	274
THAILAND	CAPACITY	26	26	26	26	26	26	26	26	26	26	26	26	26
	SUPPLY	-9	-8	-7	-10	-11	-12	-13	-14	-14	-16	-17	-18	-18
	DEMAND	4	8	8	10	12	16	22	29	37	46	56	66	77
	BALANCE	-13	-16	-15	-20	-23	-28	-35	-43	-51	-62	-73	-84	-95
SINGAPORE	CAPACITY	-	-	-	-	-	-	-	-	-	-	-	-	-
	SUPPLY	-4	-7	-9	-11	-13	-15	-15	-15	-15	-15	-15	-15	-15
	DEMAND	2	2	2	2	2	2	2	2	2	2	2	2	2
	BALANCE	-6	-9	-11	-13	-15	-17	-17	-17	-17	-17	-17	-17	-17
ASEAN TOTAL	CAPACITY	619	619	1168	1929	2261	2404	2831	3301	3797	3947	4097	4097	4097
	SUPPLY	391	349	797	1441	1754	2009	2367	2731	3172	3347	3498	3516	3529
	DEMAND	875	952	1254	1440	1608	1760	1881	1992	2089	2178	2255	2342	2424
	BALANCE	-484	-603	-457	1	146	249	486	739	1083	1169	1243	1174	1105

Table 3. PROJECTED SUPPLY/DEMAND BALANCE OF UREA, ASEAN REGION - ALTERNATIVE CASE

(Urea 000 ton)

		1982	1983	1984	1985	1986	1987
Supply	Indonesia	2,788	2,858	2,914	2,913	2,912	2,911
	Philippines	-13	-13	-14	-14	-15	-15
	Malaysia	-15	356	380	428	427	426
	Thailand	-14	-14	-16	-17	-18	-18
	Singapore	-15	-15	-15	-15	-15	-15
	Total	2,731	3,172	3,249	3,295	3,291	3,289
Demand	Indonesia	1,722	1,796	1,858	1,905	1,965	2,019
	Philippines	312	328	344	362	378	394
	Malaysia	112	119	128	136	144	152
	Thailand	29	37	46	56	66	77
	Singapore	2	2	2	2	2	2
	Total	2,177	2,282	2,378	2,461	2,555	2,644
Balance		544	890	861	834	736	645

Notes: 1. This alternative case is forecasted on the following assumptions:

1) Demand for urea in Indonesia and the Philippines will increase by 10% compared with the projected demand in Tab. II-1-19.

2) The NH_3/Urea plant under planning in the Philippines will not be materialized in the above projection period.

2. Negative figures in "Supply" means that the demand for industrial urea exceeds urea production.

Table 4. ESTIMATED EXPORT REQUIREMENT OF INDONESIAN UREA

(Urea 000 ton)

	1983	1984	1985	1986	1987
Based on the original projection:					
Urea Balance in Indonesia					
Supply	2,858	2,914	2,913	2,912	2,911
Demand	1,633	1,689	1,732	1,786	1,835
Export Requirement	1,225	1,225	1,181	1,126	1,076
Demand from ASEAN countries (excld. Indonesia)	191	155	116	118	124
Export Requirement for outside ASEAN	1,034	1,070	1,065	1,008	952
Based on the alternative projection:					
Urea Balance in Indonesia					
Supply	2,858	2,914	2,913	2,912	2,911
Demand	1,796	1,858	1,905	1,965	2,019
Export Requirement	1,062	1,056	1,008	947	892
Demand from ASEAN countries (excld. Indonesia)	205	219	233	247	261
Export Requirement for outside ASEAN	857	837	775	700	631

Table 5. SUPPLY/DEMAND PROJECTION OF UREA, MAJOR ASIAN COUNTRIES EXCLUDING ASEAN COUNTRIES

(Product 000 ton)

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
CHINA	CAPACITY	5204	8852	9304	9480	9833	10187	10539	10891	11246	11422	11422
	SUPPLY	2846	5009	5887	6491	6928	7054	7311	7565	7822	7983	8128
	DEMAND	3418	5067	5777	6338	6799	7110	7470	7805	8122	8524	8766
	BALANCE	-572	-58	+110	+153	+129	-56	-159	-240	-300	-541	-638
BURMA	CAPACITY	135	135	135	135	135	235	333	333	333	333	333
	SUPPLY	107	107	107	107	107	170	176	185	265	265	265
	DEMAND	115	133	154	180	209	230	252	274	296	326	350
	BALANCE	-8	-26	-47	-73	-102	-60	-76	-89	-31	-61	-85
VIETNAM	CAPACITY	109	109	109	109	109	109	109	109	274	439	439
	SUPPLY	76	82	82	82	82	82	82	82	181	313	330
	DEMAND	460	485	511	530	552	567	583	597	610	620	632
	BALANCE	-384	-403	-429	-448	-470	-485	-501	-515	-429	-307	-302
INDIA	CAPACITY	6139	8104	8698	8850	8850	9287	10112	11112	11612	11612	11612
	SUPPLY	3187	4135	5044	5540	5670	5798	6126	6672	7203	7494	7567
	DEMAND	4351	5044	5694	6167	6524	6986	7533	7746	7701	7979	8534
	BALANCE	-1164	-909	-650	-627	-854	-1188	-1407	-1074	-498	-485	-967
PAKISTAN	CAPACITY	618	618	1192	1192	1192	1852	1852	2198	2198	2198	2198
	SUPPLY	593	593	1024	1052	1110	1605	1638	1964	1981	2015	2015
	DEMAND	942	884	1024	1052	1110	1157	1273	1394	1520	1633	1767
	BALANCE	-349	-291	0	0	0	448	365	570	461	382	248
AUSTRALIA	CAPACITY	248	248	248	248	248	413	578	578	578	578	578
	SUPPLY	130	130	130	130	130	204	211	220	307	307	307
	DEMAND	156	166	178	190	217	280	308	331	364	394	415
	BALANCE	-26	-36	-48	-60	-87	-76	-97	-111	-57	-87	-108

Table 6. SALES PLAN OF UREA FROM ACEH PLANT, INDONESIA

(Urea 000 ton)

		1982	1983	1984	1985	1986	1987
Production (A)		427	456	513	513	513	513
Shipment for:							
Domestic Market							
Aceh	BG	17	18	19	21	21	22
N. Sumatra	BL	0	132	140	146	154	160
Domestic Total		17	150	159	167	175	182
ASEAN Countries							
Philippines	BG	76	47	35	21	20	20
	BL	176	109	80	49	47	47
	Total	252	156	115	70	67	67
Malaysia	BG	108	-	-	-	-	-
Thailand	BG	36	26	31	37	42	48
Singapore	BL	14	9	9	9	9	9
ASEAN Total		410	191	155	116	118	124
Total (B)		427	341	314	283	293	306
Export Requirement for outside ASEAN (A - B)		0	115	199	230	220	207

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 Republic of Indonesia (GRI) has been making intensive efforts to develop a project to construct a urea fertilizer complex in Indonesia with a joint investment by the ASEAN member countries. This project is to produce urea by the use of natural gas produced at the Aceh Utara (North Aceh) district of North Sumatra, with the intent to supply this produced urea to ASEAN countries.

The GRI, as the host country for the development of this project, has already 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 ASEAN Economic Ministers Meeting held in Thailand in September, 1977. As a result, the member countries have agreed in principle to take the necessary measures to materialize 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 Indonesian Government, thereby thoroughly evaluating the feasibility of this project. In this study, investigations were made also to find the optimal scheme of this project with due consideration of the scheme proposed by the Indonesian Government. That is to build a urea fertilizer complex capable of producing 1,725 tons per day (or approximately 570,000 tons per year) of urea.

Note:

*) The outcome of the feasibility study is referred to in the following reports issued by the Indonesian Government:

- Feasibility study on the ASEAN Ammonia - Urea Project Aceh in Indonesia
- Project Proposal for ASEAN Ammonia - Urea Project Aceh in Indonesia

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 ASEAN countries

B. Study on the availability of natural gas

C. Investigations and selection of the plant site

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

E. Examination and definition of required infrastructure facilities

F. Examination of technical and managerial aspects concerning operation and management of the complex

G. Examination and projection pertaining to the marketing of the product produced at the complex

H. Estimate of the capital cost required for the contemplated complex and related infrastructure facilities

I. Projection of the manufacturing cost of urea

J. Financial projection and financial evaluation 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 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 Indonesian 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 Team) headed by Dr. Shigeo UEKI and consisting of other eleven experts*) to undertake this study. The Evaluation Team accompanied by six officers in charge of the ministries or agencies of the Japanese Government concerned, visited Indonesia for field surveys of about one month beginning February 5, 1978. 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 under Gen. Agus Sujono, the Director General of Chemical Industries, the Department of Industries of the Indonesian Government, with the members consisting of officials or experts nominated from governmental authorities or institutions in Indonesia.**)

During the field surveys, the Evaluation Team collected and analyzed necessary data and information by co-working and discussing in detail with the Indonesian counterpart team. The Evaluation 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 Team visited other ASEAN countries as well as Indonesia and, through cooperation of the respective governments and their agencies, collected necessary data and information, while identifying underlying problems, relating to the fertilizer market and production in each country.

Prior to the finalization of this study, the Evaluation Team has presented an interim report to the Indonesian Government and held meetings for four days from July 4, 1978, to

Notes:

*) Names of the members of the Evaluation Team are listed in Annex I-1.

**) Names of the members of the Indonesian counterpart team are listed in Annex I-2.

discuss with the Indonesian counterpart team concerning the outcome of the study. Thus, the study has been finalized with full consideration of comments presented by the authorities as well.

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:

A. Fertilizer market aspects

B. Natural gas aspects

C. Technical aspects concerning the construction and management of the urea fertilizer complex and related infrastructure facilities

D. Capital requirement of the project

E. Financial analysis and economic evaluation

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

(1) Study of the fertilizer market aspects

The primary objective of the study on the fertilizer market aspects was to examine the possibilities of marketing in ASEAN countries of the urea produced at this urea plant. In addition to this study, the Evaluation 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, it studied feasibility of the marketing projection of this project.

As a basis for a projection on the future outlook of urea markets in ASEAN countries, the Evaluation Team forecast the future supply/demand balance of nitrogenous fertilizers, particularly urea, in ASEAN countries, where an assumption was made that, while this plant will start commercial production at the beginning of 1982, another ASEAN urea project in Malaysia will also start commercial operation at the beginning of 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 Annex II of this report.

(2) Study of the natural gas aspects

Natural gas which is used for the feedstock and fuel in this complex will be supplied from the Arun gas field in the North Aceh district of North Sumatra. The majority of the gas produced at this gas field is appropriated to LNG and the remaining gas should be appropriated to this project. In view of this policy of the Indonesian Government mentioned above, the objective of study on this gas aspects was set out to confirm the availability of gas for long-term supply and also to clarify the conditions on gas supply to this plant. The confirmation of the gas availability was based upon (a) the confirmation of the recoverable gas reserves of the Arun gas field, and (b) the confirmation of gas demand projection for a long-term period. It must be noted, however, that since the Evaluation 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 Indonesian Government, while evaluating in general the acceptability of these figures by means of clarifying and delineating the background of this estimate. The outcome of these studies are described in Part III and Annex III of this report.

(3) Investigations of the technical aspects

For a proximity to the supply source of natural gas, the location of the plant should be in the North Aceh district. The Evaluation Team investigated site conditions in this area in general and, on the basis of findings of site investigations, examined the following aspects:

A. Selection of the plant site

B. Definition and conceptional design of plant facilities to be involved in the contemplated fertilizer complex

C. Definition and conceptional design of related infrastructure facilities to be constructed within the scope of this project

D. Planning of project implementation programs

E. Examination of organization and man-power requirement as well as operational management of the plant

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

(4) Estimate of the capital requirement

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

(5) Financial analysis and economic evaluation

On the basis of the projected capital requirement as stated above, the Evaluation Team estimated the manufacturing cost of the urea produced at the plant, and then made the financial analysis and the economic evaluation of this project, including the assessment of profitability, financial soundness 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 Annex VI.

Chapter 3 Basic Agreement among ASEAN Member Countries concerning Fundamental Aspects of this Project

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 countries. This chapter summarizes these conditions and structure in accordance with information provided by the Indonesian Government in the course of this study, a copy of which is attached as Annex I-4.

3-1 General

The basic policy on the development of this project had been agreed on at the First ASEAN Economic Ministers Meeting held in Pattaya, Thailand, in September, 1977. Since then, various issues concerning the project have been discussed at subsequent Economic Ministers Meetings and/or ASEAN Expert Meeting, and the ASEAN countries have reached an agreement concerning the framework as summarized in the following sections.

3-2 Execution entity of this project

The ASEAN countries will establish a joint-venture company in Indonesia to engage in the implementation of the project. The company will be incorporated with joint investment of these countries under the Indonesian Foreign Investment Law and other relevant regulations in force in the Republic of Indonesia. The outline of the company is as follows:

(1) Legal status of the company: P.T. (limited liability company)

(2) Name of the company: P.T. ASEAN Aceh Fertilizer Co.

(3) Equity capital: Equivalent to 30% of the total capital required (Although the Indonesian Government has estimated the amount of U.S.$88.8 million for the equity capital on a presumption that an amount of U.S.$296 million is required for the total capital. The amount of equity capital may be revised to meet the result of this study.)

(4) Ownership: Percentage of ownership among ASEAN countries is as follows:

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

(5) Manner of Subscription: The respective governments of the ASEAN countries will appoint or establish a shareholding entity of the company in each country. Each shareholding entity will subscribe to equity shares in accordance with the percentage of the company's ownership mentioned above.

The Indonesian Government has appointed P.T. Pupuk Sriwidjaja (PUSRI), a state-owned fertilizer manufacturing company, as the Indonesian shareholding entity.

3-3 Organization of the company

Regarding the basic agreement for the development of ASEAN Industrial Projects and the supplemental agreement for the development of this project, the legal framework has been agreed upon among the countries at the Sixth ASEAN Economic Ministers Meeting held in Jakarta, Indonesia, June 5-7, 1978. As soon as shareholding entities of the company have been appointed or established in the respective countries, a shareholding entities' meeting will be held to finalize the basic agreement for the establishment of the joint-venture company and the articles of association. The company will be incorporated promptly after the execution of the basic agreement and the articles of association mentioned above.

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.

PART II

MARKET STUDY

Introduction Objective and Contents of the Market Survey

This part includes the results of the survey and analysis of the markets for urea manufactured at the urea plant to be built under this project. Among matters requiring careful analysis, special attention has been paid to the followings:

1. To attempt forecasts for the demand/supply situation of urea in the ASEAN countries including Indonesia, and to find how much urea those markets can potentially absorb from the projected urea plant. (Chapter 1)

2. To make forecasts of the world's demand/supply situation of nitrogenous fertilizer, particularly that of urea in Asia in an attempt to study the possible amount of urea, which cannot be absorbed within the ASEAN region, to be exported outside the ASEAN region. (Chapter 2)

3. To attempt forecasts of the international urea price and to make the study of the international competitiveness of urea manufactured in Indonesia in the export market. Based on the studies, further study will be made on the possibility of exporting urea manufactured at the projected plant to the markets outside the ASEAN region. (Chapter 2)

4. Based on the above studies, further study will be made on the sales plan for urea manufactured under this project, which will serve as a basis for designing loading facilities and also for financial evaluation of this project. (Chapter 3)

Chapter 1 Present and Future Supply/Demand of Nitrogenous Fertilizers (Particularly Urea) in the ASEAN Countries

1-1 Indonesia

This section outlines the present status and future prospect on the supply/demand of nitrogenous fertilizers, particularly urea, in Indonesia. These are stated in more detail in Annex II-1-1.

1-1-1 Demand for nitrogenous fertilizers

Table II-1-1 shows the records of current consumption and a projection on future demand for nitrogenous fertilizers in Indonesia. Majority of the current consumption was consumed in the food crop sector, whereas the consumption in the estate crop sector was relatively small.

The consumption, which had been steadily climbing upward showed a sudden stagnation after 1973, adversely reflecting a steep rise in the international market price of fertilizers. In 1977, however, the consumption started to pick up sharply, taking effect of various practices taken by the governmental authorities since 1976 for intensive expansion of fertilizer use by farmers. Of these positive practices undertaken by the authorities, the major ones are as follows:

(1) Relaxation of fertilizer subsidy system to allow free use by farmers of the subsidized fertilizers which were limited to use only for the rice cropping under BIMAS/INMAS programs.

(2) Gracing of repayment of fertilizer purchase loan in poor cropping seasons.

(3) Reduction of the retail prices of fertilizers.

These measures could be further intensified along with the achievement of self-sufficiency of nitrogenous fertilizers in Indonesia. It is expected that further expansion of the demand for the fertilizers will develop into the following two directions:

(1) Further extension of high yield varieties of rice, and consequential increase in fertilizer application.

(2) Further extension of fertilizer application to the farmers of the following categories who have so far practiced no fertilizer use or poor application:

- Upland rice growing farmers and paddy rice growing farmers in rain-fed areas
- Maize growing farmers whose fertilizer application has so far been poor.
- Small-holding farmers cultivating estate crops to whom no permission has so far been made as to the utilization of subsidized fertilizers.

Of the above, the expansion of demand for nitrogenous fertilizers in (1) will begin to stagnate by around 1985. Therefore, the overall demand growth of these fertilizers in the country will also show a gradual stagnation in the pace of development, after this the demand should continue steadily increasing until the early part of 1980's.

Table II-1-2 shows the major factors affecting the fertilizer demand which have been presumed as the basis for the forecast of nitrogenous fertilizer demand.

The projected urea demand is shown in Table II-1-3. For the projection of urea demand, it has been assumed that, in the light of the fact that the legislated limitation on use of subsidized urea has already been relaxed, urea will catch nearly all the demand for nitrogenous fertilizers except that for sugar cane farmers traditionally consuming ammonium sulphate as well as for those farmers who have been well accustomed to using complex fertilizers.

1-1-2 Demand of urea for industrial use

Present consumption and projected future demand of urea for industrial use are given in Table II-1-3.

1-1-3 Domestic production of urea

Current records and a projection for the future on the domestic urea production are shown in Table II-1-4. As the basis for the projection, it has been assumed that the existing urea plants will hence operate at the rates of capacity utilization similar to those achieved in the

past, while new plants will operate at 75% of a rated capacity for the first year operation, 80% for the second year, and 90% for the third year onwards.

Regarding PUSRI I plant, it has been assumed that the urea production will be shut down from 1982 onwards, as has been indicated by Indonesian authorities.

1-1-4 Supply/demand balance of urea

The projected supply/demand balance of urea is shown in Table II-1-4. Indonesia will have urea production over self-sufficiency from 1978 onwards and, especially after 1982, will have exportable surplus of urea of about 1.2 million tons a year.

1-2 The Philippines

This section gives an outline of the present status and future prospect on the supply/demand of nitrogenous fertilizers, particularly urea in the Philippines, which are described in detail in Annex II-1-2.

1-2-1 Demand for nitrogenous fertilizers

Table II-1-5 shows the present consumption and projected future demand for nitrogenous fertilizers. Until 1973, the consumption in the food crop sector was situated in a level nearly the same as the export crop sector. However, a relative share of the former in the consumption had since been increasing until 1975. This is due to the fact that fertilizer price hike from 1973 until 1975 has caused a large amount of decrease in consumption in the estate crop sector, whereas the extent of decrease in the food crop sector has been only slight because of the following reasons:

(1) Several governmental programs for fertilizer application promotion such as MASAGANA 99, etc. are being carried out.

(2) Because of the adoption of dual-price system of fertilizers, it has been possible for the food-crop growing farmers to purchase fertilizers at a comparatively low cost than for the export-crop growing farmers.

Since 1976, the dual price of fertilizers has been abolished, while fertilizer distribution was controlled solely by the Fertilizer and Pesticide Authority. Under such situations, the

fertilizer demand recently shows a gradual recovery.

The demand for nitrogenous fertilizers is expected to grow in the future; however, it is likely that a pace of demand increase will be slightly lower than that registered during a period from 1970 to 1974. The reasons for this forecast are as follows:

(1) The demand increase which was achieved from 1973 to 1974 obviously involved the so-called apparent demand generated by speculative procurement of fertilizer importers/distributors on the overlook of possible supply shortage and price hike of fertilizers, so that the growth of the actual demand should have been much lower than the apparent demand growth.

(2) Although the expansion of fertilizer use for paddy rice cultivation is expected, it is at the same time predicted that the physical expansion of lands for paddy cultivation will stagnate.

(3) The per-hectare fertilizer application level for sugar cane cropping has already attained the maximum height, and at the same time, the control on cultivated area of sugar cane are deemed necessary in order to maintain a wholesome level of the market price of sugar.

Table II-1-6 shows the major factors affecting the demand which have been presumed as the basis for the demand projection.

There is no significant difference in the proportions of urea taken up among the nitrogenous fertilizers in between the food crop sector and the export crop sector. The proportion of urea in these two sectors has been fluctuating year by year in line with the ups and downs of the import prices of fertilizers and also by the selling prices of agricultural products. Such patterns will persist in the future. Nevertheless, it is likely that the proportion of urea will keep showing a slight increase in a long run because of the fact that urea will take up the major portion of the imported nitrogenous fertilizers and that urea is an economical fertilizer because of its high nutrient. (Ref. Table II-1-7.)

1-2-2 Demand of urea for industrial use

Present consumption and projected future demand of urea for industrial use is shown in Table II-1-7.

1-2-3 Domestic production of urea

Current records and a projection for the future on the domestic urea production are shown in Table II-1-8. There is one existing urea plant, but this plant has stopped operation since 1977, because of the uncompetitive production cost with imported urea. It is assumed here that the plant will not resume the urea production. The Government of the Philippines has a plant to build a natural-gas-based new ammonia/urea plant. The Government's projection schedules the commercial operation of the new plant to be started in 1983. The materialization of this project, however, should be dependent upon a success in the undergoing exploration of natural gas sources. No gas field in a commercial size has been found yet. Nevertheless, it is assumed here that this project will be implemented to start commercial production of urea in July, 1984, although it is also presumable that the project will be suspended. The aforesaid schedule has been set on an assumption that commercial gas reserves will be found in the immediate future and also by taking into account the time required for further development work.

The operational rate of the new plant has been assumed as 65% of a rated capacity for the first year, 70% for the second year, and 80% for the third year onwards in view of the past records of production in the existing plant, and also in consideration of the fact that the Philippines has less experience in operating a large-scaled ammonia/urea plant.

1-2-4 Supply/demand balance of urea

The projected supply/demand balance of urea is shown in Table II-1-8. It is estimated that urea importation of about 300 thousand tons will be necessary by 1982, and then the import requirements will be reduced to approximately 130 thousand tons after the commencement of operation of the new plant. In case the new project is not materialized, all the urea requirement has to be met by imports.

In addition to the requirements for urea as mentioned above, the Philippines will also need an importation of about 85 thousand tons N (as of 1982) of other type of nitrogenous fertilizers such as ammonia, ammonium sulphate, complex fertilizers, etc.

1-3 Thailand

This section gives an outline of the present status and the future prospect of supply/demand balance of nitrogenous fertilizers (particularly urea) in Thailand. The details are stated in Annex II-1-3.

1-3-1 Demand for nitrogenous fertilizers

The records of current consumption and a projection on future demand for nitrogenous fertilizers in Thailand are shown in Table II-1-9. So far, about 50% of the total consumption has been consumed in the paddy rice sector, whereas recent years show a trend of increase in the consumption for sugar cane cropping and fruit growing. The Government of Thailand has so far no intensive practices for stimulating fertilizer consumption. However, in view of the fact that agricultural products such as rice, maize, sugar cane, cassava, etc. are important export resources for Thailand, and that the country is actually running out of further allowance for physical expansion of agricultural lands, although it is not possible to expect any rapid uptrend in the growth of demand for nitrogenous fertilizers, the future prospect is a continuing slight increase as has been made so far in the past. Table II-1-10 gives the major factors affecting the demand taken as the basis for the demand forecast.

The present demand for urea is very small. Urea has been used only partially for vegetables. This is attributed to the fact that, because of the high import tax imposed on urea for the protection of the domestic urea production, the most popular type of fertilizers imported were the complex fertilizers. Now that the protective import duty on urea for fertilizer-use has been reduced, farmers will be able to obtain urea on a cost lower than that of complex fertilizers. It is therefore expected that the application of urea will expand not only in the field of vegetable cropping but also in paddy-rice fields and other cropping areas like other Southeast Asian countries. The urea consumption is expected to expand for its application as straight fertilizer as well as a material for compound fertilizers. (Ref. Table II-1-11.)

1-3-2 Demand of urea for industrial use

Present consumption and projected future demand of urea for industrial use are given in Table II-1-11.

1-3-3 Domestic production of urea

There is one existing urea plant in a small scale, which is running in low efficiency. The Government of Thailand envisages to build an ammonia plant, while it has no plan to produce urea. (Ref. Table II-1-12.)

1-3-4 Supply/demand balance of urea

Although the total amount will be still small, the urea importation into Thailand is

expected to steadily grow. (Ref. Table II-1-12.) Thailand will need to import about 137 thousand tons N of nitrogenous fertilizers other than urea 1982. If an ammonia plant is constructed after 1985, it is likely that all the necessary nitrogenous fertilizers except urea may be met by domestic production.

1-4 Malaysia

This section outlines the present status and the future prospect of supply/demand balance of nitrogenous fertilizers (particularly urea) in Malaysia. The details are described in Annex II-1-4.

1-4-1 Demand for nitrogenous fertilizers

As shown in Table II-1-13, the largest consumer of nitrogenous fertilizers in the past was the rubber plantation. Along with the progress in the diversification from rubber to oil palm plantation, the consumption for oil palm is growing, whereas the consumption for rubber is falling down. The consumption for paddy-rice cultivation has also been increasing. This trend is expected to continue in the future.

Table II-1-14 gives the major factors affecting the demand presumed as the basis of the demand forecast. The current consumption and the projected future demand of urea in Malaysia are shown in Table II-1-15. At present, urea is being applied only in the form of a straight fertilizer centering on paddy rice. After the commencement of domestic production of urea, it is likely that the demand of urea for complex fertilizers will also gradually increase.

1-4-2 Demand of urea for industrial use

Present consumption and projected future demand of urea for industrial use are shown in Table II-1-15.

1-4-3 Domestic production of urea

Malaysia has no urea manufacturing facilities in operation at present. A project for constructing a new urea plant is now undergoing development. The commencement of operation of this plant is assumed here to be January 1983. The operational rate of this new plant has been assumed as 75% of a rated capacity for the first year, 80% for the second year, and 90% for the third year onwards in view of the fact that the existing ammonia plant has so far recorded

operation at a high rate. The projected production of urea is shown in Table II-1-16.

1-4-4 Supply/demand balance of urea

As shown in Table II-1-16, the import requirements of urea in Malaysia will increase from the present import of approximately 90 thousand tons to 120 thousand tons until 1982. After the new plant starts production, however, Malaysia will have the exportable surplus of about 200 thousand tons of urea every year.

1-5 Singapore

As for Singapore, no field survey was conducted for the purpose of this study. Table II-1-17 shows the present consumption and the projected future demand of urea for fertilizer use and industrial use which have been derived with appropriate revision, from those given in the "Fertilizer Market Study in ASEAN Region" conducted by the Government of Indonesia. The details are described in Annex II-1-5.

1-6 Prospect on the future supply/demand of nitrogenous fertilizers particularly urea in the ASEAN region

Given in Tables II-1-18 and II-1-19 are the supply/demand in the ASEAN region respectively for nitrogenous fertilizers as a whole and for urea in particular which have been summarized on the basis of the supply/demand of each ASEAN country shown in the previous sections.

It is expected that the supply/demand of nitrogenous fertilizers in the whole of this region will nearly come to a balance in 1981, and the supply thereafter will exceed the demand. In the ASEAN region, a surplus of the supply will increase year after year as a result of the realization of this project and also a new urea project in Malaysia, reaching as much as 667 thousand tons N in 1986/87, although the surplus will gradually decrease after that year owing to the increase of demand in each country.

With regard to the supply/demand of urea, Indonesia will have the supply exceeding the demand in 1978 and onward. The surplus will be around 900 thousand tons in 1981 when this plant starts production. After that, along with the upturn in the operational rates of the plant, the surplus will increase to 1,220 thousand tons in 1984. However, after 1985, because of the increase in the domestic demand, the surplus will show a gradual decline.

Malaysia will also have a surplus of urea supply in 1983 when the Malaysian urea project planned as one of the ASEAN projects starts production, and the surplus will increase year after year, reaching a peak of 290 thousand tons in 1985.

The Philippines, Thailand, and Singapore will remain in the importers of urea during the decade of 1980's. The Philippines will need to continue the import of urea in spite of the construction of a new urea plant scheduled to be onstream in 1984. The import requirement in the country will increase to approximately 300 thousand tons in 1982/83, and then decrease to around 130 thousand tons in 1987 due to the commencement of production in the new plant. After that the import requirement will tend to increase again along with the increase in the demand year by year. The import requirement in Thailand is expected to increase gradually from around 40 thousand tons in 1982 to around 70 thousand tons in 1985. Singapore will statically continue the annual import of around 17 thousand tons during the 1980's.

As a result of above-described supply/demand of urea in each ASEAN country, the balance of urea in the ASEAN region as a whole will turn to an oversupply in 1979, with the surplus increasing year by year from 490 thousand tons in 1979 when this plant becomes onstream. The regional surplus of urea will increase to 1.08 million tons in 1983, 1.17 million tons in 1984 and further to 1.24 million tons in 1985 due to the facts that the Malaysian urea plant and also the Philippines plant start their production in these years.

Table II-1-20 enumerates for comparison the projected urea supply/demand of each ASEAN member country (shown as item "B" in the table) which was used as a basis for the feasibility study of this project previously conducted by the Indonesian Government and those provided by the government of the respective countries during the field survey of the Evaluation Team (shown as item "C" in the table). Table II-1-21 gives the difference between the projection of the Evaluation Team sited from Table II-1-19 and the above-stated projection made by the Indonesian Government.

As is apparent from these figures, the demand projected by the Team is considerably lower than that projected by the Indonesian Government, and the surplus in the ASEAN region projected by the Team is accordingly much larger than that projected by the Government of Indonesia. This difference was derived mainly from the differences in the estimation of urea demand of the respective countries, especially Indonesia, Thailand and the Philippines. In general, the Team's projection is moderate when compared with that of the government of Indonesia. This is due to the reasons that, as for the Indonesian demand, the Team's projection was based upon an assumption that the present policy of the government concerning the promo-

tion of fertilizer consumption will persist in future, and also that, as for those of the Philippines and Thailand, the Team estimated the portion of urea in the total demand for nitrogenous fertilizers at a rate lower than the estimation made by the Government of Indonesia, whereas the Government of Indonesia estimated that the overwhemling part of the demand for nitrogenous fertilizers will be taken up by urea.

The urea demand in Indonesia and the Philippines, however, as mentioned earlier in the sections of these countries, encompasses the great possibilities of increasing by about 10% more than the projected demand shown in Table II-1-19. At the same time, as for the supply side, as stated in Section 1-2, it may be that the new urea project in the Philippines will be suspended.

When these factors are taken into consideration, as shown in Table II-1-22, the extent of surplus becomes smaller than the case of the original projection. In this projection, the surplus will be approximately 890 thousand tons in 1983 when the surplus reaches the largest.

Indonesia will be the largest consumer and producer of urea in the ASEAN region, and will become an exporter of urea after 1978. The exportable surplus of urea in the country will be around 800 to 900 thousand tons in 1981 when this plant will be onstream, and will increase to 1.0 to 1.2 million tons in 1982 and onwards. The urea produced at this plant will be exported to the ASEAN countries as required by ASEAN countries. After the Malaysian urea plant starts operation, export to ASEAN countries (i.e., the Philippines, Singapore and Thailand) will be equally shared by these two plants of Indonesia and Malaysia. (Ref. to Chapter 3.) When taking these factors into account, the possible export to the ASEAN countries from this plant is assumed to be 450 to 470 thousand tons in 1981, and 480 to 500 thousand tons in 1982. However, this amount will decline to 200 thousand tons in 1983 and onwards due to the sharing of the amount with Malaysia, as shown in Table II-1-23. Consequently, Indonesia as a whole, including the urea produced by this plant, will have to export urea annually outside the ASEAN countries in the amount of 400 to 500 thousand tons in 1981, 500 to 700 thousand tons in 1982, and 800 to 1,000 thousand tons for a few years thereafter.

Chapter 2 Possibility of Exportation of Urea to Markets Outside the ASEAN Region

In Chapter 1, studies were made on the present status and future outlook on the supply/demand of nitrogenous fertilizers, particularly urea, in ASEAN countries. As a result, it has been revealed that, although an expansion on the demand for nitrogenous fertilizers including urea is likely to take place, the expansion in the production capacity will also be remarkable on the other hand, thereby making it highly likely that the supply capacity of the nitrogenous fertilizers will be much higher than the scale of demand within the ASEAN region. It is therefore reasonable to state that whether Indonesia having a large amount of supply surplus can maintain a normal level of production in its ammonia and urea plants including this plant, is dependent upon its success in the exportation of surplus urea to the markets outside the ASEAN region.

From this viewpoint, this chapter will first discuss regarding the future outlook on the worldwide supply/demand of nitrogenous fertilizers in general, and then regarding the outlook on the supply/demand of nitrogenous fertilizers, especially urea, in the ASEAN region in particular, since the Asian market is expected to be the first and foremost outlet for the urea to be turned out by this plant.

On the other hand, on the basis of thus analyzed balance, a forecast will be made on the future trend of urea price in the international market. Further, by employing such forecasts on the nitrogenous fertilizer supply/demand balance and the urea price trend as the bases, an observation will be made on the possibility of exportation of the urea produced by this plant to markets outside the ASEAN region.

2-1 Supply/demand of nitrogenous fertilizer in the world and in Asia

2-1-1 Supply/demand of nitrogenous fertilizer in the world

(1) Demand for nitrogenous fertilizers in the world

1) Introduction

The demand for nitrogen may be classified into two broad categories, i.e.,

the demand for fertilizer use and the demand for industrial-use. At present, the demand for industrial-use accounts for about 20% of total demand. The increase of nitrogen demand for industrial-use became apparent only recently, and the source of the demand is rather limited in the so-called industrialized countries. In the following paragraphs, observations will be made on the fertilizer-use demand of ammonia and urea which occupies about 80% of the total consumption.

The world consumption of nitrogenous fertilizers had grown at a remarkable rate during the decade of 1960s. The following table shows a comparison of average growth of the consumption during decades from 1951 to 1961 and from 1961 to 1971 in the developing countries and the developed countries (including the U.S.S.R. and East European countries).

Past Trend of Consumption of Nitrogenous Fertilizers

Million tons N

	1951/61	1961/71
Developing countries	0.17	0.64
Developed countries	0.47	1.50
Total	0.64	2.14

Note: Average annual growth was figured out by linear regression of the trend.

As shown in the above table, the annual growth in the post-1961 decade is 3.8 times as much of the pre-1961 decade in the case of developing countries, while the rate in the developed countries (including the U.S.S.R. and East European countries) grew to a level 3.2 times as much.

There are a number of reasons for such a remarkable growth. The major reasons are as follows:

A. General upheaval of food crisis consciousness and implementation of famine elimination activities centering on the United Nations.

B. Consequential intensification of food production increase program especially among developing countries. The program increasingly emphasized the introduction of high-yielding varieties of food crops.

C. The U.S.S.R. and East European countries suffered from a series of crop failure, thereby making it compulsory for these governments to review their basic agricultural policies. Consequently, the governments decided to embark upon food production increase programs centering on promotion of fertilizer application.

D. Due to the increasing consciousness of food crisis together with frequent instances of abnormal weather conditions in the U.S.S.R., etc., food exporting countries also embarked upon expansion of cropping area in anticipation of food exportation increase.

In view of the regional consumptions in the world the following points may be mentioned as conspicuous features:

A. As of 1964, about 60% of the world consumption was consumed by Japan, West European countries, and North American countries. The share in the consumption taken by these countries since has begun to fall year after year, while the rate of consumption by developing countries (including Oceanian countries) started to rise. This was due to the fact that the consumption growth rate in the developed countries already started to fall during and after 1964, while at the same time, the demand for fertilizers in the developing countries began to increase.
Among the developed countries, the consumption growth in Japan has already stopped, and that of West European and North American countries displayed growth rates less than one-half of the world average level.

B. Among the developing countries, the importance of Asian nations has been conspicuous. Central and South American countries have gradually been showing a growth in the share, while African countries are still comparatively inconspicuous in spite of the vastness of land area they occupy.

With respect to the product-wise demand, urea and NP/NPK fertilizers (com-

pound and mixed) take up the highest shares of 23% each, followed by ammonium nitrate sharing 17% of the total. Ammonium sulphate, calcium ammonium nitrate, and direct applied ammonia each accounts for 10% of the total.

However, in terms of regional demands, the utilization rate profile shows a largely different picture. In North America, 38% of the regional total consumption is made in the form of direct application of ammonia. In West Europe, 23% is made in the form of calcium ammonium nitrate, while ammonium nitrate accounts for 37% in the case of East European countries. In Asia, urea takes up an overwhelmingly high rate of 50%. Generally speaking, the utilization of rate of NPK fertilizers is higher in developed countries.

These differences in the form of fertilizer consumption are due to the difference in the type of crops grown and in the manner of farm management. In the European countries upland-field crops are predominant, in Asia, the major crop is the paddy for which the application of ammonium nitrate fertilizer is not practicable. As another instance, mechanized farmings in a large scale practiced in the U.S.A. call for direct application of ammonia or liquid fertilizers, which enable reduction in the cost of fertilizer application work. In the Asian countries, the respective governments put their emphasis on urea in view both of production and transportation efficiency when they began to introduce nitrogenous fertilizers to their agriculture.

2) Forecast of the future demand for nitrogenous fertilizers

Table II-2-1 shows a projection on the future demand for nitrogenous fertilizers in the world. *1)

As shown in this table, it is likely that the growth rate of demand for nitrogenous fertilizers in the world will drop year after year. The annual average growth rate is forecast at 2.6% for the period from 1985 until 1990 as against 5.6% for the period from 1975 until 1980. Further, not only the growth rate, but also the growth amount itself is estimated to gradually fall to 13,565 thousand tons N for 1975/80, 11,103 thousand tons N for 1980/85, and 9,265 thousand tons N for 1985/90. This implies that the world demand for nitrogenous fertilizers in 1980's will tend toward stabilization from the past growth.

In view of the growth rates in each region, there will be a rather conspicuous difference in the growth rates among regions in 1980, although such difference among regions will become unified except for Africa.

The growth rate in the developed countries, as of 1975 is already as low as 4.7% as against the worldwide average growth rate of 7.1%, and it will hence keep falling down to slightly less than 3% as of 1990. In view of the share of the developed countries in the total worldwide demand, after showing a fall from 57% in 1964 to 42% in 1975, it will be stabilized on a level of around 39% from 1980 onwards owing to the slackening of growth in other regions in the 1980's.

On the other hand, in the case of developing countries, although the growth rate will drop annually as mentioned earlier, the growth rate level itself will be above the worldwide average until 1985. As of 1990, the growth rate of the developing countries will finally drop to the world average.

Among the developing countries, the fall in the growth rate will become apparent first among Asian and Central/South American countries, followed by the Mideast countries, all of which will show a gradual approach to the world average level. On the other hand, in the case of African countries, they will still show a level of 4.4% in growth rate which will be higher than then prevailing world average.

This is due to the fact that the application of chemical fertilizers in Asian and Central/South American counties started comparatively earlier than the developing countries in other regions, so that the attainment of the stabilization period in the growth rate will be earlier than the others. Particularly in the case of Korea and Taiwan, as the level of fertilizer dosage is already high, it is unlikely that there will be any further significant growth in the future. This is one of the obvious reasons as to why the growth rate in the African countries will persist for the longest time. As a result, the developing countries will occupy a share of 35% of the total worldwide demand as of 1990.

The U.S.S.R. and East European countires have attained the consumption growth at high rates until 1975, and showed a growth in the share among the worldwide demand accordingly. This trend, however, will not continue after

about 1980. The share will not increase more than about 28% as well.

3) Forecast on the demand of ammonia and urea for industrial-use

Table II-2-2 gives the results of a demand forecast concerning industrial-use ammonia and industrial-use urea. *2)

In view of the usage-wise demand, the largest growth in the recent years was shown in the urea demand classified as the "Other Industrial-Use Urea". In the above table which consists mainly of urea used as a raw material for resin (adhesive, urea resin for molding, melamine resin, etc.), this reflects the current growth of demand for resin. The extent of growth in this demand, however, is rather small because the demand in the developed countries appears to be almost in the uppermost limit and, on the other hand, the developing countries have no positive market as yet.

The largest share in the total demand for industrial-use was so far occupied by ammonia used as a raw material for manufacturing industrial-use nitric acid; however, the growth itself is still slight, and the share occupancy is now showing a slight decrease. Although about a 23% share is being occupied by ammonia used as a raw material for manufacturing synthetic fibers, it is predicted that the demand will be static, in light of the facts that there is so far no significant movement on the expansion of production capacity for acrylonitrile nor caprolactam to realize in 1980 and onwards and further that recent improvement in the manufacturing processes for synthetic fiber materials are calling for less consumption of ammonia.

(2) Supply of nitrogenous fertilizers in the world

1) Introduction

The major features of the past trend concerning the world supply of nitrogenous fertilizers may be summarized as follows:

A. The share occupied by the supply of Japan, West European countries and North American countries has been continuously falling. Their share in the total world supply fell to 47% in 1975 as against about 50% in

1974. On the other hand, the share of the developing countries, the U.S.S.R. and East European countries has been showing growth year by year.

B. Among the developing countries, a conspicuous growth has been shown by the countries in Asia and Mideast. Central/South American countries remain having no significant change in their position.

C. The U.S.S.R. and East European countries occupy a large share in the world supply, showing a high rate of growth.

The above-mentioned trend has been due mainly to the facts that the developing countries have undertaken intensive measures for the increase of food production and also for self-sufficiency in fertilizer supply to meet an increasing demand. The U.S.S.R. and East European countries also took positive measures for the increase in fertilizer production to meet the intensive programs for the increase of fertilizer application which were undertaken in order to cope with crop failure caused by abnormal weather conditions.

2) Future supply of nitrogenous fertilizers

Table II-2-3 shows a projection on the worldwide future supply of nitrogenous fertilizers. *3)

As shown in Table II-2-4, it is predicted that, while the production capacity in the developed countries will reach, by 1985, 1.4 times as much as the capacity in 1975, the developing countries and also the U.S.S.R. and East European block will increase the production capacity respectively to 2.6 and 1.8 times over the above-mentioned period. As a result, the share of the developed countries in the worldwide capacity will fall from 49% in 1975 to 38% in 1985, whereas the share of the developing countries will increase from 24% to 35%. The U.S.S.R. and East European block will maintain the share of around 27% during this period.

When comparing the share of each region in terms of supply shown in Table II-2-3, the share of the developed countries in the worldwide total supply is higher by about 10% than their share in the production capacity, whereas

the supply share of the developing countries is lower by 13 to 14% than their share of the production capacity. East European countires occupy their supply share higher by 4 to 6% than their share in the production capacity. Such difference in a share arising between the supply and the production capacity is derived from a variety of operational rates attainable for the production by each country. In other words, improvement in operational rates will make the share of supply close to that of the production capacity.

The average annual growth rate of supply throughout the world is forecast at 8.1% for the period from 1975 to 1980. The group-wise regional growth rate is forecast at 4.6% for the developed countries as against more than 16% for the developing countries.
These annual growth rates will become small for the period from 1980 to 1985; 5.3% for the world average, 1.4% for the developed countries, and 5.5% for the developing countries. Among the developing countries, Central/ South America, Africa and Mideast are expected to show a high growth rate in particular.

Of the total world supply, about 75% will be produced at the existing plants as of the date, and 20% at new plants under construction. This implies that 95% of the projected supply will be surely realized.

The supply from the existing plants will occupy 80% of the total supply in the case of the developed countries, while it will be 68% and 74% respectively in the case of the developing countries and the U.S.S.R. and East European block. Among the developing countries, in African and Mideast countries, the supply from existing plants will be only 45% of the total. This implies that the majority of supply source will be new plants in these regions.

As of 1985, the share of production will be 64% of the total by the presently existing facilities, 22% by the facilities under construction, and 14% by new facilities which are under planning at present. In the case of the developing countries, the share of the supply from new facilities under planning occupies a relatively high percentage of 23%. Particularly, the share is as high as 30 to 40% in Central/South America, Africa and Mideast. This signifies that these regions will hence undertake the expansion of production capacity intensively.

Notes: *1) Regarding the supply/demand of nitrogenous fertilizers in the world, several authorities, or institutions have published their own forecasts. Of these, representative ones are as follows:

- United Nations Food and Agricultural Organization (FAO)
- United Nations Industrial Development Organization (UNIDO)
- International Bank for Reconstruction and Development (IBRD)
- Tennessee Valley Authority, the U.S.A. (TVA)
- The British Sulphur Corporation Limited, the U.K.
- UNICO International Corporation, Japan

The projection varies to some extent among these authorities or institutions, although it is difficult to judge the most reliable one. Almost all of the published are only the summary of projection without background data. Since UNICO's projection was in an agreeable range in comparison with other projections and also made details available for the study of each country, especially Asian countries which are essential for this study, the Evaluation Team employed this data as a basis, while revising the projection concerning Asian countries on the basis of the Team's field surveys. The detail of methodology employed in the UNICO's projection is given in Annex II-2-1.

*2) The same as the above note.

*3) The same as the above note.

(3) Outlook on the supply/demand balance of nitrogenous fertilizers in the world

Table II-2-5 shows the results of forecast on the supply/demand balance of nitrogenous fertilizers in the world in the second half of 1970s and 1980s based on the demand forecast and supply forecast discussed in the foregoing. In the supply projection, the production amount is first calculated on the basis of the estimated production capacity and technological level of each of the subject countries. Then the amount equivalent to industrial-use consumption and the production/distribution loss was subtracted from the production figures. Therefore, the fertilizer supply amount termed here represents the suppliable amount to fertilizer-use consumption under the given technological conditions of the subject countries.

According to this result, it is likely that the gap between the suppliable amount